Land Stewardship Plan

for

Plan Development date: 12/1/2019 ~ Period covered by the plan: 10 years

Middle Fork Willamette Watershed ~ Anthony Creek Sub Basin

Map and Tax Lot #: 1901290000105 ~ Total Tract Acreage: 87

Plan prepared by:

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NRCS Technical Service Provider #: TSP-18-22221

Maps & Graphic Design by Michael Godfrey

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1. General Plan Information

Landowner Information

Landowner:	Lost Valley Center
Phone:	541-937-3351

Plan Information

Period covered by this plan:	10 years
Date completed:	12-1-2019
Plan Completed by:	Resilience Permaculture Design LLC

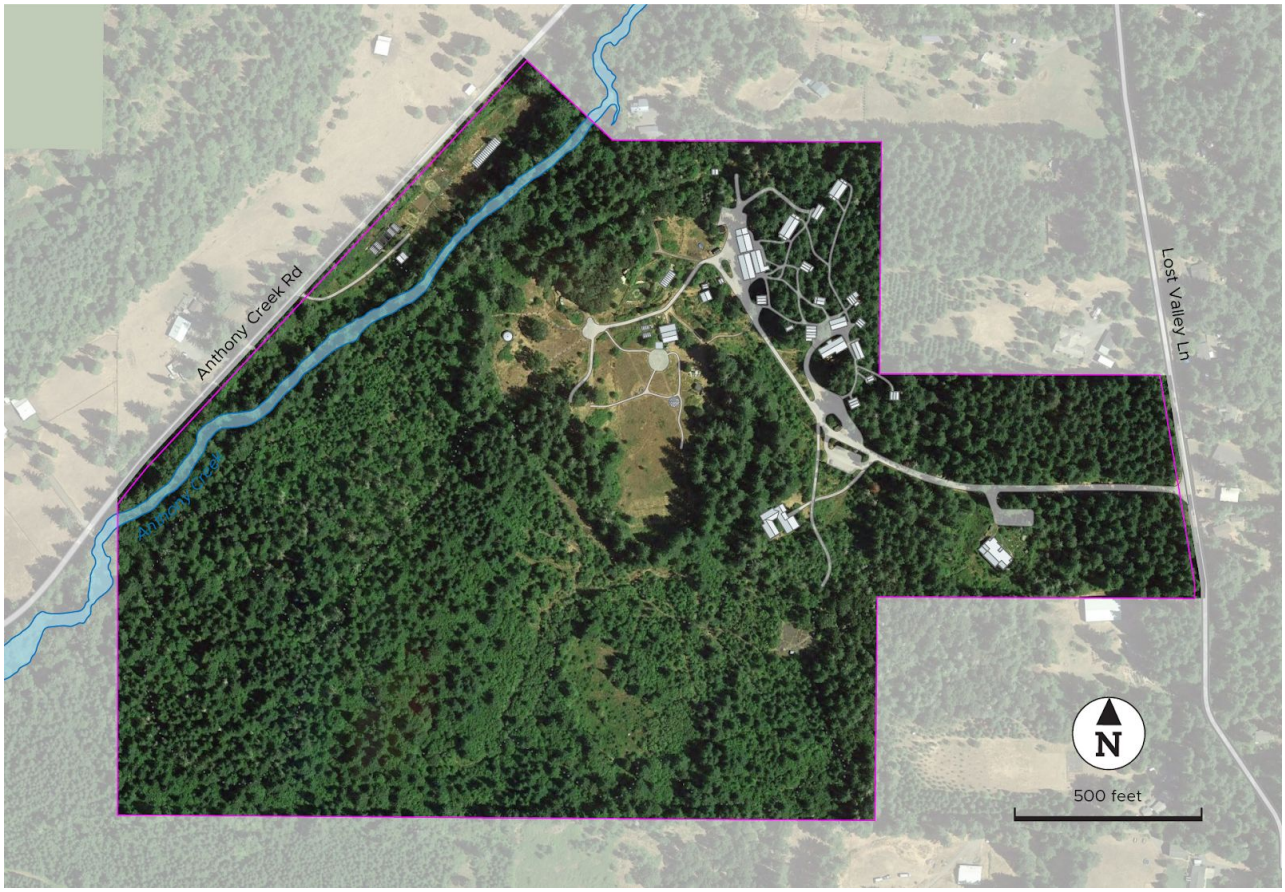
Property Information

Name:	Lost Valley Education Center
Address:	81868 Lost Valley Ln. Dexter, OR 97431
County:	Lane County
Township:	Township 19 South
Range:	Range 1 West
Section:	Section 19
Elevation:	Average 795 feet asl (ranges from 750 to 840 ft)
Total acres:	87 acres
Forested acres:	~75 acres
Fire Protection District:	Dexter RFPD
Watershed:	Middle Fork Willamette ~ Anthony Creek Sub Basin
Watershed #:	HUC-8 17090001 (Middle Fork Willamette River) HUC-12 170900010103 (Lost Creek Sub Basin)
Latitude:	43° 53' 24" N
Longitude:	-122° 49' 34" W
Map Lot Number:	*1901290000105*
Zoning:	401 Tract, Improved
Douglas Fir Seed Zone:	8

2. Introduction

Lost Valley Education Center is an 87-acre community and residential education center situated around a working landscape of orchards, gardens, meadows, mixed conifer forests, and hardwood groves. It is located on Anthony Creek in the Middle Fork Willamette Watershed, a tributary of the Willamette River in Oregon's Willamette Valley. The landscape is a mosaic of open meadow, seasonal waterways, mixed conifer forest, oak woodlands and savanna, and riparian forest.

This Stewardship Plan describes the natural and physical resources of Lost Valley and articulates specific actions for the restoration, maintenance, and enhancement of the mosaic of woodlands, forests, meadows, and waterways that makes up the site. It is intended to be a multifunctional document, used as a guiding framework for tending the property. It is also meant to be an educational tool, used to facilitate learning on the site. Finally, the plan identifies opportunities for funding conservation measures and restoration projects across the property.



Map 1: Lost Valley Education Center

3. Stewardship Goals and Objectives

- **Increase biodiversity and ecosystem health through:**
    - Maintaining and enhancing in-channel watershed function and connection to off-channel riparian habitat.
    - The upkeep and establishment of meadow, woodland, and aquatic habitat
    - Maintaining and enhancing oak woodlands and other unique species and plant assemblages.
    - The restoration and establishment of off-channel aquatic habitats and summer drinking water sources.
    - Regenerating soil and water resources across the site.
- **Improve resilience to fire and disease as well as stresses brought about by climate change through:**
    - Increasing landscape-scale plant and animal species diversity while focusing on retaining resilient and beneficial species that mitigate the effects of pests and disease.
    - Undertaking stream restoration work that increases capacity to withstand erosion during high flow events.
    - Implementing regenerative agriculture and forestry practices that support a holistic approach to increasing soil organic matter and vegetative cover.
    - Establishing sustainable on-site source of water for potable, non-potable and firefighting purposes.
    - Developing a property-wide firefighting capacity that includes road access, gravity fed water sources, and management of fire resilient farm and forest landscapes.
- **Achieve a synthesis of farm productivity and land health through the development of systems that support the ecological well-being of the site while providing economic sustainability and a high quality of life through:**
    - Developing a framework for targeting grant-funding opportunities for all vegetation types and management units.
    - Developing a detailed picture of the site, its various habitat types, their management priorities, and opportunities for further development; into which more detailed economically and socially generative farm and forest management agreements can be developed with residential and regional partners.

• Part I •

Lost Valley

Descriptions

4. Land Use History

Lost Valley is within the ancestral territory of the Winefelly Band of the Kalapuya People (now organized as part of the Confederated Tribes of the Grand Ronde). For over 8,000 years, the tribes of the Willamette basin actively managed the land through controlled burning, digging, coppicing, and propagation. These horticultural practices maintained a range of plant and animal assemblages for food, medicine, and craft materials. Prior to European settlement, the Kalapuya population was large and management was extensive with fire employed on an annual basis at the watershed scale from the valley floor to upwards of 5,000 feet elevation into the huckleberry belt in the Cascades and Coastal Mountains.

The many benefits of fire management included circle hunting deer and elk, maintaining clearings for travel and village sites, gathering tarweed (a sunflower species whose resinous seed are rendered non-sticky by fire), improving acorn production, and increasing hazelnut and berry yields. A more circumstantial benefit may have been the fire's ability to limit white travellers ability to travel, camp, and graze their animals in the area. The role that human management played in determining the plant communities and vegetation cover across the landscape is hard to overstate. It can be said that humans have been a "keystone species" given their sustained management of ecosystems and species, some of which are presently on the brink of extinction throughout the Pacific Northwest. The many artifacts found on the property indicate that this land was utilized extensively as part of a larger bioregional land base of the Kalapuya people. At this time, Lost Valley was most likely dominated by seasonally wet and upland meadows, oak woodlands and savanna, scattered mixed conifers, and bottomland hardwood forest.

Disease began to take its toll on the tribes of the Northwest in the early 1500s as malaria, smallpox and other illnesses spread across the continent from the explorations of colonists in the East and Spanish exploration up the Pacific Coast. The extent of this impact can be read in the cessation of annual fire intervals and the appearance of low elevation Douglas fir forests throughout the valley; both signifiers of a sharp decline in land management across the region.

By 1849, the population of the tribes of the Willamette basin had dropped to approximately 600 people as a consequence of both conflict and disease. Indigenous burning was outlawed in 1850 and the Luckimauke signed a treaty with the US government in 1851. The main stipulation of this treaty was that they were to maintain small reserves in the traditional territory. The original reserve was to be located just West of the farm. The treaty, as well as all others in this year, was not ratified. In 1855, a second treaty ceded the entire drainage area of the Willamette river to the US government and the Luckimauke were moved a second time before they were permanently relocated along with 27 other groups to the Grand Ronde reservation outside of Salem. By 1900, the entire population at Grand Ronde had dropped to approximately 300 individuals. In 1954, the Western Oregon Indian Termination Act terminated the tribal status of all remaining Kalapuya descendants. Tribal status was finally restored through the Confederated Tribes of the Grand Ronde in 1983 and the Confederated Tribes of the Siletz in 1977.

The beginning of the fur trade in the late 1700s marks the second major event in the landscape history of the region. Beginning in 1821, The Hudson Bay Company carried out a policy of beaver extermination throughout the Columbia River basin, seeking to maximize its profits amidst the prospect of American Settlement of the West while dissuading American trappers from having incentive to enter the Oregon territory. The company focused its efforts on the Willamette basin in 1825. By 1900, beavers were nearly extinct in the Pacific Northwest.

The impact of the sudden eradication of beavers from the watershed led to significant changes in the hydrology and structure of stream channels as ancient beaver terraced headwater streams lost their dams, drained their sediment, and formed permanent down-cut channels. Other events, such as the region-wide poisoning of Pacific lamprey and extensive flood control projects in the 1950s contributed significantly to the alteration of the region's waterways and riparian habitat.

The Donation Land Act of September 29, 1850 incentivised American movement to the West. Married settlers were given 640 acres of land and single settlers were given 320 acres of land provided that they live on and cultivate it.In 1853, the Free Immigrant Trail was opened across the Cascades, down the Middle Fork of the Willamette River and into the Willamette Valley. This route took the new settlers past the junction of Lost Creek and the Willamette River through the area known at this time as "Lost Valley." Settlement of the watershed was largely underway by 1860 and the entire valley floor around the Lost Creek subbasin was settled by 1870. Open grasslands and savannas were likely the first areas to be cleared and plowed by farmers. In order to enable agriculture and settlement on the valley floor, settlers removed in-stream log-jams for river navigation and lowered the water table through surface ditching for drainage. By the 1900s, tile drainage, promoted by the State of Oregon and later supported with grants through the Soil Conservation Service, further lowered the water table in the prairies. As railroad transport became possible and settlement continued, settlers cleared the lowland forests for agriculture and grazing. At this time, streams and rivers were cleared for navigation as well as log transport leading to further degradation of river systems, riparian forests, and wet prairie habitats throughout the watershed.

When General Land Office surveyors walked the section lines of the area in 1855, they described the landscape around Lost valley as containing timber grade fir and oak. Oak, which still covered many of the foothills around the valley, was still a dominant feature on this site. Some fallen oaks on the property have shown ring counts of more than 200 years old. Mature conifer forests were likely a more recent occupant by the mid 1800s, having grown in with the loss of routine fire management as early as the 1500s. The first logging occurred in the watershed in the late 1800s and increased throughout the early 1900s with larger sawmills well established by the 1930's. Springboard notches on large stumps indicate that Lost Valley was cut at least once with handsaws prior to World War II. Forest clearing and log skidding likely led to debris torrents throughout the downstream reaches of the watershed leading to extreme erosion and deposition effects in the zone occupied by Lost Valley today. Drainages were also used for log transport and added significantly to the degradation of stream systems. Splash dams were built to transport lumber from the upper watershed to the main river corridors. It is likely that Anthony Creek was used for this purpose. The scouring impacts on river systems from these log drives was significant. The impact of logging is often seen to have culminated in the flood of 1964 when record rainfall carried topsoil and debris out of the recently cleared uplands leaving channelized and downcut drainages downstream. Following this event, many headwater creeks throughout the valley were converted from year-round to seasonal streams.

Map 2: 1855 General Land Office Survey of Anthony Creek

The first record of ownership on Lost Valley's land dates to 1877 when Anthony Jaughlin acquired 142 acres through the Donation Land Act (Accession Number: ORRAA 002468). The homestead included the 87 acres currently occupied by Lost Valley. The land soon passed to John and Sara Hanna in 1878 as part of a larger 322 acre homestead claim (Accession No. ORRAA 002470). At this time, the land was likely plowed for agriculture and used as part of a larger grazed land-holding. In the following years, it is likely that at least one rotation of timber was removed from the site. In 1969, the 87 acre site was purchased by the Shiloh Youth Revival Center to serve as a Christian retreat. Approximately 30 structures were built on the property in the early 1970s including housing facilities of various types for approximately 150 individuals and 35 families, dining facilities, a clinic, classrooms, offices, a community store and various agricultural and miscellaneous buildings. During the early 1980s, use of the property evolved into a study and retreat center serving a broader population base. Records state that Shiloh hosted an average of 3000 guests per year as a retreat center. They kept a 2 acre vegetable garden and maintained a large pig operation. Other farm animals including cattle, poultry, goats and rabbits, were also kept. The property was clearcut in the late 1980s as a means of paying off the organizations debts. Following this harvest, there was no slash treatment or herbicide used for vegetation control while followup planting did not occur until the 90s. This led to a strong natural reproduction across the site with an abundant cohort of oak, hazel, maple, and other hardwood trees amidst a mixed planting of grand fir, Willamette Valley pine, incense cedar, and Douglas fir.

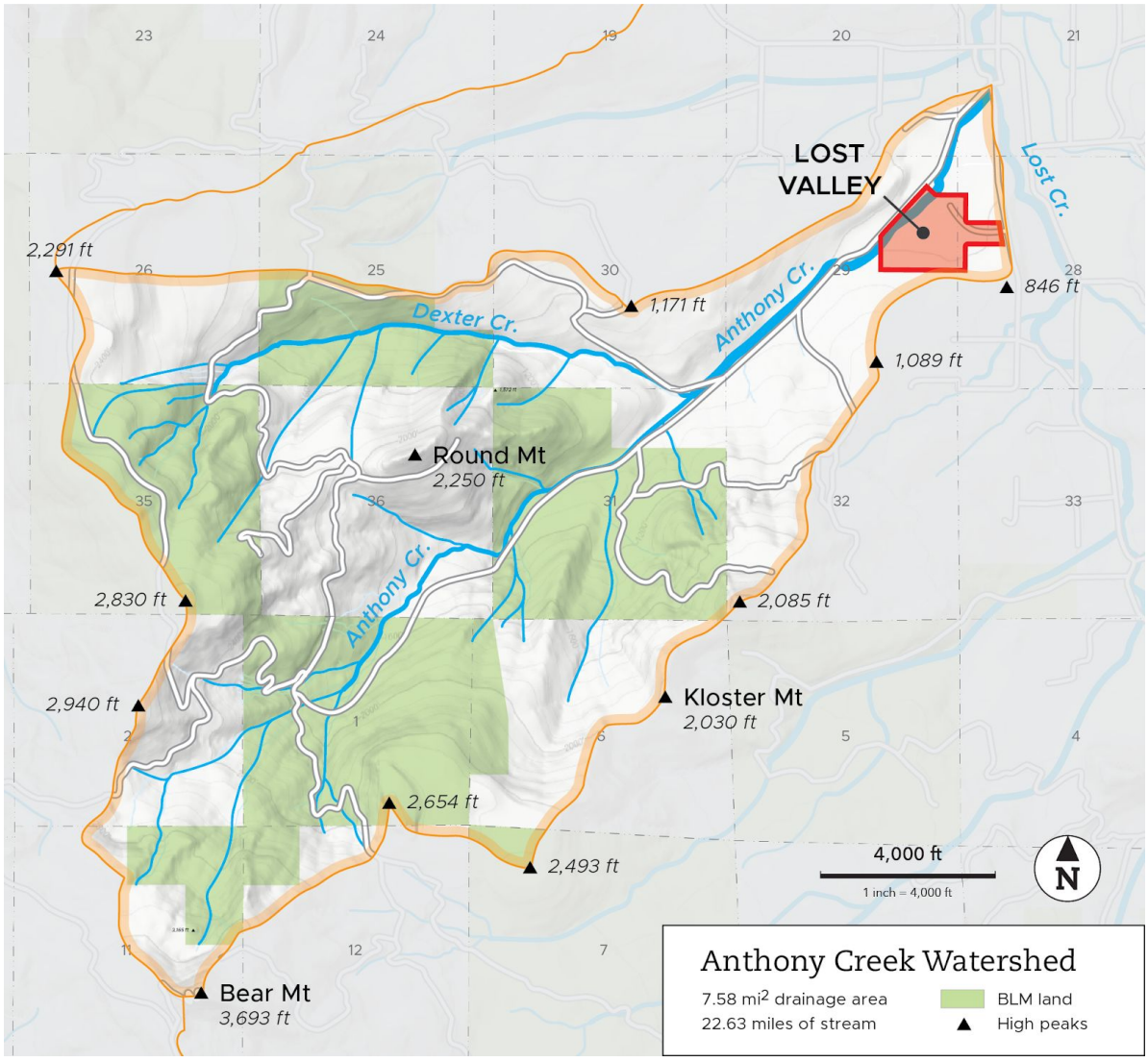
In April 1989, the property was acquired by Seven Generations Land Trust for use by the Lost Valley Center. Lost Valley continued the prior use of the property for seminars, conferences, and residential educational programing. The meadows, with their scattered large open grown oak trees, riparian forest, a section of approximately 40 year old Douglas fir forest, oak woodlands, and a large section of regenerating scrub remained. Lost Valley planted a mix of

conifers into the regenerating clearcut sections of the property and continued the small scale agriculture already established on the site. Small regeneration thinnings have occured in the conifer sections of the site since that time and one burn was recently carried out in the meadow.

5. General Site Overview

The following section outlines elements that apply broadly to the whole site. In-depth discussions for all habitats and stewardship areas can be found in the sections that follow.

5.1 Watershed



Map 3: Anthony Creek Watershed

Lost Valley is located in the Anthony Creek Subbasin of the Middle Fork Willamette Watershed. Anthony Creek has a total length of approximately 22.63 miles and drains 7.65 square miles of land area. Two forks of Anthony Creek drain out of steep uplands and combine into a single 3rd order stream before connecting with Lost Creek. Lost Valley is situated on this 3rd order reach just before Anthony Creek's confluence with Lost Creek. Lost Creek flows Northwest to connect with the mainstem of the Middle Fork Willamette North of Highway 58 between the towns of Lowell and Jasper. The Middle Fork watershed is bounded by the Willamette River to the West, the crest of the Cascade Range to the east, the Coast Fork WIllamette river to the South and the McKenzie River to the north. The River begins in the Cascade Ecoregion where it drains out of the Eastern slopes of the mountains into the Willamette Valley. The Middle Fork Willamette watershed is a tributary of the Willamette River which charts a northward course through a 20–40 mile wide and 150 mile-long floodplain to its confluence with the Columbia River near Portland, Oregon.

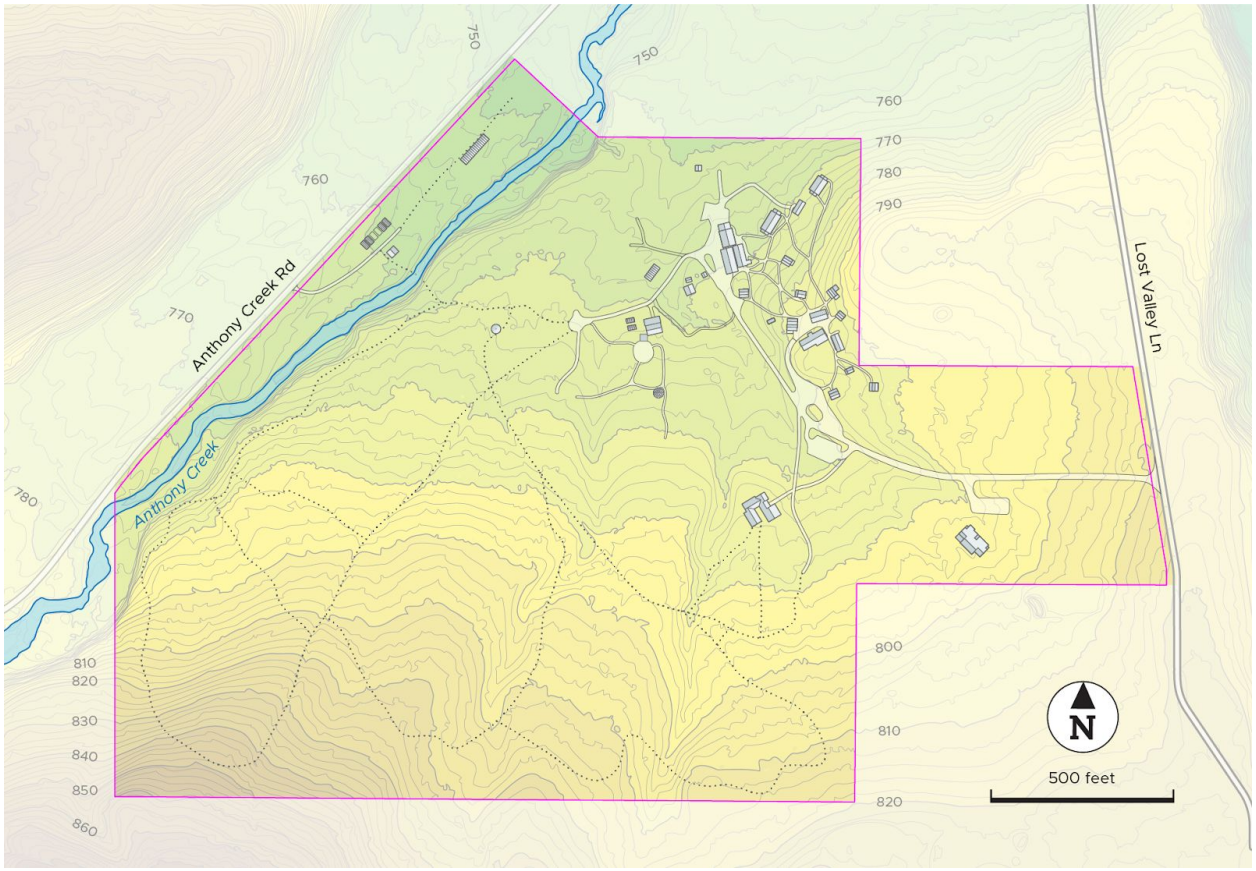
5.2 Climate, Microclimate, and Landform

At the regional scale, Lost Valley lies within the Willamette Ecological Province. This province is characterized by its maritime Mediterranean climate whose mild temperatures and seasonal rainfall result in prolific plant growth while arid summers produce unique plant assemblages adapted to extreme dry periods. Annual rainfall averages (approximately 47 inches) have remained fairly consistent since the start of recordkeeping in 1916 but have fallen off consistently over the past decade. Recent rainfall averages have been approximately 50% of normal while rainfall intensity has increased to upwards of 200% of normal. Rainfall occurs primarily between mid-October and mid-May. Like other Mediterranean zones, oceanic high-pressure systems block incoming moisture during the summer months, creating a period of drought through this season. No specific climate data exists for Lost Valley's sub-basin.

At the site scale, lost valley resides in a relatively low and sheltered valley. This leaves it fairly well protected from strong winds. It has been noted that the valley has relatively minimal damage from the Columbus Day storm; one of the strongest indicators of severe wind impacts in the region. Its low-lying landscape position, leaves it prone to frost settlement and cooler microclimates in general.

The upper reaches of Anthony Creek are characterized by steep ridges, narrow valleys, and volcanic soils typical of the western slope of the Cascades. Past episodes of glaciation and active stream erosion have created a highly dissected landscape that results in steep, high-gradient stream reaches within the upper parts of the watershed, and low-gradient stream reaches within the flatter, lower portions of the watershed where Lost Valley is located.

Map 4: Lost Valley Topography

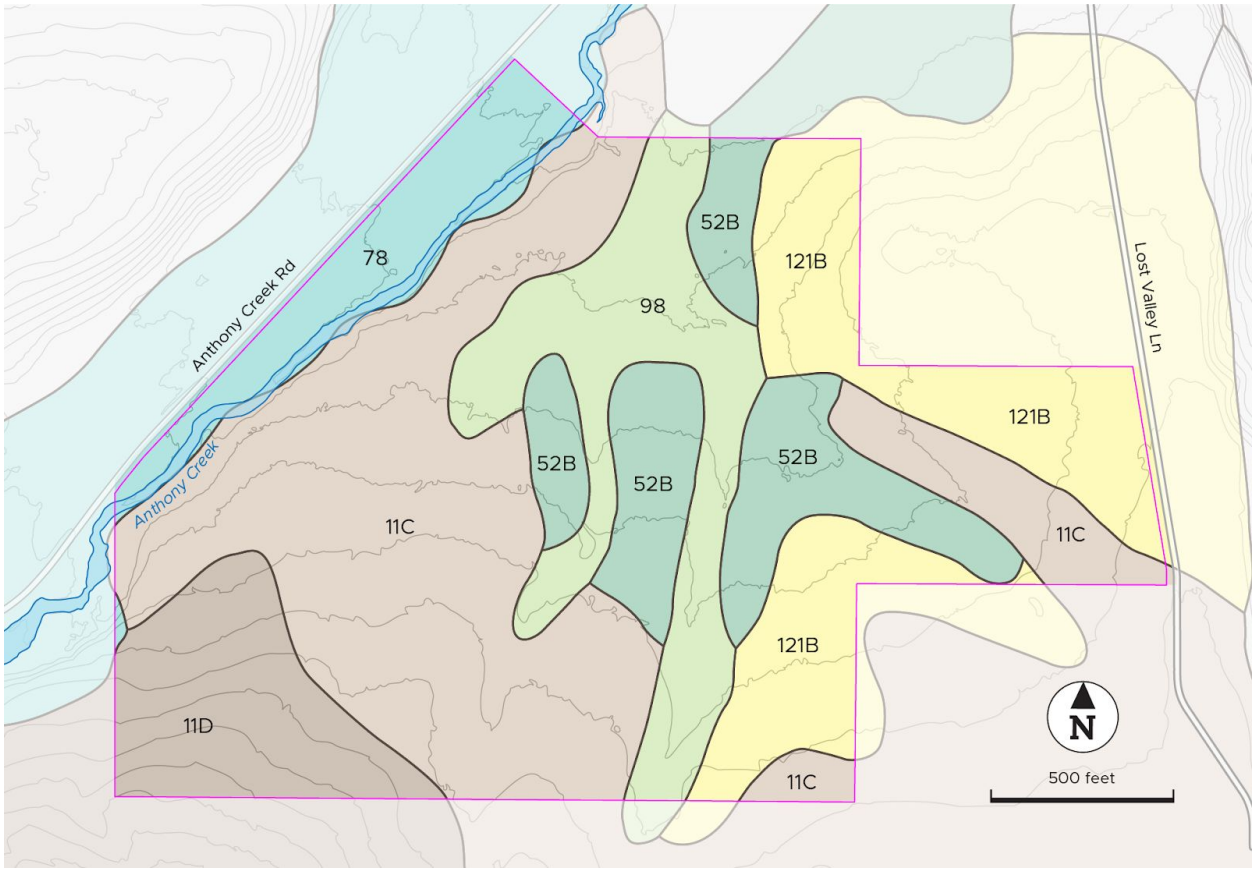


5.3 Geology and Soils

Lost Valley is situated at the edge of the Western Cascade foothills in a headwaters valley of the Willamette River. The mountains formed 40 million years ago with eruptions of ash and lava from an arc of cone volcanoes that arose when the oceanic crust began to subduct under the North American continental plate. Volcanic activity ceased 5 million years ago and was followed by accelerated stream erosion. The bedrock is primarily basalt, andesites, and lighter colored rhyolite that poured through the basin 15-30 million years ago. Atop the bedrock, the site topography is formed from geologically recent river floodplain deposits of unconsolidated sand, silt, clay, and gravel and volcanically derived sediments including old volcanic mudflows and lake sediments. The soils derived from these rocks are predominantly clay types and include the Hazelair, Bellpine, and Salkum soil series. The Mc Alpin soil type, an alluvial rocky clay loam, is found along anthony creek.

(For a complete set of descriptions for each soil type, see Appendix 1)

Map 5: Lost Valley Soils



Soil Types Key					
11C	**Bellpine silty clay loam** 3 to 12 percent slopes	32.6 ac	78	**McAlpin silty clay loam**	6.5 ac
11D	**Bellpine silty clay loam** 12 to 20 percent slopes	8.2 ac	98	**Noti loam**	12.4 ac
52B	**Hazelair silty clay loam** 2 to 7 percent slopes	12.0 ac	121B	**Salkum silty clay loam** 2 to 8 percent slopes	14.7 ac

6. Cultural Resources and Special Sites

This site is within the historic range of the Southern Bands of the Kalapuya Tribe. Stone tools, arrowheads, and flint knapping sites have been found on the farm and it is clear that the Kalapuya People utilized this area. It is suggested that Lost Valley contact the Confederated Tribes of the Grand to conduct a full archeological analysis.

7. Forest Health

As is presently common for low elevation Douglas fir throughout the valley, fir trees are showing signs of drought stress with crowns dying from the top down, stress cone crops, and significant tree mortality across the property. Trees in the valley foothills on clay-heavy soils are showing the greatest impact. Although Douglas fir engraver beetle, laminated root rot, and other factors are adding additional stress to the trees, higher than average heat coupled with lower than average rainfall is the primary culprit. Drought kills trees through a process called vapor pressure deficit (VPD). VPD is the difference between the amount of moisture in the air and how much moisture the air can hold. The higher the VPD, the more the air pulls water from the plant. Because warmer air can hold more water, on hot days, the VPD is even higher and will exert more pressure on the plant to lose water. Maintaining or creating cool microclimates, reducing competition for water, allowing for natural reproduction from seed in order to enhance genetic adaptation, and adding heat tolerant species to the stand are all ways Lost Valley could mitigate the effects of drought. Specific prescriptions will be discussed in section 13 below.

Lost Valley has patches of trees affected by the grand fir engraver beetle, *Scolytus ventralis*, and the Douglas fir engraver beetle, *Dendroctonus pseudotsugae*. Beetle kill is largely a drought response by trees unable to drive beetle larvae out of their bark through their sap because of insufficient hydraulic pressure and water for sap production.

8. Invasive Species

Sections of the property are under moderate encroachment by Himalayan blackberry and Scotch broom. Further discussion on invasive species management will be discussed in section 13 below.

9. Threatened and Endangered Species

There are no known threatened or endangered species on or adjacent to this site. Conducting a comprehensive survey would be a valuable exercise in establishing a full species list for the site.

10. Vegetation Types and Management Unit Descriptions

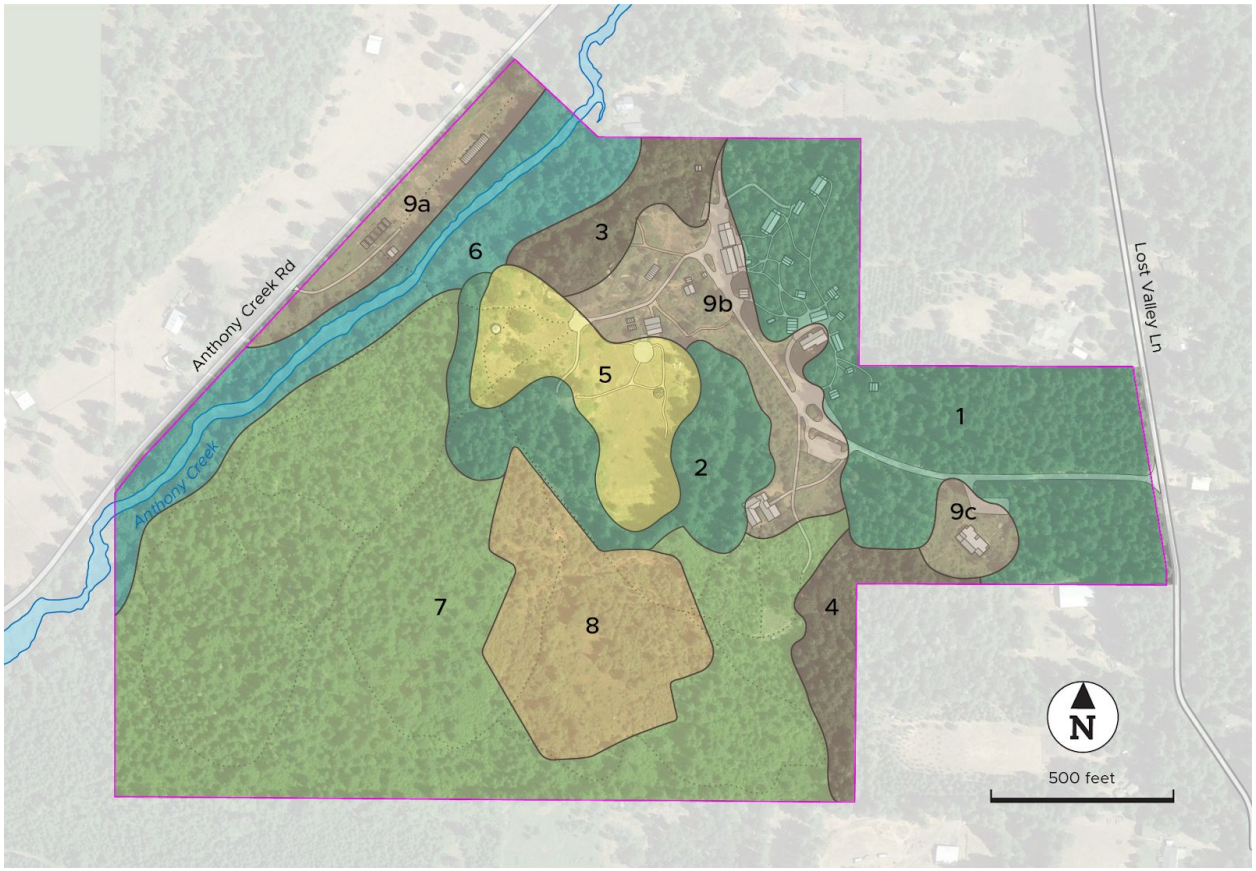
The 9 management units outlined in this plan have been broken into a series of overarching vegetation types. A stand volume and survey was undertaken for all managed forest units and a plant inventory was conducted for each vegetation type.

By reviewing early written accounts and land survey records made when the upper reaches of the Willamette Basin were being subdivided during the 1950s, contemporary researchers have concluded that oak savannas and oak woodlands with scattered fir and pine were the dominant upland forest type while bottomland hardwood forests and periodically burned wet meadows and shrub thickets covered the lowlands and river floodplains. Today, defenders of Wildlife estimates that oak woodlands have been reduced by 80% of their original land cover in the Willamette Valley. Wetland habitats have been reduced by 87% and bottomland hardwood forest ecosystems by 70%.

Middle Fork Willamette Conservation Opportunity Area

The Oregon Conservation Strategy, an overarching set of restoration goals developed by the Oregon Department of Fish and Wildlife, has highlighted the Middle Fork Watershed as a priority restoration area for stream restoration and riparian and oak habitat. It is identified in the strategy as Conservation Opportunity Area (COA) 115. Together, riparian forests, meadows, seasonal waterways, and oak stands on this site create a habitat assemblage that is ideal for the habitat enhancement goals pertaining to the COA. A description of these priority habitats along with other habitat and wildlife narratives follow below.

Map 6: Lost Valley Management Units and Vegetation Types



Management Units Key					
1, 2	Mixed Conifer	19.8 ac	7	Mixed Hardwood	32.5 ac
3, 4	Oak Woodland	4.8 ac	8	Agroforestry	7.2 ac
5	Meadows & Oak Savanna	5.0 ac	9a–c	Agricultural & Residential	9.7 ac
6	Riparian Forest	7.4 ac			

10.1 Mixed Conifer Units 1 and 2

Lost Valley's conifer forests are broadly defined as a Douglas fir dominant forest type characteristic of the Cascade foothills of the Willamette Valley. The goal for Lost Valley's managed forest sections is to manage toward an old-growth forest type in the context of human management that obtains yields as a by-product of forest regeneration. Old-growth mixed conifer forests are defined by plant species composition, overstory tree age and size, and the forest structure. They include characteristics such as a multi-layered tree canopy, shade-tolerant tree species growing in the understory, large-diameter trees, and a high volume of dead wood, such as snags and downed logs. Federal lands (primarily BLM) within the Watershed still contain sections of mature and late successional forests, but these forests occur in a patchwork surrounded by the much younger and simplified even aged forests managed on shorter rotations to generate timber products. Where historical stands were perpetuated for 200 to more than 1,000 years, commercial forestlands are now commonly harvested every 60 years or less. These younger forests still maintain their capacity to become older forests, and as they proceed from open meadow to closed overstory, they can often support many species. However, late successional forests support a wide array of species, many of which require large patches of older or mature forests to survive and may be sensitive to changes in the forest seral stage. Old-growth conifer forests are particularly important for wildlife, mosses, and lichens. The Oregon Conservation Plan lists the red tree vole, northern spotted owl, the Columbian white tailed deer, the American martin, ringtail, the Copes giant salamander, the northern flying squirrel, and Nelson's checkermallow as strategy species within this vegetation type.

Unit 1

This 14.2 acre section of forest was logged in the 1950's and left to reproduce from on-site seed. The most abundant age, therefore of the Douglas fir and associated species is approximately 65 years. Prior to the 1970s, when seedling tree planting became a more common practice, it was typical to leave trees within the harvest unit and to rely on adjacent stands for a supply of seed to regenerate the next rotation of forest. Additionally, the forest was not broadcast sprayed to reduce competing vegetation. These factors resulted in a relatively high diversity of forest species co-emerging on site since that time. The seed trees, whose age predate the last clearcut represent an older age class. These trees bring an additional level of structural diversity to the otherwise even aged forest. Many of these older trees have broken tops and forks where wind and sun-scald impacted their health after being exposed. In some cases these trees have living cavities which provide important habitat for birds and mammals. This unit is predominantly Salkum silty clay loam. The soil is considered a high productivity forest soil with a site index rating of 116. The "site index" is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. In this case it is Douglas fir at 50 years of age. The site index applies to fully stocked, even-aged, unmanaged stands.

Unit 2

This 5.3 acre section of trees shares the same history with unit 1. However, the trees are larger and more widely spaced with well preserved crowns. This is due mostly to greater solar access afforded by meadows and clearings surrounding the unit and abundant water emanating from adjacent waterways . The soil in this unit is Hazelair silty clay loam. It is considered a lower productivity soil than the Salkum soils of unit 1. Hazelair can have wetland inclusions and is considered a poorly drained soil. Modern drought conditions and the soil quality has likely

contributed to greater degrees of laminated root rot and drought stress over time. Currently, more than half of the trees in this unit are showing signs of moderate to severe stress.

10.2 Oak Woodland Units 3 and 4

Historically, Oregon white oak savannas and woodlands were a major component of the Willamette Valley landscape. By reviewing early written accounts and land survey records made when the valley was being subdivided during the 1850s, contemporary researchers have concluded that oak savannas and oak woodlands with scattered conifers were the dominant upland forest type for this site. It is recognized that conifers only emerged as dominant species in these habitats only after the population of Native Americans was severely reduced through disease and genocide in the early- to mid-1800s.

Oregon white oak habitats have persisted in areas where periodic grazing and mowing has maintained oaks and their plant associates despite the pressures of conifer competition. Additionally, many small patches are scattered throughout the otherwise conifer dominated uplands where soils are too shallow or wet or the microclimate is too hot to offer a competitive advantage to Douglas fir. The loss of fire as a tool for prairie and savanna management and the conversion of these systems to modern agriculture and forestry use has resulted in one of the most complete conversions of habitat types in North America. Most of the remaining oak woodlands and savannas exist on private farms and forests throughout Western Oregon where they are often being converted to plantation forestry, agriculture, residential, and other uses. This points to the important role landowners need to play in maintaining this critical ecosystem. To a very large degree, private landowners hold the future of the remaining oak ecosystems in their hands.

Of all forest types in Western Oregon, oak-dominated stands have the highest bird species diversity in all seasons. Almost 80 species of birds use oak habitats in the valley. 10 of the avian species have special status designated by federal and state agencies. Having twice the number of cavities than big leaf maple and 30 times that of Douglas fir, white oak trees are important nest sites for cavity nesting birds and mammals. Open grassland and the shrub layer in woodlands also provide unique habitat types and foraging areas for bird and mammal species. Thirteen plant species are listed by the State of Oregon as threatened and endangered, or proposed as candidates for listing in the Willamette Valley. All of these species are associated with the oak habitat type. Twenty animal species that are closely associated with oak prairies and woodlands in the Willamette Valley have been listed as Oregon Conservation Strategy species because of their declining populations or their vulnerability to habitat loss. These animals include include the Columbian white-tailed deer, Chipping Sparrow, White-breasted Nuthatch, Lewis's Woodpecker, Fender's blue butterfly, western rattlesnake, and the great spangled fritillary.

Unit 3:
This 2.4 acre unit is a mature oak woodland. A series of larger legacy oaks remain from a time when this stand was likely part of a larger savanna vegetation type. Today, seedling oaks have formed a dense stand of mixed oak and fir. The soil for this unit is primarily Salkum silty clay loam; the soil type in Unit 1. The high Douglas fir productivity associated with this soil has placed this Unit at risk of conversion over time to conifer dominance. In addition to competition, understory species associated with this habitat type are under competition from Himalayan blackberry and woody brush including English hawthorne and Scotch broom.

Unit 4:

This 2.4 acre unit has a higher amount of open grown trees. These trees have large lateral limbs and greater diameter than Unit 3 in general. The unit grades into the riparian forest habitat to its North and therefore contains some ash and maple. This unit like unit 2, is under competition from conifers and to a lesser degree maple and ash. Both this unit and Unit 2, contain stands of camas, tarweed, checkermallow, and other oak woodland wildflower species.

10.3 Meadow Unit 5

Lost Valley's meadow covers approximately 5 acres. Meadow's or Grasslands are dominated by grasses, forbs, and wildflowers. Many grasslands in the Willamette Valley are interspersed with ephemeral pools and riparian drainages with woodlands and savanna forming a mosaic in the landscape. Oak savannas are grasslands with scattered Oregon white oak trees, generally only one or two trees per acre (denser oak stands are considered oak woodland). Oak trees in savannas are usually large with well-developed limbs and canopies. A series of these larger trees remain on Lost Valley's land on the borders of open meadow zones. The greatest loss of grasslands has been in valley bottoms and foothills where they have been impacted by conversion to plantation forestry, agriculture, and development. Disruption of historical fire regimes has allowed for shrubs or trees to encroach, replacing grasslands with forest. In many areas, including Lost Valley, grazing and agriculture has impacted grasslands, affecting plant composition and structure. Historically, non-native species were seeded for livestock forage, decreasing the abundance and diversity of native plants. Approximately 1% of the original grassland cover of the Willamette Valley persists today and what remains is particularly fragmented and isolated.

Grass species that were historically common but are now threatened with extinction include Idaho fescue (*Festuca idahoensis* var. *roemeri*), California oatgrass (*Danthonia californica*) and purple needlegrass (*Stipa pulchra*). A number of bird species are considered to be Willamette Valley meadow habitat specialists. These species include the yellow-breasted chat, grasshopper sparrow, vesper sparrow, and western meadowlark. Lost Valley's meadow habitats often exist in a mosaic of savanna, woodland, closed canopy forest, vernal pools, and wetlands. This mosaic leads to high microclimate effects at the landscape level. Of the 12 species of native amphibians, 9 have an opportunistic association with grasslands and 10 with woodlands. Prairies, savannas, and dry woodlands are also the preferred habitat of the valley's reptiles. Of these species, the western painted turtle (*Chrysemys picta*) and the western pond turtle (*Actinemys marmorata*) are listed as sensitive.

10.4 Riparian Forest Unit 6

Although streamside riparian forests were a dominant historic feature in the Willamette Valley, the scale of these forests has been significantly reduced within the last century. Since the 1850's riparian forests in the valley have been reduced by over 70%. Bottomland riparian forests, which originally formed up to a seven-mile wide riparian corridor along the Willamette, have been reduced to an average of only a few hundred feet in width. Most easily accessible large trees were being removed from Western Oregon's riparian forests by the 19th century. Removal continued until 1971 when the Oregon Practices Act began regulating the removal of timber from riparian zones. Adding to the problem of channel degradation was the policy until the 1970s of removing full spanning log jams from creeks. The loss of large streamside trees and in-stream woody debris has led to a chronic undersupply of channel supporting debris in Oregon streams.

The edge between water and uplands occupied by riparian forests creates a rich habitat for terrestrial wildlife. More than 200 species of forest- dependent wildlife breed or rear young in riparian and wetland zones of Western Oregon. These zones create travel corridors

and nesting habitat for wildlife and create refuge for predators of insect pests. Riparian areas are essential to the maintenance of aquatic habitat by providing shade to moderate water temperature and contributing woody debris that provide refuge for fish and other aquatic organisms. The roots of trees and shrubs also stabilize the banks of the waterway, helping control sediment and pollution inputs. Riparian forests also function as pollution barriers to streams retaining sediment, agricultural chemicals, and surplus nutrients that would otherwise wash into streams.

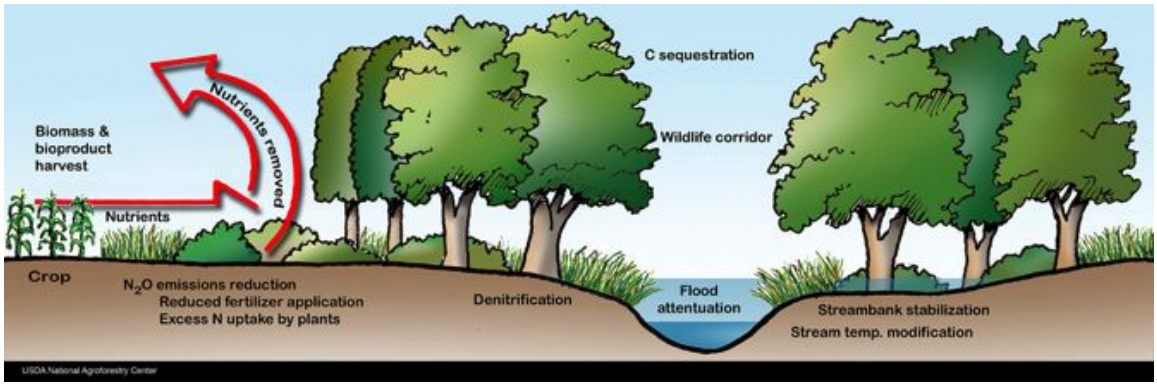


Image 1: *Riparian Buffer Functions (National Agroforestry Center)*

The riparian forest covers a total of 7.4 acres along both sides of Anthony Creek. Rock debris berms with cottonwood and alder possibly are found within and adjacent to the stream and these may date from the 1964 flood. The rest of the forest is a mix of upland conifer species including red and incense cedar, Douglas fir, and grand fir. These trees were planted about 40 years ago and have continued to regenerate from on site seed since that time. The creek its self runs on bedrock through Lost Valley's land and is reduced to a set of disconnected pools during most summers. A brush check dam and a series of interplanted rock gabions have been placed in the stream for the purposes of creating induced meanders and sediment retention in the actively aggrading channel. Contentious placement of gabions has led to partially anchored trees falling into the main channel. These trees have been used as structures for enhancing meander in the channel.

10.5 Mixed Hardwood/Conifer Scrub Unit 7

The 32.5 acres covered by this habitat type is known as the New Forest. It was clearcut in the mid-1980s and left to regenerate from on site seed for a series of years before being further planted by Lost Valley in the early 1990s. Sequoia, European Black Spruce, Douglas fir, incense cedar, and hybrid KMX pine were planted at this time.

10.6 Agroforestry Unit 8

This 7.2 acre section of the above habitat type has been managed more intensively over the past decade to become a mixed planting of fruit and nut trees interspersed with the mixed forest regenerating in this section. Plantings have been integrated into a series of earthworks including swales and habitat ponds and accessways have been cut through the unit in order to enable tree crop management.

10.7 Agriculture and Residential Units 9a, b, and c

This zone represents a unique human intensive habitat type. It blends upland meadow, mixed woodlands, wetlands, open ponds, and tree/shrub thickets with intensively managed organic gardens and orchards. The area covers three separate zones which together make up approximately 9.7 acres.

11. Habitat Elements

Habitat elements occur as components of overarching habitat types and their importance is great enough to merit a section of its own. Aquatic habitat, hardwoods, snags, downed woody debris, and forest openings are all habitat elements that support biodiversity and ecosystem health.

11.1 Aquatic Habitat

Rainfall averages have remained fairly consistent since the start of recordkeeping in 1916. Despite this, stream periodic flow has changed considerably in most headwater creeks of the WIllamette Basin. However, because streams emanating out of the Cascade foothills are largely spring fed, they tend to have more consistent year-round water supplies than Coast Range streams. Watershed factors date back to the trapping era and perhaps even to the cessation of fire. However, more recent logging, log skidding, and road construction has had a significant impact on local hydrology. It is important to recognize that it is the pace of drainage out of the watershed that has seen the greatest hydrologic change over time. This is because the retention in vegetation, surface litter, and the soil has been reduced. Quicker movement into waterways results in more volume and friction and leads to channel degradation as an equilibrium between erosion and degradation is lost in the system. Mountain streams in disequilibrium lose their sediments and smaller rocks downstream until bedrock is exposed. The bedrock erodes at nickpoints creating headcuts. These cuts represent small waterfalls that migrate upstream as they give way to erosion; further lowering the depth of the stream channel and increasing the movement of water out of the headwater streams into the main channel of the Willamette.

As land use and changes in rainfall regimes have combined to increase the erosion of the uplands, it has led to an increase in the overall friction of water moving through the lower river sections. Combined with the fore mentioned practices in the river valley (ditching, wetland draining, log jam removal, and the loss of a significant cohort of streamside trees contributing long term woody debris) the friction lowers the depth of the river bottom and increases sediment in the river which has negative impacts on fish species and reduces spawning potential. These processes lead to a disconnection of the river from the floodplain forest which in turn further reduces the overall potential of the river corridor to absorb river friction and infiltrate high water. Total flow therefore is contained within the river itself and concentrates energy along banks to a degree significantly greater than the background erosion history of the river.

Without hydraulic connectivity to the floodplain, the historic condition with braided side channels and ephemeral pools is lost and the river is reduced to a single straight channel. This has lowered the subsurface water levels, limiting the extent of riparian forest cover and significantly reducing the total water retention capacity of the riparian zone as water is no longer able to spread and sink into the floodplain. Because reconnected floodplains and re-built

channels lead to increased water retention, a reversal of these processes has been able to return creeks to year-round flow.

These processes have also reduced the overall aquatic habitat potential of the creek. Aquatic species including salmonids, trout, lamprey and invertebrates respond to floods by moving to portions of the stream that are less hydraulically stressful. Some species, particularly invertebrates, take refuge from floods amongst in-stream boulders and woody debris or bury into the substrate of the stream itself. Invertebrate and fish species also move to shallow, newly inundated floodplains during high flow events. Often without this off channel refuge, they are killed. Given the consistent lack of floodplain connectivity throughout the river, this source of refugia is unavailable to in-stream wildlife.

This narrative gives a snapshot of the overall aquatic habitat condition and point to the need for addressing restoration goals at the watershed scale. It is clear that work at the individual property level will not suffice to address the overarching degradations in water quality at the watershed scale. Lost Valley can only act as an anchor point and catalyst for research and action; ultimately projecting the work from the site scale to the watershed scale and partnering with adjacent landowners and local institutions to restore the overall habitat potential of the river.

11.2 Downed Woody Debris

Large stumps and downed trees remain throughout the forested sections of the property. Woody debris and old stumps serve as food for fungal colonies and insects and retain moisture over the dry season in the sponges of their decaying biomass. Decomposing wood also create an organic matter rich and moist medium for seedling growth.

The riparian forest has the capacity to contribute large woody debris to the river. In-stream debris provide grade control for streams, help dissipate stream energy, retain spawning gravel, help with pool formation, increase stream meanders, and create habitat and food sources for aquatic species. Coniferous trees are considered to be of higher value than hardwoods given their much lower decay rates in the waterways. Wood accumulation in streams is dependent on the contribution of wood from two sources: slope failure and riparian recruitment. Without trees being added to the stream corridor there are few other ways save for human intervention, that an active channel can remain connected to the floodplain. Wood is an important habitat and source of food for aquatic organisms. Wood is also a substrate for the growth of biofilm, which is consumed directly by a number of invertebrate species

11.3 Deciduous Trees and Shrubs

This site has a rich mix of deciduous trees and shrubs. The presence of deciduous trees and shrubs greatly increases the diversity of wildlife. Reasons for this include a higher presence of cavity nest sites for birds, a far greater diversity of insect associates, and enhanced light penetration to the forest floor for the growth of understory forage in the form of herbaceous plants, nuts, and berries. A more than doubling of the species diversity across the plant and animal kingdoms is found in forests with both conifer and hardwood plant communities.

The mosaic of meadows, hardwood trees and shrubs, and conifers across this site is an excellent template for present and future biodiversity on the site. At the landscape scale, the waterways and wooded corridors create wildlife access from the bottomlands into the upland hills. The utility of this vegetation can be enhanced through the regeneration of oak woodlands, assuring the continued succession of a diverse mixed-forest ecology, the development and

maintenance of meadow and woodland zones, and the integration of multifunctional hedgerows, windbreaks, forest gardens, and riparian plantings.

11.4 Snags

Approximately 8 snags per acre occur in the mixed conifer sections of the property. Intensive forest management has drastically reduced the abundance of snags in the Pacific Northwest. Consequently, critical habitat for many cavity-nesting birds and mammals is in short supply throughout the region. West of the Cascade Mountains, 39 species of birds and 14 species of mammals depend on tree-cavities for their survival. Altogether, over 100 species of birds, mammals, reptiles, and amphibians need snags for nesting, roosting, shelter, denning and feeding.

In addition to housing birds and mammals, snags also serve as feeding areas for insect eating birds. Forest dwelling insects feast on decaying wood, which also feeds the communities of mushroom mycelia and diverse soil-dwelling microorganisms. Flickers and woodpeckers excavate holes in dead trees for nest sites, which are subsequently used by bluebirds, tree and violet-green swallows, chickadees, nuthatches, house wrens, wood ducks, squirrels, and owls who cannot excavate holes by themselves. Favored tree species for snags include Douglas fir, Western red cedar, Big-Leaf Maple, and Black Cottonwood. Large snags more than 12 inches in diameter and more than 15 feet high offer ideal hunting perches for hawks, eagles, and owls. They also offer resting places, food storage areas, and song posts for birds and other creatures passing through the area. Conifer snags last longer, but deciduous trees can make snag-like conditions even when they are still alive as they shed large branches.

11.5 Hedgerows and Thickets

Shrub thickets and hedgerows occupy the edge of the woodland and agricultural sections of the site. Existing tree and shrub thickets and hedgerows are important nesting sites for birds and insects, as well as corridors for mammals. These wild edges are important to the integrity of farm ecosystems. Further development of native and multifunctional hedgerows along roads, fences, woodland edges, and between permanent agricultural plots will enhance the biological integrity of the landscape as a whole by providing habitat and nectar sources for beneficial insects and other wildlife, serving as wind and heat buffers to wildlife, crops, and domestic animals, and providing forage for domestic animals and wildlife.

12. Plant List

The plant inventory can be found in Appendix 2 below.

• Part II •

Lost Valley Stewardship Prescriptions

13. Stewardship Objectives and Strategies

The following section outlines objectives and their specific strategies as they relate to the 10-year goals for this stewardship plan. Objectives are arranged by habitat type in order to maintain a system of categorization for specific stewardship units. The objectives represented in each section are based on the following overarching goals:

A. <u>Climate Adaptation and Resilience</u>

Since 1900, the largest increase in observed U.S. temperatures has occurred in the Western region with an average increase of approximately 2° F. The region is expected to continue the warming trend to *at least* 5° F warmer temperatures by the end of the century. Temperature increases will bring stress while increasing the presence of pests and diseases. As a consequence of warming, Oregon is projected to see warmer wetter winters and hotter drier summers. Precipitation is expected to increase in its intensity and shorten in its duraton. Rises in annual temperatures without a proportional rise in annual precipitation will increase the overall aridity of the region. This will lead to decreased snowpack, increase fire risk, and further the impacts on waterways while increasing the stress on crops and wild plants and animals. Restoration and ongoing management activities at Lost Valley will be undertaken with consideration for building the overall resilience of the site and its plants and wildlife to climate change impacts and associated extreme weather events.

B. <u>Biodiversity and Ecosystem Health</u>

Management objectives will focus on increasing species diversity, functional diversity, and diversity of habitats across the site. Functional diversity, which relates to overall ecosystem health, is derived through the sum of ecological services created by plants and systems on the farm. The capacity of the property to sustain floods, drought, wind and other stress without losing its overall functional integrity is related to the functional diversity of species and habitats and the overall health and resilience of the sets of relationships within the habitats.

C. <u>Social and Economic Well-being</u>

Ecological, social, and economic wellbeing tie together to form healthy farms and communities. As appropriate to the capacities of the project, economic yields and cultural activities will seek to be derived as a byproduct of management objectives on the site. Tending land takes energy and financial resources and it is important to consider ways to derive yields from necessary activities. There are sets of seasonal activities that will be associated with gatherings and residential workshops on the site. The intent is to create a context for harvesting materials from the site in a way that is compatible with the overarching stewardship goals and objectives.

13.1 Mixed Conifer Regeneration and Management

The forested units on this property are to be managed toward increased diversity and old-growth character. These characteristics include:

- Complex and multilayered tree canopies
- Mature mixed conifer and/or hardwood forest plant assemblages
- High species diversity and richness
- The presence of large downed woody debris and standing dead trees
- High standard deviation in tree diameters

A stand survey for all managed forest units was conducted in 2019. From this survey, trees per acre, average diameter at breast height, relative density, height, and periodic growth

data were developed into a spreadsheet. This data can be found in the appendix. Specific harvest rates for all managed units were derived from this data by Abel Kloster and are articulated in the management prescriptions in section 16 below. The following principles and strategies will help guide forest management over the next 10 years.

A. <u>Forest Regeneration Strategies</u>

During the 10 year period covered by this plan, forest management will be based on "single tree" and "group selection" strategies for all actively managed units. Single tree and group selection systems are designed to guide the growth of uneven aged and mixed species stands for long term structural and species diversity. The goal of these selection systems is to maintain a distribution of tree diameters, ages, and species within the forest while also increasing the overall genetic vigor and health of the stand. Individual and group selection are often combined because they are usually implemented within the same stand; small groups of usually two to 5 trees are harvested in some areas while in others only single trees are removed. Variation in canopy cover allows for variation in understory composition. For instance, Douglas fir, a shade intolerant tree can be regenerated under larger forest openings whereas hemlock and grand fir can be established in the scattered light of a more closed canopy.

As the thinning of unhealthy and out competed trees favors more vigorous trees, the goal is to initiate the germination of healthy genetic populations of new trees in the forest. This rule can be applied to understory shrubs and groundcover as well.

B. <u>Harvesting to Favor Healthy and Dominant Trees</u>

Tree selection over the next 10 years will be mostly limited to the following types of trees:

- Trees which naturally fail to thrive due to suppression
- Trees with severely limited crown cover
- Damaged trees that would likely be broken or killed due to storms
- Co-dominant trees that share canopy with dominant trees but do not display as vigorous characteristics.
- Co-dominant trees that threaten to weaken the growth of dominant trees.

The future understory of natural regeneration will be thinned in a similar manner. Small group cuts may be allowed in certain situations to emulate natural age mosaics and to favor unique species. It will be possible to include the removal of dominant trees but *not* to the extent that the total volume of growth is compromised. By choosing some dominants to remove, other dominants, co-dominants, and understory trees are given a better chance to continue growing.

C. <u>Retain Tallest Trees</u>

As a general rule, the tallest trees, which stand above the canopy and possess the most crown cover should not be harvested during the next harvest. Because of their adaptation to stronger winds, these trees will maintain the greatest resilience to the thinning effects and be less likely to be affected by sun scald and wind throw.

D. <u>Management by Age</u>

Commercial saw timber production will mostly be limited to the predominant age group of 65 year old Douglas fir and grand fir. Pole wood and firewood will come from

this age group as well as understory thinning of younger Douglas fir, cedar, and grand fir trees.

Trees in an older age class are to be considered “legacy trees” and should not be harvested. These trees are significant as they provide variance in age, height, and structure of an otherwise even aged forest. The legacy trees will be allowed to remain standing until they fall to the floor naturally thereby contributing to the forest nutrient cycling process and providing opportunities to wildlife. Additionally, these trees may be felled if they are considered a threat to people or infrastructure. In this case these trees are to remain on the forest floor in order to perform the above-mentioned services.

E. Management for Diversity

When appropriate, tree selection will follow a principle of increasing forest diversity by favoring less dominant species. Considerations for managing diversity should be applied at the individual tree level but also projected to the landscape scale.

F. Management for Woody Debris

All woody debris save for wood removed for use will remain on the forest floor after each cut. A target of more than 10% of the commercial pole harvest will be set for retention in all forest units. All butt logs, tops, branches, milling off-cuts, and defective stems should be left on the forest floor. *When possible, this debris should be lopped and scattered or chipped and blown into the understory.* Debris in good contact with the forest floor will not be considered a wildfire threat as long as it is more than 15 feet from the nearest ladder fuel. This debris will contribute to forest nutrient cycling, retain soil moisture, create habitat for fungi, microbes, insects, amphibians, and reptiles, and compensate for the general loss in biomass through future timber harvests.

Trees may be felled and left to lie in the forest to increase the presence of decaying wood on the forest floor. Maser and Trap (1984) state that large debris greater than 20 inches in diameter have the greatest potential for long-term nutrient cycling.

G. Management of Forest Climate

It will be necessary, when thinning, to strike a balance between the goal of reducing competition through tree removal and preventing stress to the forest by maintaining existing microclimates. Because of the concern of tree stress and wind-throw (already occurring across sections of the site) thinnings will be graduated over time rather than implemented in one larger event. Thinning rates, which would call for removal of more than ½ of the stand volume if implemented now, will be carried out over the course of the next 10-15 years in at least 2 harvests.

Care should be taken during the removal of trees in order to maintain a partially closed canopy whenever shade tolerant understory species are being established and to admit enough light through small group cuts to promote the growth of shade intolerant species. It is important, given the long period of drought and projected climate trends, to limit the amount of direct sun that passes to the forest floor. This will prevent overdrying of the forest understory that contributes to current drought conditions. In addition, managing microclimate will prevent understory species from going into light-shock and slowing their growth.

H. Natural Regeneration

Naturally regenerated seedlings with good form and rates of growth should be favored over introduced plants of the same species. As the thinning of unhealthy and out competed trees favors more vigorous trees, the retention of vigorous trees will favor

healthy genetic populations of germinating trees in this forest. This rule applies to understory shrubs and groundcover as well.

I. Retention of Snags

A target of 2 snags per acre will be set for all forested units. These should be more than 50 feet from the edge of managed open spaces and adjacent clearcuts. This equates to approximately 30 snags across the entire site. Snags can be created through girdling, plugging with fungus, or topping by saw or dynamite. However, as a general rule, only trees in the predominant 65-year age class, and not legacy trees may be targeted for snag creation. Although creating snags may be seen as a loss of potential timber revenue, snags are an investment in the long-term ecological health of the forest. Trees with broken or forked tops, large taper, hollow stems, or bowed trunks should be prioritized for snag creation because of their low economic value. Some “defects” in these trees are perfect nesting and roosting sites for birds. Additionally, snags may be created in clusters or otherwise sited to limit their conflict with future logging operations. Locating snags amidst other living trees can prevent wind-throw and extend the extend the standing dead-tree period.

J. Situational Tree Selection from the Older Aged Cohort

In places where there is a concentration of the original older cohort, the patch should be assessed for the opportunity to release the dominant trees in the original cohort. This should be done by creating snag trees. Any trees from the original cohort cut down should be left as woody debris. This could be an opportunity to reach the target snags per acre; especially in areas where there are not many suitable candidates.

K. Coppice Management

Coppice refers both to a growth response in certain species and to a system of plant management. Many hardwoods and some conifers have adapted a regeneration response to fire, browsing, or human management that allows them to send up young shoots from dormant cell tissue around the point where the plant is injured, cut, or burned. When intentionally carried out, coppice management can be an important way to ensure a supply of quality hardwood material from a site.

The goal of coppice management is to acquire a fast supply of straight and long sprouts without compromising the health and vigor of the tree. A well managed coppice can provide kindling, tool handles, or biomass for charcoal making in its first three years, fence posts and firewood until year 10, and round-pole building material after that. As a general rule, direct sun is required to encourage rapid resprouting and straight growth in most coppice species. For this reason, canopy openings in the otherwise shaded forest zones will represent the best opportunity sites for coppice production. First or second year growth of willow, hazel, or bigleaf maple contain few or no side branches growing off of the main stem. This makes them desirable to weavers because is easier to split the material and scrape off the bark.

With no human intervention, most coppice species send out many shoots at once and allow the shoots to self-thin over time into a series of large stems.. The growth response in well-established stumps can be significant. Some species like black locust and bigleaf maple will grow 3-9 feet per year. Management entails culling all crooked and suppressed stems to direct energy into the most productive and straight stems. One study on bigleaf maple suggests thinning a coppice to one shoot for every 25 cm

of stump circumference. The trees can be cut at the base in order to have sprouts originating at ground level or “pollarded” at or above head height. Cutting at head height is good for management of small diameter whips and works as a deer protection strategy. Ultimately, large trees with wide diameter pole-sized sprouts will average about 4 stems per coppice while younger shoots from trees and sprouts from bushes may be managed at higher densities on each stem.

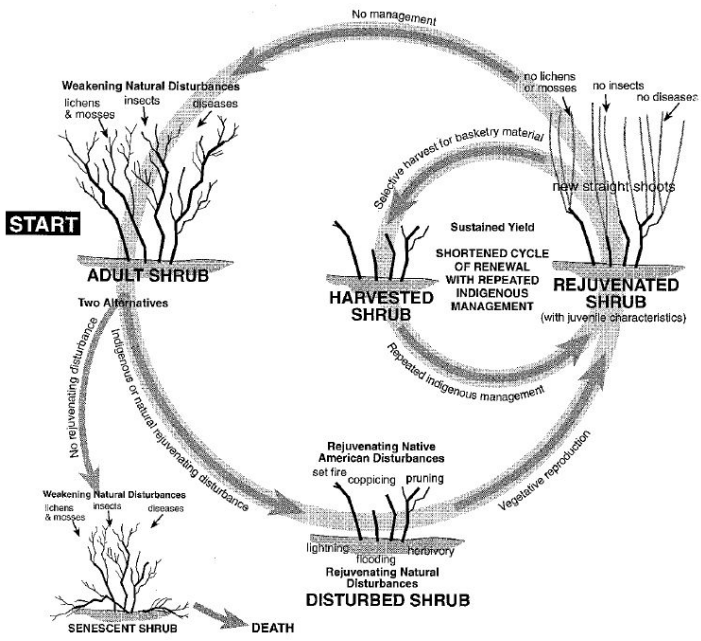


Image 2: *Cycle of growth for a coppiced shrub managed for basketry material.*

Source: USDA-NRCS

Given the high presence of hardwood trees and shrubs, coppice management will be a useful way of managing for high quality firewood, round poles, green woodworking, and basketry materials. Plants ideal for coppice in the Pacific Northwest include:

- California redbud (*Cercis occidentalis*)
- California lilac (*Ceanothus thyrsiflorus*)
- Buckbrush (*Ceanothus cuneatus*)
- Hazelnut (*Corylus cornuta*)
- Sumac (*Rhus glabra*)
- Willow species (*Salix spp.*)
- Creek Dogwood (*Cornus sericea*)
- Bigleaf Maple (*Acer macrophyllum*)
- Oregon white oak (*Quercus garryana*)
- Chokecherry (*Prunus virginiana*)
- Oregon Ash (*Fraxinus latifolia*)
- Chinquapin (*Chrysolepis chrysophylla*)
- Black locust (*Robinia pseudoacacia*)

L. Management of Non-Timber Forest Products

As markets are seen to exist for non - timber products, these products may be managed to maximize their yield for various applications. The use of coppice for basketry, lath construction, and other weaving arts, the tending of woodland medicines, the production of wood for mushroom culture, and a sustainable harvest of shrubs and groundcover for nursery production and the ornamental bouquet trade, are all possible value added avenues for this forest operation. Species of particular

potential on this site are hazel and willow for basketry, Oregon grape and ginseng for medicine, and alder for mushroom cultivation.

M. Adaptive Management

Future management goals and prescriptions will be adapted to learned experience in carrying out the prescriptions in this plan. Projects evolve over time and the approach to land care must be fluid and capable of adaptation.

13.2 Oak Woodland, Savanna, and Meadow Activities

A. Stand Thinning and Oak Release (Timber Stand Improvement)

The first step in oak restoration typically involves removing competing conifers and hardwoods encroaching on the oak tree canopy. This element of the restoration project is called timber stand improvement. Lacking the intermediate level of disturbance within which oak woodlands and savannas have co-evolved, an oak tree can become outcompeted by other more vigorous forest species like Douglas-fir and bigleaf maple. Over time, this encroachment causes oaks to lose their lower branches and their crowns to become vase shaped. Gradually, acorn productivity decreases and oaks fail to establish seedlings. This encroachment transforms oak savannas and woodlands into conifer dominated forests over time.

A study conducted in Western Washington by Devine and Harrington (2013) found that removing all competing canopy vegetation in one single thinning was consistently associated with the greatest annual diameter growth and acorn production. Tree removal should happen in the late summer / early fall in order to time reseeding immediately after disturbance. Also, because oak trees do re-sprout, cutting trees when they are not in dormancy will reduce resprouting vigor. Care should be taken in tree removal to not damage leave trees. Alternative to felling, trees may be girdled and left as snags when trees or entangled or when felling is difficult or unsafe. Thinning will maintain approximately 40%-60% canopy opening across the stand.

B. Tree Selection

Trees with large spreading crowns, strong lateral branches, and no sign of visible decay in the stem are priority candidates for retention. Other candidates for retention include trees with one or all of the following characteristics: taller older trees, trees whose crowns are above the canopy of a younger or suppressed sub canopy, living mature trees with nesting cavities for wildlife, trees with greater than approximately 40% or more crown cover, trees with a relatively low width to height ratio in the crown (ex. 2:1 or lower). If you have noticed that certain trees are good acorn producers, you may want to favor these trees for their ability to produce wildlife food and for regeneration. Other trees, can be retained as appropriate. Epicormic branches can form on oaks and the trees can establish new branch architecture over time. So long gangly trees, if they are the only option in a patch, can be kept.

C. Canopy Opening

Oaks occupy two primary forest types in Western Oregon. The woodland forest type, is characterized by relatively dense stands that typically emit 30-70% light into the

understory while the savanna forest type has diffuse open grown trees occurring on the landscape at a density as low as 1-3 trees per acre. These trees can be three times wider than they are tall and abundant acorn producers. These two conditions can be integrated on smaller sites and within individual management units. Oak stands with a woodland character should be thinned to approximately 40-60% canopy opening in order to favor the growth of the most vigorous trees and emit light into the understory for the production of grasses and wildflowers. Some trees which still display “open grown” character inside the woodland are likely older “legacy trees”, having established without competition from younger seedling oaks. Legacy trees can be maintained with a cleared radius of 30 + feet beyond their dripline. These trees will have the greatest opportunity to produce acorns in the years to come. A trail network between these trees can allow for a mowing or grazing ley in order to assure long term understory management below and around these trees.

C. Followup Brush Management

Large amounts of logging slash will be created during the release operation. The plant and animal communities associated with oaks and prairies are not associated with large amounts of wood on the site. Piles left in the understory will become sites for blackberry establishment in the high light conditions created by the release. Also, because prescribed burning will be used to maintain the understory after releasing oaks, remaining slash could make the fires much hotter than desired. Therefore, all remaining woody debris should be processed for firewood with the smaller debris burned in small piles across the unit (these piles will be utilized for native seed establishment sites).. Alternately, slash could be turned into biochar and distributed around the dripline of trees.

D. Meadow, Woodland, and Savanna Understory Regeneration

Small burn piles scattered throughout the units are potential plant establishment islands for native forbs and grassses. In general, the best time to sow native seed is in October and November. This will allow moisture and cold stratification needs to be met. Establishing perennial forb species while the soil is bare favors their long-term persistence as the grass starts to dominate the site. The annuals will drop out in significant numbers by the third year. Periodic disturbance by burning, mowing, or managed grazing will expose bare soil and shift the plant population character toward annuals by allowing them to successfully germinate and compete. Diversity can also be achieved by sowing a variety of mixes across a patchwork of burn plots. Yearly seed collection and seed scattering days (“shuck and huck”) can also be scheduled to sustain understory diversity over time. This activity utilizes the mosaic of varying plant assemblages within a field as “mother gardens” for propagule dispersal. Farmers and researchers alike have documented increased survival of broadcasted seed when the hoof action of animals is utilized. Highest success is under Farmers in the Willamette Valley have success sowing seed among their animals as part of a *time controlled, short duration, and high-density* grazing through the fall and late winter/early spring. One method for economic establishment of native wildflowers is to follow a rested pasture rotation. First a paddock is established by cross fencing, prepped by mob grazing, then seeded to a forb mix. After 1-2 years of rest, the paddock is returned to general rotational grazing. This rest paddock can be moved across the site over time to

establish stronger seed banks of native forbs. Deferring grazing for 4-6 weeks during the late spring allows both perennial grasses and forbs time to grow, flower, and set seed before moisture leaves the soil. As part of this grazing program, a grazing pass will often take place near the end of the summer dormant period. This helps to remove dead stem bases and thatch through hoof action or trampling. This puts the dead material in contact with the ground and increases nutrient turnover while reducing fire risk.

E. Meadow, Woodland, and Savanna Understory Management

Herbivory and periodic fire are both natural processes in grassland systems. They act together to maintain the dynamics of oak prairie ecosystems. Although fire was the principal tool of the tribes of the Willamette Valley, its use today is complicated by private property boundaries, hazardous fuel loads, the risk of fire spreading to adjacent landowners, and a general lack of expertise in effective fire management. Additionally, if not financed by restoration grants, the cost of a burning project is a significant expense to the landowner as it will be necessary to carry out any burning with the assistance of the local fire district and under consultation with regional experts. It is typical that a prescribed fire takes years to pull off given the present-day resources and the inability of fire-crews to be available whenever the weather is perfect. So, fire will probably at the most used as a periodic complement to more routine maintenance through mowing and grazing.

Given the restoration emphasis of grazing in oak ecosystems, a more targeted species by species approach to vegetation management will likely need to occur. In general, management intensive grazing is the best practice for smaller acreage oak grasslands. In management intensive grazing, fields are broken up into smaller paddocks in order to manage the timing of grazing. Typically, a field or paddock will be surrounded by permanent fence and cross-fenced with temporary electric fencing. The animals are moved progressively through the field in timed pulses determined by the stocking rate and the plant recovery period. Carrying out grazing to maintain a shifting mosaic of intensively grazed and underutilized patches helps to maintain structural variation and diversity throughout the grazed zones.

For best results, grazing should be designed to prevent overgrazing of choice species. The time it takes for a plant to regrow to its full energy potential following being bitten is called the recovery period. The key to preventing overgrazing is to carefully time the grazing of plants so that they have an adequate recovery period. Recovery periods vary by species and by season. During the highest flush time of the year, the recovery period may be as little as 10 days, during the drier periods of the year, a plant may take 90 days to recover. During the dormant period, it may take more than 180 days for a plant to recover.

Seasonality of grazing is another important factor. Preventing animals from grazing spring ephemerals, allowing wildflowers to set seed, and limiting herd impacts on soil during the wet season stand out as three timing objectives for herd management in oak savannas. To assist with this time based management, The Savory Institute provides a timed rotation tool called the “Aid Memoir” which assists in planning grazing’s impact on a species by species basis in intensively managed systems

When grazing is not preferred or impractical, mowing and burning can serve as alternative management strategies.

F. Controlled Burn and Biochar

Prescribed fire is an option for brush and thatch management in the oak woodland, meadow, and savanna areas. However, given the logistics of permitting, it may be preferable to undertake controlled burns in protected kilns. The biochar can then be distributed around the dripline (feeder root zone) of the oak trees. As part of an annual biochar production cycle, woody plants, dried herbaceous vegetation, and competing trees should be cut and stacked to dry through the summer. Fall/winter burns can then occur outside of fire season. Grass and other herbaceous vegetation should be mowed in the late fall after nesting season and seed set to prevent the re-establishment of brambles and woody plants below the oak canopy. Periodic low intensity burns should be attempted as logistics and permitting allow in all oak and meadow units.

G. Establishment of Silvopasture and Rotational Grazing Systems

Silvopasture is defined as the intentional integration of animal pasturing into the woodland or savanna landscape. This system follows a prescriptive grazing regime that relies on monitoring and well-timed and moderated herd effects to manage competing vegetation, maintain unique habitats, increase soil health and biodiversity, diversify farm income, and improve animal welfare.

All woodland and meadow units will incorporate silvopasture. Moving animals from pasture to forest ensures they get a balanced diet by having access to a higher diversity of forage options. Herbaceous forb and grass plant species vary greatly from open pasture to woodland understory environments. Growth and dry-down periods also vary, meaning a potentially longer season of high quality forage. In cool temperate climates, pastures consist primarily of cool-season grasses, which decline in productivity during the hotter summer months. In many cases this decline parallels the time when there is the greatest nutritional need for lactating animals. The main goal of silvopasture at Lost Valley will be to utilize animals to establish and maintain a mixed oak/hardwood savanna. The scattered tree cover in savanna systems improves pasture nutrient cycling and forage availability while increasing the potential yields of the landscape. Additionally, given the context of dry summers in our Mediterranean climate, the fruit and nut supply through the Summer and Fall provides increased carbohydrates at a time when grass and forb palatability is at its lowest. Trees on pasture enable animals to adapt their microclimate needs in hot and cold weather. Heat stress reduces the appetite of an animal and can cause reductions in weight gain, decreases in milk production, increased calving mortality, and thus increased cost.

Well-designed silvopasture systems include a diversity of tree crops including patches of conifers for winter “living barns” for livestock, and timber, fruit, and nut producing trees, which provide multiple income streams.

The first key to success with silvopasture is adequate sunlight at ground level. It is recommended to aim for about 50% shade in forest silvopasture systems. This supports good growth of cool season grasses. The second key is establishing target forage species.

The third key to successful silvopasture is to ensure adequate rest periods between pulses of grazing. Most grasses should be grazed to 50% of their aboveground biomass and then allowed to rest. Rest periods of 30 days are typical for Western Oregon. Number of days on a given pasture is usually 3 to 5 days for efficient forage

consumption. A mixture of temporary and permanent fencing will be required to manage the animal rotations.

Silvopasture management requires a mix of good forest practice and pasture management. The benefits of fire prevention, animal health, forest nutrient cycling, and maximizing the yields of the site are vast when good observation, monitoring, and adaptive management are applied.

H. Tree Establishment and Protection

It has been established that direct seeding of acorns is superior to planting trees out from containers. Motz (1997) describes a direct seeding method that has been found to have germination rates exceeding 95%. The most important criteria for successful germination include careful collection and storage of seed, and the use of low cost tree shelters to protect the seedling in the ground. If the correct procedures are followed, establishment of trees from acorns does not even require supplemental watering.

I. Seedling Survival

There are three main factors that affect survival of seedlings: creating the ideal conditions for the desired species to naturally regenerate through seed, protecting new seedlings from competing plants, and protecting new seedlings from deer and other browsing animals.

Whether maintaining existing trees, newly planted stock, or small seedlings, it will be important to reduce the impacts of competing vegetation. The goal of brush management will be to allow target trees and other vegetation to acquire a “free to grow” condition. This means that the trees or stand of trees are of good form, have a high probability of remaining vigorous, healthy, and competitive to undesired vegetation. The primary strategy will be to cut back brush and brambles within a radius of at least three feet from the base of the tree. The brush should not go right to the stem of the tree but be arranged in a doughnut a foot or more from the stem in order to limit the shelter for rodents that will chew the bark. The brush can also be used as a “brash hedge” – piled up to dissuade deer from browsing on the new vegetation. When grass offers significant competition, it should be removed from the immediate root zone of the tree and replaced with mulch. A bucket of wood-chips piled 1-2 feet around the tree will suppress competing grasses and retain soil water.

It is important to recognize that complete protection from animal damage is unnecessary or practical. Plants have adapted to tolerate certain levels of damage and disturbance. Animals play very important roles in the establishment and maintenance of forest ecosystems and the tradeoff from some losses is acceptable. However, deer and rodent browsing on young tree can be a significant concern.

The first strategy for minimizing wildlife impacts is to favor large and vigorous seedlings with strong and well-developed root systems. Plants that can forage effectively for nutrients and water and grow fast will have the best chances of survival following browsing. The most viable strategy to prevent loss from wildlife may be to increase the odds of successful establishment by retaining far more trees than will eventually be needed. This gives the added benefit of being able to keep the most healthy and vigorous species in the long-run. It also hedges against the likelihood that some saplings will be killed during timber harvests. The final consideration is plant protection through either the use of brash hedges, individual tree guards, or fencing. It is preferable to protect trees until their central leaders are above browse height. For shrubs, protection should last for a few years in order to allow them to establish

vigorous root systems and a capability to re-sprout following heavy browsing. Trees need to be as tall as 6 feet to provide complete protection from deer, Hardwood trees are often favored over conifers by deer. It may be a good idea to utilize tree-guards on special high value hardwoods like oak, walnut and chestnut. Tree guards will also be necessary in all grazed silvopasture zones.

Oak and other seedlings and saplings that are growing in areas accessible to livestock will need to be protected in sturdy cages to prevent them from being eaten or trampled. Mature trees can be injured by soil compaction or root exposure caused by animals aggregating under trees. Soil compaction can be particularly severe during wet weather and on fine-textured clay soils. Avoid using oak woodlands as long-term overwintering areas for animals. Livestock can utilize tree shade without damaging oaks if watering facilities, feeding areas, salt block locations, and trees are widely spaced, encouraging animals to use the entire pasture unit. It is important to monitor the health of oaks and soil conditions on pastures and take the necessary steps to protect the trees when problems develop.

J. Encourage Habitat Connectivity and Edge

The oak woodland is located at a nexus point between all upland habitat types. Given its role in supporting high biodiversity for numerous rare and threatened species, these units serve as a habitat hotspot while linking into corridors ranging from open meadow, riparian, to upland conifer forest. Management will hold this concept in mind by maintaining open passage for winged species while assuring cover for other wildlife to move between habitats.

13.3 Riparian Forest and Anthony Creek Activities

The riparian zone will be maintained with the following objectives in mind:

- Increasing and maintaining conifer presence in the forest
- Contributing a long-term source of woody debris to the stream
- Preventing erosion of the waterways and retaining sediment
- Increasing and streamside shade
- Increasing off-channel aquatic habitat
- Increasing in-stream habitat for fish and other aquatic species
- Increasing forest habitat for birds and other wildlife

A. Promoting Stream Structural Complexity and Off-Channel Habitats

Lost Valley will investigate the viability of increasing off-channel and in stream habitat through the reconnection of historic floodplains and increasing in-stream channel meandering and structural diversity. Work will involve the promotion of wood accumulations as well as promoting and mimicking beaver dam activity. The installed structures will act as sediment and grade control systems designed to increase off-channel habitat, and instream structural habitat for fish, lamprey and other aquatic wildlife. This will also improve the ecological well being of the forest zones while providing an outlet for stream friction in the main channel during high water. While overall these activities are considered to be beneficial to waterways, construction activities may have short-term impacts that require various local state and federal approvals. In general there are two state agencies that regulate work in waterways and wetlands. These agencies are the Oregon Department of Forestry (ODF) when a project is done as part of a forestry operation and the Oregon Department of State Lands (DSL) in most other cases. Lost Valley will engage the Middle Fork Willamette Watershed

Council and the Oregon Department of Fish and Wildlife to assist with project planning and funding.

B. <u>Installation of Log Check Dams and Beaver Analogue Structures</u>

By retaining sediment and expanding the width of the floodplain, check dams and beaver analogue structures can effectively prolong water and moisture within stream systems and extend the width of riparian forests. Log check dams and other beaver analogue structures will be utilized as a strategy to mitigate channel erosion and to increase the extent of the water lens beyond the current extent of the riparian forest. This will allow for greater widths of forested areas on either side of these two waterways. Planning and construction will follow the guidelines in the State of Oregon technical guide "Placement of Wood, Boulders, and Gravel for Habitat Restoration".

Because larger stream systems like Anthony Creek can lift and move large woody debris, logs will likely need to be stabilized to prevent excessive movement. This makes large wood placement more complex and may require complicated or alternative techniques . Therefore this project should be assumed to require agency review and/or approval of the design.

Design of log structures (and bank stabilization projects described in the following section) revolves around the measurement of bankfull width. Bankfull width is the width of the stream at bank full flow that occurs every 1 or 2 years . This is also known as ordinary high water or the point where water starts to flow into the floodplain. In lower gradient streams like the Luckiamute, the bankfull mark usually is where the bank slope changes from steeper to more gentle or even flat (see figure 2). The Oregon Department of Fish and WIldlife advises that Fisheries Biologists should review all projects in streams greater than 50 feet in width.

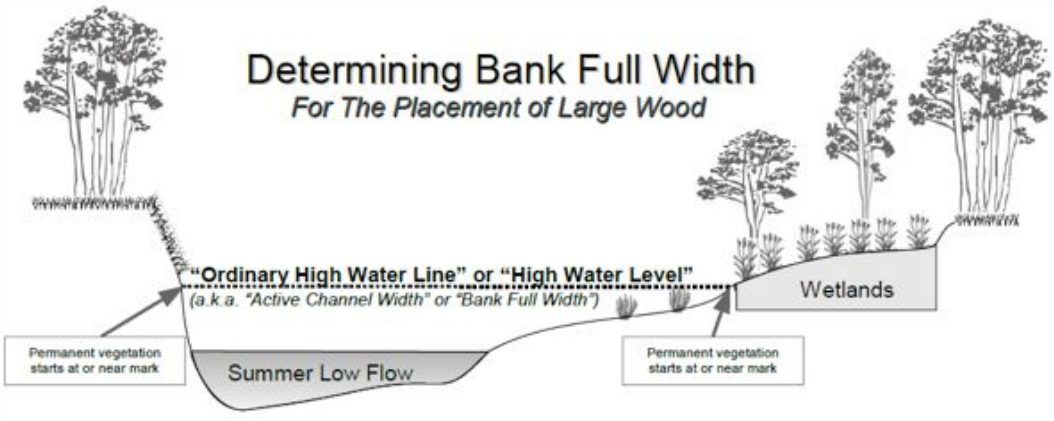


Image 3: *Cross section of a stream with normal and bankfull flow levels indicated. Source: ODFW*

The length of logs chosen for the project is determined by bankfull width. A piece that is longer than the stream is wide is less likely to be carried away when the water is high. As a rule of thumb, a log with a rootwad still attached should be at least one and one-half times (1.5X) the bankfull width. A log without a rootwad should be twice (2X) the length of the stream's bankfull width. As the best fish habitat is formed around jams composed of 3 to 7 logs, at least 2 key pieces should be used at each structure.

These logs lengths require a larger storm event to move them to a new location and have a higher probability of becoming stable at the next meander bend or obstruction. Leaving limbs and branches on the logs also increases stability and provides additional cover for fish. Hardwood logs or smaller trees with branches can be added to the structure to accelerate the development of a functional logjam.

The key to establishing a successful logjam is utilizing larger diameter wood that resists decay. These pieces of wood serve as the anchors for the logjam structure. Conifers (spruce, fir, cedar) have the potential to last 7 times longer than hardwoods (alder, cottonwood, and ash) given the same diameter and conditions. Therefore, conifers should be used as the anchor logs. The combination of conifers and hardwoods increases the complexity of the structure. Since hardwoods break down more rapidly they serve as feeding platforms for a variety of insects increasing biological diversity. Hardwoods also are structurally weaker so during flood events the hardwood pieces will break allowing water pressure to be reduced through the new open area. The smaller pieces move down-stream and can be accumulated on the next structure.

Wood can improve fish habitat only if the wood is large enough to stay, influence flow patterns, and sediment sorting. Larger diameter wood retains its size longer as abrasion and decay occurs over the years. Larger diameter wood is more effective in creating pools and complex channels that improve fish populations. Whenever possible a tree with a rootwad attached should have the rootwad in the active channel. The roots create excellent hiding habitat for juvenile fish. The roots also add to the stability of the structure by maintaining contact with the stream bottom over a wider range of stream flows. The minimum diameter required for a key piece of wood depends on the bankfull width of the stream. The weight of the log on the bank increases the stability and reduces down stream movement. The orientation of the wood is not important because the length and diameter of the wood along with the stream forces will position the wood to form a stable structure. Equipment can manipulate the logs to increase their stability by placing the wood between 2 standing trees that will lock the log in place by creating a pivot and stop point (Image 15 panel A). In addition, one log can be placed on top of another so the weight of the top tree can pin the second tree (Image 15 Panel B).

Logjams should be woven with branches and tree-tops in order to make them fully functional as sediment control structures. While the first few upstream structures capture most of the coarse wood floating down stream and matures quickly, downstream structures in particular will need to have smaller wood added.

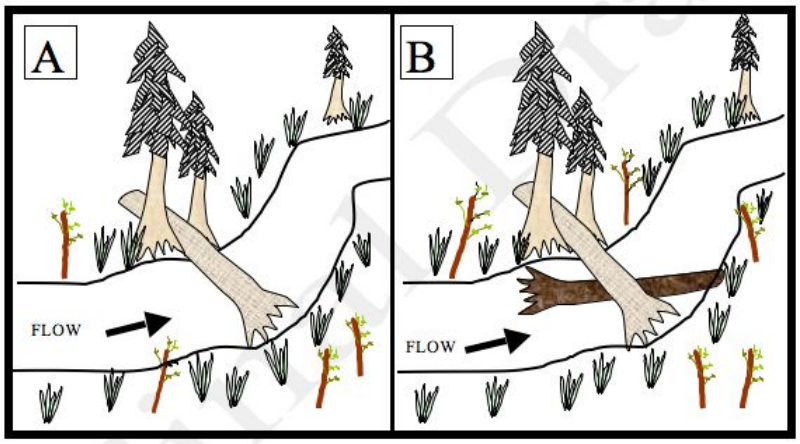


Image 4: *Panel A is single log placed between two standing trees to create a pivot and lock point. Panel B is an X pattern where the weight of the top log pins the bottom log to reduce the movement. Not shown is small wood or limbs that will create better habitat.*

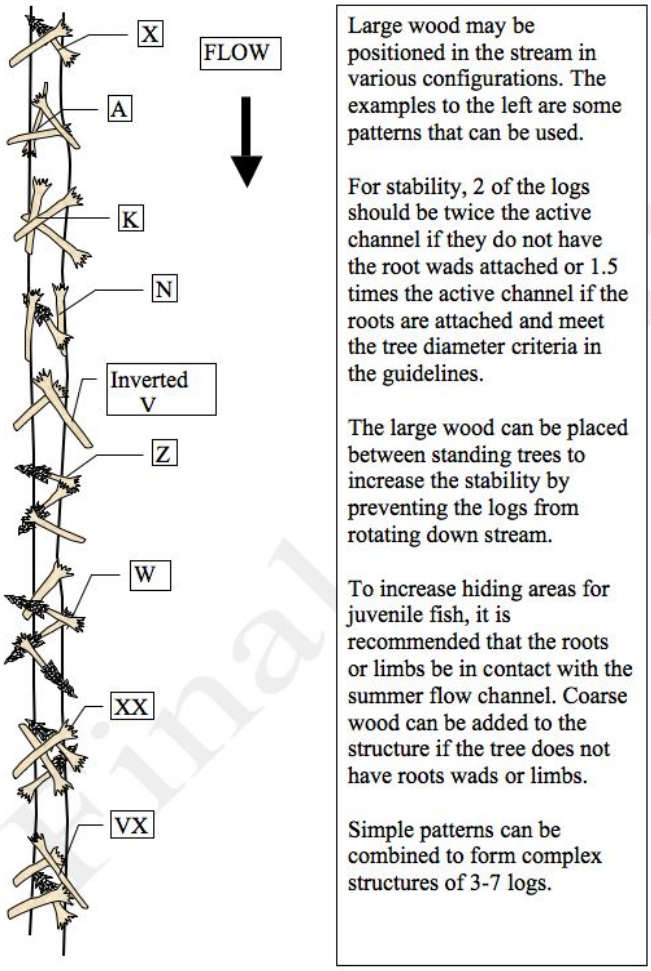


Image 5: *Typical plan view of wood configurations. Source: ODFW*

C. Retain Conifers for Long-Term Stream Structure

Large conifers, with their slow rates of decay, are important elements of stable river systems. They provide grade control and increase the presence of spawning gravels while providing a long-term source of nutrients for the aquatic food-web. All future large conifers, greater than 15" DBH will be retained within 100 feet of either side of the high water mark of the stream channel. Smaller conifers may be harvested, depending on the ultimate Riparian Management Area (RMA) guidelines, only to the degree that they increase the growth and vigor of the next generation of trees within the area. Trees smaller than 15" DBH may be turned into snags as an alternative to felling in order to decrease the competition with neighboring trees and to increase habitat for tree dwelling wildlife.

D. Streambank Bioengineering

Although streambank erosion is a natural process, land use and other impacts such as beaver trapping, channel dredging, log jam removal, changes in rainfall intensity, and loss of upland forest cover have caused the frequency and magnitude of water forces to increase in the Luckiamute Watershed. Erosion and an overall lowering of the channel depth has led to an undersupply of streamside vegetation throughout the riparian area. Loss of vegetation further increases susceptibility to erosion forces and leads to heightened bank failure and the development of abrupt sheer cuts dropping from the upper forest to the stream below.

First priority for streambank engineering are to take measures that:

- are self-sustaining and reduce requirements for future human support;
- use native, living materials for restoration;
- restore the physical, biological, and chemical functions and values of the stream;
- improve water quality through the reduction of temperature and chronic sedimentation problems;
- provide opportunities to connect disconnected riparian habitats; and
- retain or enhance the stream corridor.

Streambank revegetation and engineering will follow the protocols of local project advisors and the guidelines described in Chapter 16 of the NRCS Engineering Handbook titled "Streambank and Shoreline Protection". Common bioengineering methods include the setting of live-stakes and bundled "fascines". Both provide soil anchoring at the root zone and reduce friction, trap sediment and cast shade from their vegetation. Geotextile and brush mattresses are used to provide soil cover and anchor young seedlings. Rock "riprap" is often utilized at and below the average water elevation to reduce current erosion and stabilize uphill plantings.

E. Off-channel Watering Systems and Livestock Exclusion Fencing

It will be necessary to keep livestock out of the riparian zone both for the sake of water quality and the protection of young trees and shrubs. Fencing waterways and supplying water to pastures protects the riparian zone while improving the quality of the grazing systems on site. Fenced paddocks and water supplied within the pastures will be a necessary step in the process of creating a well-designed rotational grazing system. Woven wire fences will be established along the edges of grazing zones in order to protect all riparian waterways.

Photovoltaic (PV) panels are often used to power livestock and irrigation watering systems. A benefit of using solar energy to power agricultural water pump systems is that increased water requirements for livestock and irrigation tend to coincide with the seasonal increase of incoming solar energy. When properly designed, these PV systems can also result in significant long-term cost savings and a smaller environmental footprint compared to conventional power systems. It will be necessary to apply for a domestic livestock watering permit with the Oregon Department of Water Resources in order to utilize the waterways for stock watering.

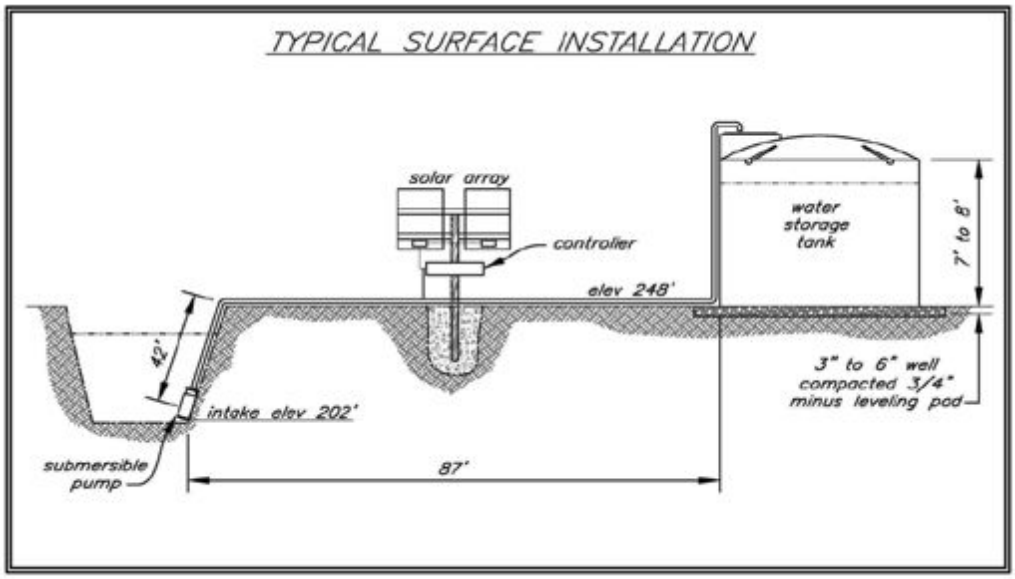


Image 6: *Elements of a typical installation supplied by a surface water source (Natural Resource Conservation Service Technical Note 28)*

D. **<u>No Harvest Zones and Riparian Management Areas</u>**

The stream classification for Anthony Creek is a Large Type F (fish bearing) All type F streams in western Oregon are protected by a 20 foot no-harvest zone for trees and a 10 foot no-harvest zone for understory native vegetation. It is also mandatory that any tree leaning over the active channel is retained.

The no-harvest zone is contained within a larger riparian management area (RMA) within which timber harvests are regulated. The width of the RMA is 100 feet for large Type F streams.

Oregon's riparian management guidelines include an "active management" option that uses a basal area credit system for live tree retention in an RMA. If habitat enhancement projects are implemented the target basal area may be reduced to allow more harvest in the RMA. For instance, each log placed in a large or medium type F stream, receives a basal area credit twice that of the log placed in the stream. The credit for other restoration or enhancement projects is negotiated with the Oregon Department of Forestry and the Oregon Department of Fish and Wildlife.

13.4 Agricultural Zones and Seasonal Waterway Activities

A. Maintain Soil Health

Soil health represents the continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans. Healthy soil is an intricate symbiotic ecosystem that forms the basis for plant and animal vitality. Maintaining soil health at Lost Valley will rest on 4 interrelated principles: minimize disturbance, maximize soil cover, maximize biodiversity, and maximize presence of living roots. The first two principles focus on protection of the soil habitat. Practices that minimize disturbance and maximize cover include no till approaches to cultivation, cover cropping and intercropping, maintaining consistent plant cover, and mulch applications. This maintains or increases soil stable aggregates and organic matter that improve water infiltration, drainage, and storage, nutrient availability, and the soil food web. The second two principles focus on feeding soil organisms through diversity of food sources for soil organisms and increasing overall biodiversity above and below ground. Increasing the diversity of food sources below ground and plant and animal diversity above ground increases the diversity of soil microorganisms. Diversification stimulates additional benefits such as breaking disease cycles, providing habitat for pollinators, and stimulating plant growth. Maximizing the presence of living roots in the soil can be accomplished through diverse crop rotation, inclusion of cover crops, and dedicating sections of fields to grasslands (native or pasture).

Image 7: *The four interrelated principles of soil health.*

B. Beaver Dam Analogue Structures

Seasonal waterways will be augmented with Beaver Dam Analogue structures (BDAs). BDAs utilize driven posts and woven brush to mimic the beaver dam function of slowing, spreading, and infiltrating water within the waterway. Stakes and brush can be made of willow and other living material capable of taking root and creating a living

in-stream structure. BDAs will be constructed following the guidelines in the book "Low-tech process-based restoration of riverscapes: Design manual—Version 1.0."

C. Install Upland Forest Buffers

Forest Buffers are mixed plantings of multifunctional trees and shrubs located adjacent to waterways in agricultural settings designed to mitigate impacts to waterways while creating pollination and pest control to agriculture operations. Buffers remove 95% of sediment and 80% of nutrient load from streams and lead to increases in bird and wildlife species. When buffers are designed for wildlife and beneficial insect species, increases in bird presence can go up by 5 times and predatory insects and pollinators overtake imbalances in pest species in the open field.

Buffers will be installed along the seasonal waterways in the meadow unit. They are to be 40-foot wide strips allowing for a 20-foot buffer on either side of the drainage centerline. Lost Valley's buffers will include up-to three distinct planting zones.

Zone 1, the area closest to the waterbody, includes trees and shrubs that provide important wildlife habitat, litter fall for aquatic organisms, and shading to lower water temperature. These species are typically native fast growing tree and shrub species. Trees and shrubs in zone 2 (along with zone 1) intercept sediment, nutrients, pesticides, and other pollutants in surface and subsurface water flows.

Zone 2 can be managed as a "working buffer" to provide timber, wood fiber, and horticultural products. Periodic harvest encourages continued growth which is necessary to sustain nutrient uptake over time.

Zone 3, is established if periodic and excessive water flows, erosion, and sediment from upslope fields or tracts are anticipated. In Lost Valley's case, this zone will not be necessary but could also be included. Zone 3 is generally of herbaceous plants or grass and a diversion or terrace, if needed. This zone is meant to assure proper functioning of zones 1 and 2. Buffers with no grass filters allow concentrate flows to pass through almost unimpeded and lead to gullies while a grass filter traps 100% of surface runoff sediment. Grass establishment in the understory of hardwood patches also limits sediment flow to stream channels.

Zone 3 can function as an alley or ley for livestock circulation into adjacent pastures and as a permanent access way between cultivated zones and the forest plantings.

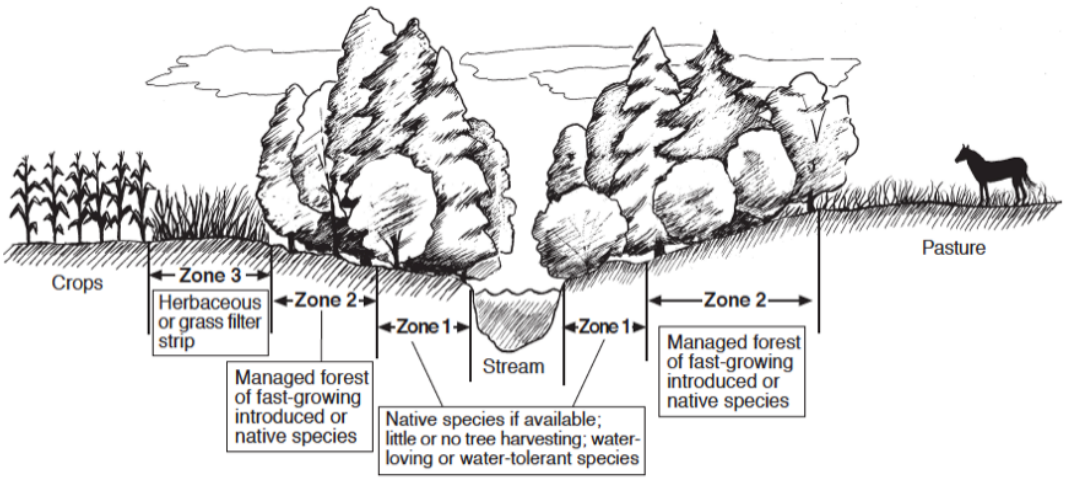


Image 8: *Upland Buffer Design (National Agroforestry Center)*

Buffer tree species

Thin and prune to maintain ground cover and improve tree quality for long term harvest. Pruning also removes nutrients and regenerates the growth cycle thereby prolonging nutrient and water uptake.

- Red Alder (*Alnus rubra*)
- Oregon white oak (*Quercus garryana*)
- Black Walnut (*Juglans Nigra*)
- Hinds walnut (*Juglans hindsii*)
- English walnut (*Juglans regia*)
- Cottonwood (*Populus trichocarpa*)
- European chestnut (*Castanea sativa*)
- Heartnut (*Juglans ailantifolia*)
- Cherry (*Prunus subg. Cerasus)*
- Bigleaf maple (*Acer macrophyllum*)
- Little leaf linden (*Tilia cordata*)

*Buffer shrub and small tree species (native plants included with *)*

- Persimmon (*Diospyros spp.*)
- Asian pear (*Pyrus pyrifolia*)
- Cornelian cherry (*Cornus mas*)
- Cherry (*Prunus subg. Cerasus)*
- Elderberry * (*Sambucus spp.*)
- Goji berry (Lycium spp.)
- Aronia berry (*Aronia melanocarpa*)
- Apple (*Malus domestica*)
- Peach (*Prunus persica)*
- Sea buckthorn (*Hippophae rhamnoides*)
- Chokecherry * (*Prunus virginiana*)
- Red osier dogwood * (*Cornus sericea*)
- Willow * (*Salix spp.*)
- Nanking cherry (*Prunus tomentosa*)
- Crabapple * (*Malus fusca*)
- Hazel * (*Corylus cornuta*)
- Ninebark * (*Physocarpus capitatus*)
- Spiraea * (*Spiraea douglasii*)
- Cascara * (*Rhamnus purshiana*)

Buffer market opportunities

- Decorative florals and basketry materials (2-3 years dogwoods, willows, pussy willows)
- Nut trees 5-15 years (hazel, walnut, chestnut, heartnut)
- Fruit trees and berries (3-5 years)
- Biomass and timber (15-60 years walnut, oak, cherry, maple, alder)

D. Establish Hedgerows

Hedgerows are long rows of mixed woody shrubs and trees generally planted within agricultural settings, where they can double as windbreaks, shelterbelts for livestock, or field margins. Hedgerows can also serve as habitat for natural enemies of crop pests, including insectivorous birds, snakes, owls, hawks, and predatory or parasitoid insects. Hedgerows play important roles in maintaining on-farm diversity, and their destruction over the last half-century in the Willamette Valley and throughout agricultural areas worldwide has led to declining habitat for birds and insects.

In the Agricultural zones, hedgerows will overlap with the Zone 2 plantings in the forest buffers described above. In forested settings, hedgerows can be designed to soften the abrupt edges between clearings and forest margins. These areas are often outside the scope of mowing or grazing management, and are often where invasive species like Himalayan blackberry proliferate, so making a plan to diversify the structure and function of these marginal ecosystems can also be productive in regard to invasive species management. This application applies at the transition zone between meadows and closed forest across the site.

Hedgerow species selection will be based primarily on current and historic vegetation of the Middle Fork Willamette Watershed. Existing Hedgerows and shrub thickets are excellent reference plant communities for modeling future hedgerows. Selection can also be based on harvestable yields of nuts, berries, flowers, honey, firewood, livestock fodder, and herbal medicine, making them a good investment for diversifying farm income. Like riparian forests, hedgerows can be utilized for flood control and planted around homes and other infrastructure that would be damaged by sediment and floating debris during flood events.

In addition to the pollinator-specific plants listed in section D below, some additional species to consider for these applications include:

- Filbert (*Corylus cornuta*)
- Linden (*Tilia cordata*)
- California black walnut (*Juglans hindsii*)
- Goumi (*Elaeagnus multiflora*)
- Rose (*Rosa rugosa*)
- Yellowhorn nut (*Xanthoceras sorbifolium*)
- Mulberry (*Morus nigra*)
- Gooseberry (*Ribes uva-crispa*)
- Black currant (*Ribes nigrum*)
- Red or white currant (*Ribes rubrum*)
- Crabapple (*Malus fusca*)
- Elderberry (*Sambucus spp.*)

E. Manage for Pollinators

Pollinators are a critical feature of a functional ecosystem, as many plant species depend on their proliferation for successful reproduction. Many types of creatures perform pollination services, including bees, wasps, flies, beetles, moths, butterflies, hummingbirds, and bats. Today, pollinators of all sorts are declining in population, due to conversion of habitat to monoculture-based agricultural production, urban development, and widespread application of pesticides. Pollinators require both food and habitat for raising their young, so their needs are quite diverse. For example, insect pollinators rely on nectar resources from certain plants, pollen resources from others, and require different sorts of plants for nest building or egg deposition. So, building up pollinator numbers and diversity requires planting and maintaining a wide diversity of plant species.

Pollinator	Food	Shelter
Solitary bees	Nectar and pollen	Most nest in bare or partially vegetated, well drained soil; can also construct domed nests of mud, plant resins, saps, or gums on the surface of rocks or trees; nest in narrow tunnels in dead standing trees, or excavate nests within the pith of stems or twigs
Bumble bees	Nectar and pollen	Most nest in small cavities (approx. softball size), often underground in abandoned rodent nests, but can be in hollow trees or walls, or under a clump of grass
Butterflies and Moths - egg	Non-feeding stage	Usually on or near larval host plant
Butterflies and Moths - caterpillar	Leaves of larval host plants	Larval host plants
Butterflies and Moths - pupa	Non-feeding stage	Protected site such as a bush, tall grass, a pile or leaves or sticks or, in the case of some moths, underground
Butterflies and Moths - adult	Nectar, some males obtain nutrients, minerals, and salt from rotting fruit, tree sap, animal dung and urine, carrion, clay deposits, and mud puddles	Flowers and a variety of other resources: rotting fruit, tree sap, animal dung and urine, carrion, clay deposits, and mud puddles
Hummingbirds	Nectar, insects, tree sap, spiders, caterpillars, aphids, insect eggs, and willow catkins	Trees, shrubs, and vines. Typically need red, deep-throated flower, such as twin berry or penstemons

Source: NRCS Publication "Plants for Pollinators in Oregon"

The Xerces Society has developed the following principles for pollinators::

- Habitat along streams should contain a diversity of plants. Willows, in particular, will nourish bumblebee queens in the spring so that large numbers of workers are available when crops begin to bloom.
- Hedgerows with a wide variety of plants that have overlapping flowering periods will provide pollinator habitat and nectar sources throughout the growing season and strengthen populations of natural enemies to crop pests.
- Keeping dead trees standing provides shelter for native bees. Some solitary bees build nests in abandoned beetle tunnels in snags.
- Fallow fields and set aside zones, especially when sown with native flowers, can offer important resources for native bees.
- Insecticides kill pollinators and herbicides may destroy plants important for both food and shelter. It is preferable to minimize your use of these products.
- A vegetable, flower, or herb garden, with a diverse assortment of plants, is a good source of food for pollinators.
- Planting fields with clover or other inexpensive seed and allowing crops to bolt will supply bees with nectar and pollen.
- Leave areas next to fields untilled, sprayed, or mowed to support flowering plants and provide nest sites for ground nesting bees.
- Flowering plants-certain legumes in particular- can be included in cover crop mixes to supply pollen and nectar.
- Making bee blocks for wood nesting bees is a good way to increase the number of native bees in your landscape.

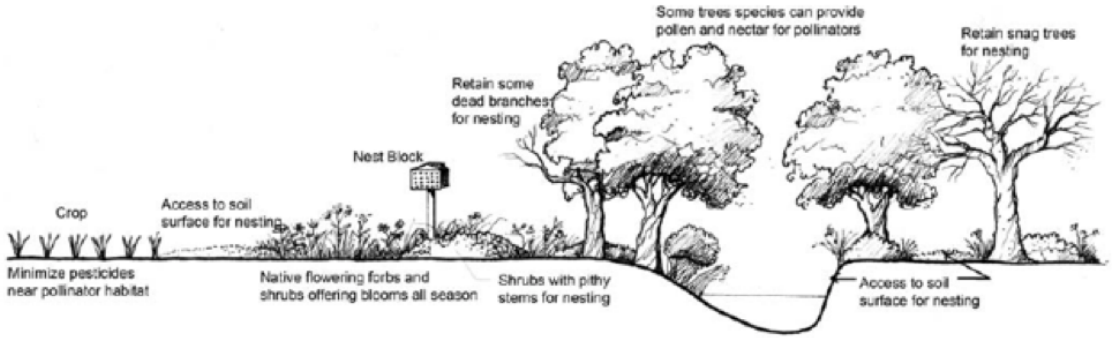


Image 9: *Pollinator Habitat Strategies (Source NRCS)*

Some regionally appropriate species for this site include:

- Fireweed (*Epilobium angustifolium*)
- Goldenrod (*Solidago canadensis*)
- Lupine (*Lupinus spp.*)
- Scorpionweed (*Phacelia tanacetifolia*)
- Golden Currant (*Ribes aureum*)
- Tall Oregon Grape (*Berberis aquifolium*)
- Red Flowering Currant (*Ribes sanguineum*)
- Meadowsweet (*Spiraea douglasii*)
- Redbud (*Cercis occidentalis*)
- California Lilac (*Ceanothus thyrsiflorus*)
- Buckbrush (*Ceanothus cuneatus*)
- Willow (*Salix spp.*)
- Spider Flower (*Cleome hassleriana*)
- Oceanspray (*Holodiscus discolor*)
- Nootka Rose (*Rosa nutkana*)
- Serviceberry (*Amelanchier alnifolia*)
- Chokecherry (*Prunus virginiana*)
- Douglas Hawthorn (*Crataegus douglasii*)

F. Plant Establishment in Buffers and Hedgerows

Plant establishment will follow the guidelines described in a recent study by Guillozet et al. (2014). This paper outlines best practices for buffer plantings. Their method, titled the Rapid Riparian Revegetation approach, emphasizes dense plantings of multi species plant assemblages followed by thinning over time in order to achieve the fastest ecosystem function and weed suppression. Prior to planting, a strict regimen of mulching, mowing, and/or grazing will be employed to suppress herbaceous vegetation within the planting zone. On open pasture, where grass will be a significant competitor to young trees and shrubs, a year of cultivation and cover cropping should be carried out allowing for at least two cultivations in order to reduce the seedbank of competing vegetation. A final smother-crop of annual clover and triticale will be seeded prior to tree planting in order to limit the rapid re-growth of competitive grasses. Wood chips will be piled 6 inches deep on top of a layer of cardboard around the base of each tree and shrub for grass suppression. Grass will need to be mowed by weed-wacker for a few years around the trees and shrubs in order to allow them to reach a free-to-grow condition throughout the site.

G. Forest Garden

Forest Gardening is a contemporary practice with ancient roots in indigenous agroforestry systems throughout the world. These multifunctional gardens of perennial and self-sowing species arranged in multiple stratas have been intensively maintained

at the home and village scale and extensively perpetuated at the landscape scale for thousands of years in the Pacific Northwest. Indeed native plants of western Oregon represent a vast array of food, medicine, and fiber species which have coevolved with human management since at least the last ice age.

Sections of the agricultural areas will continue to be developed as multifunctional forest gardens. These areas will be primarily adjacent to the main gathering areas and along trails and roads. The main yields for the forest garden areas will be low maintenance fruits, nuts, berries, herbs, craft materials, and shade for summer time activities. Specific plantings of culturally important species will be included to aid in on-site craft, art, and educational projects. For instance, blocks of basketry willow, dogbane, nettle, or dye species can be maintained for their usefulness to these activities.

H. Biochar Application

The forest gardens and vegetable garden areas will be ideal locations to incorporate biochar from forestry and vegetation management activities across the site. Biochar can be burned in contained kilns or earthen pits and applied as part of sheet mulch systems for tree and shrub establishment and will provide a long-term source of minerals and nutrient exchange while improving water holding capacity in the soils.

I. Establish and Maintain Defensible Space

Irrigated gardens, open lawns, fire resistant forest garden plantings, and other landscaping acts as fire resistant “defensible space” around buildings, vehicle routes, fire pits, and gathering areas. Structures in particular, are both sources of and vulnerable to fire. The agricultural unit will be expanded into edges of unit 1 in order to reduce the likelihood of fire moving between the forest and buildings in this area. Conifers will be thinned to a minimum spacing of 15 feet between tree crowns and no conifers will be allowed to overhang buildings in this zone. Areas currently occupied by forest will be replaced by forest garden and landscape plantings. This shift in use will be particularly useful for the main kitchen building as a zone 1 garden could be established out the back door.

J. Greywater

Following the expansion of defensible space around buildings, it will be possible to expand forest garden plantings and other fire resistant landscaping around buildings. This landscaping will be augmented by greywater irrigation systems from all wastewater sources. Greywater typically accounts for more than 70% of a household wastewater production. Therefore, routing all greywater to the landscape will significantly reduce the pressure wastewater exerts on the septic field system and reduce the potential of septic water leaching from this system into waterways.

13.5 Invasive Species Management

A. Blackberry

Blackberries can be managed mechanically by flail mower or by weed-whacker with a brush cutting attachment. All chips and cut brush, will be piled around the base of the tree. The optimum time to mow blackberries is in the spring when they are in full bloom. At this time, they have devoted the greatest amount of their energy to their above ground parts, and their roots are more likely to rot without sprouting back. Three seasons of aggressive control is typically enough to decay the roots. Following initial mowing, blackberries occurring in grazed section of the property blackberries may be prevented from re-sprouting by allowing sheep or goats to forage on fresh canes.

B. Scotch Broom

Scotch broom should be cut when the bushes are in full flower. Bushes greater than 1" diameter are least likely to resprout when managed in this way. At this time, the plants have devoted the most energy to their above ground parts and will be least likely to sprout back from the root crown. If sprouting occurs, early spring sprout burning with a propane torch has been seen to be an effective followup strategy. Limiting ground disturbance will decrease the likelihood of further seedling emergence of scotch broom. Follow removal of broom with alternate desired nitrogen fixing species such as lupine, clover, or vetches. Scotch broom will fail to thrive in a nitrogen rich environment.

C. Integrated Pest Management

Vegetation and disease management at Lost Valley will utilize integrated pest management (IPM) as a control method. IPM is a holistic approach to weed and pest control and includes the following elements:

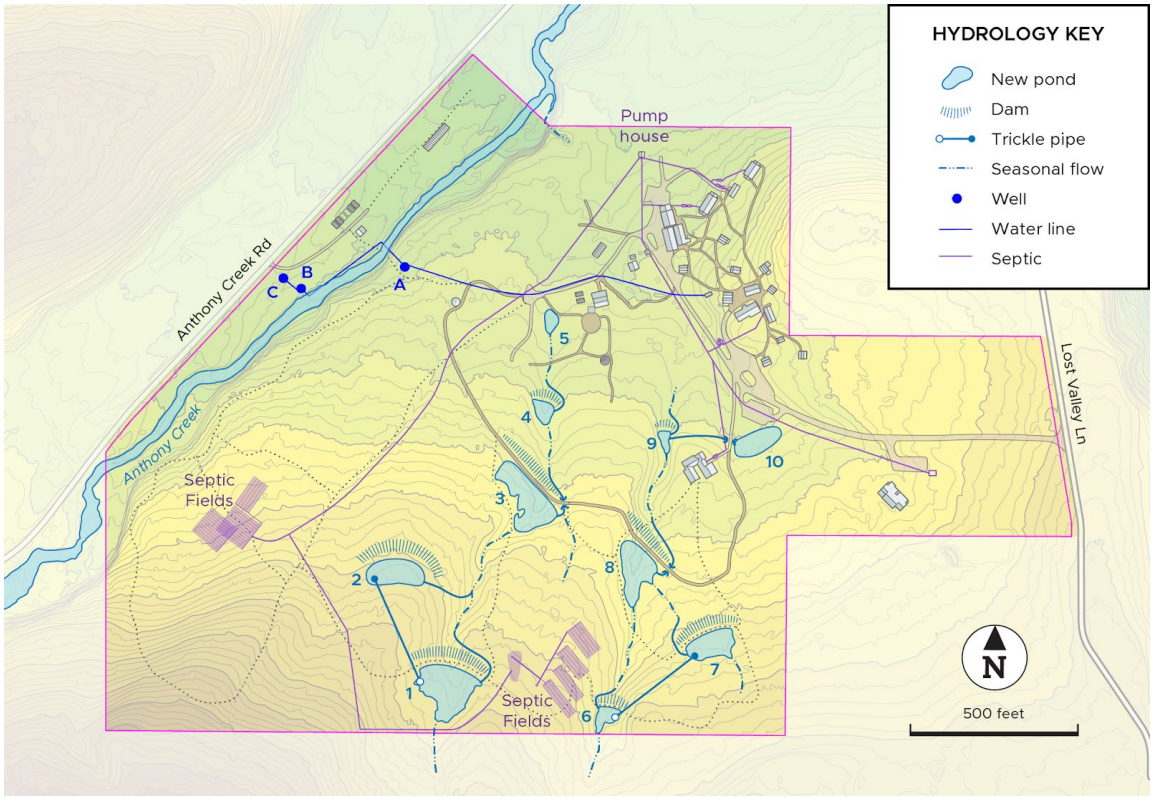
1. Monitoring for the presence of pests and pest damage.
2. Assessing the environmental conditions that are resulting in the damage.
3. Setting acceptable thresholds for pest tolerance.
4. Developing an integrated treatment plan.
5. Implementing the treatment plan at the best time to achieve control.
6. Evaluating the effectiveness of the treatment.
7. Adapting treatment plans based on the outcomes of previous treatments.

The Natural Resource Conservation Service (NRCS) provides technical and financial assistance for IPM practices by helping farmers establish:

- A diverse crop rotation that reduces habitat for major pests and increases habitat for natural enemies.
- Borders of beneficial species habitat.
- Farming techniques to improve soil quality.
- Planting of locally adapted, pest resistant cultivars.

14. Water and Access Improvements

Map 7 Water and Access Plan



Ponds					
1	**Irrigation Pond** (trickle pipe to #2)	0.45 ac +7 ft	6	**Irrigation Pond** (trickle pipe to #7)	0.08 ac +6 ft
2	**Irrigation Ridge Pond** (trickle-fed by #1)	0.26 ac +4 ft	7	**Irrigation Ridge Pond** (trickle-fed by #6)	0.22 ac +4 ft
3	**Fire Control Reservoir** (access road on dam; culvert)	0.41 ac +6 ft	8	**Fire Control Reservoir** (access road on dam; culvert)	0.29 ac +7 ft
4	**Valley Pond**	0.07 ac + 4 ft	9	**Valley Pond** (overflow-fed from #10)	0.04 ac +2 ft
5	**Lowland Pond**	0.05 ac +1 ft	10	**Fire Control Reservoir** (adj. to road; culvert to #9)	0.19 ac +2 ft

The property has an intact road and trail system. All irrigation and drinking water is supplied by a domestic well. However, water supply for irrigation and firefighting use is limited while firefighting vehicle access surrounding the primary defensible space is currently unavailable.

Access

Lost Valley will expand the road access network to enable for greater fire fighting access and agroforestry management. The road will be a dirt access road - reserved for use primarily during the dry season. It will lead into unit 2 from the edge of unit 5 and skirt the edge of unit 8 before crossing behind the teaching center where it can connect with the main gravel road. The road will also allow for access to the edge of unit 4 for oak woodland management. It can be used as a lane to move livestock between paddocks within the grazing sector of the property. Finally, it will be used as a water tanker truck access way for filling tanks from ponds in the event of a fire. A small track yarder like the one pictured below would work well for most thinning projects on the site.

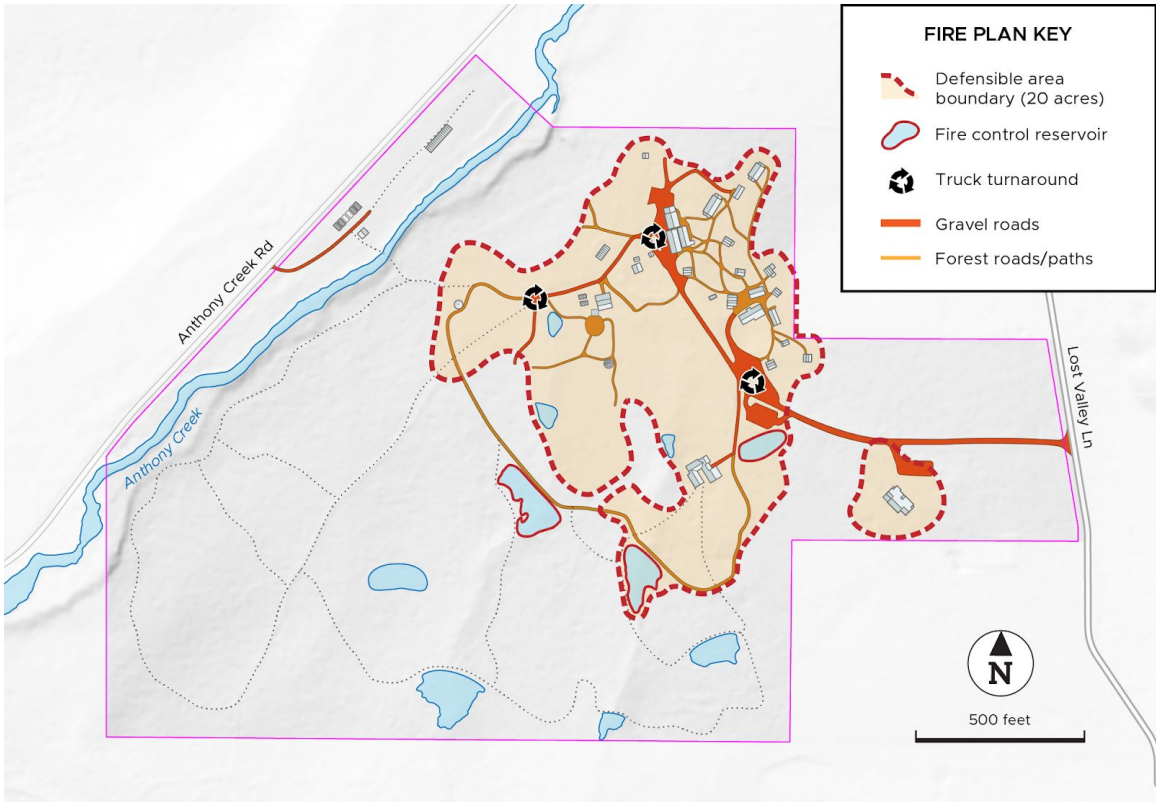
Image 10: *Mobile mini cable yarder with rubber tracks allows for harvest of multiple 16-foot logs in stand thinning projects.*

Water

Water harvesting earthworks will complement other water harvesting projects (beaver dam analogues and check dams) in all seasonal waterways. These ponds will serve multifunctional purposes: acting as summer-season groundwater recharge basins; restoring and increasing the dry season water supply to these zones while also providing for wildlife habitat, recreation, irrigation, and fire water supply needs on the property. Two ponds near the Southern edge of the site in Unit 7 will be located high enough on the land to supply gravity fed irrigation water to all agricultural and grazing units. One of these ponds will divert water to a second ridge pond in the same unit. Three ponds will parallel the access road and serve as emergency fire supply ponds. A series of smaller ponds will follow the drainages in Units 2 and 9 b. These ponds will be primarily for wildlife habitat and water recharge purposes. All ponds will be earthen lined and designed to contribute groundwater to the soil thereby recharging summer water tables.

15. Fire Plan

Map 8 Fire Plan



A. **<u>Maintain defensible space around buildings, camping, and fire pit areas.</u>**

It is important to create defensible space to protect from fire moving to the forest or vise versa. A fire-protected buffer should be maintained to within 100 ft. of all buildings and permanent fire pit areas. To create this buffer, ladder fuels are removed from trees as well as any dense vegetation that can fuel a fire. Dead plants and vegetation should be removed, woodpiles stored 50 feet or more away from other structures, and horizontal space maintained between trees and shrubs. *The following strategies will be applied to all inhabited areas:*

- Avoid horizontal ladder fuels by clearing all conifers within 50 feet of all buildings. Maintain more than 20 feet between conifer tree crowns between 50 and 100 feet from all buildings.
- Replace flammable trees with hardwoods and irrigated plantings.
- Disallow outdoor recreational burning during the summer anywhere except the designated zones. These zones should be cleared to bare earth and supplied with a pressurized water source.
- Prohibit outdoor cooking during the dry season except for in designated areas .
- Build or retrofit all structures utilizing metal roofs, metal gutters, and concealed eaves.
- Clean all debris from gutters and around structures before the dry season.
- Woodpiles should be stored 50 feet or more from other structures or ignition sources.

- Maintain pressurized water hydrants in the meadow, around all camping areas, and around the developed area.

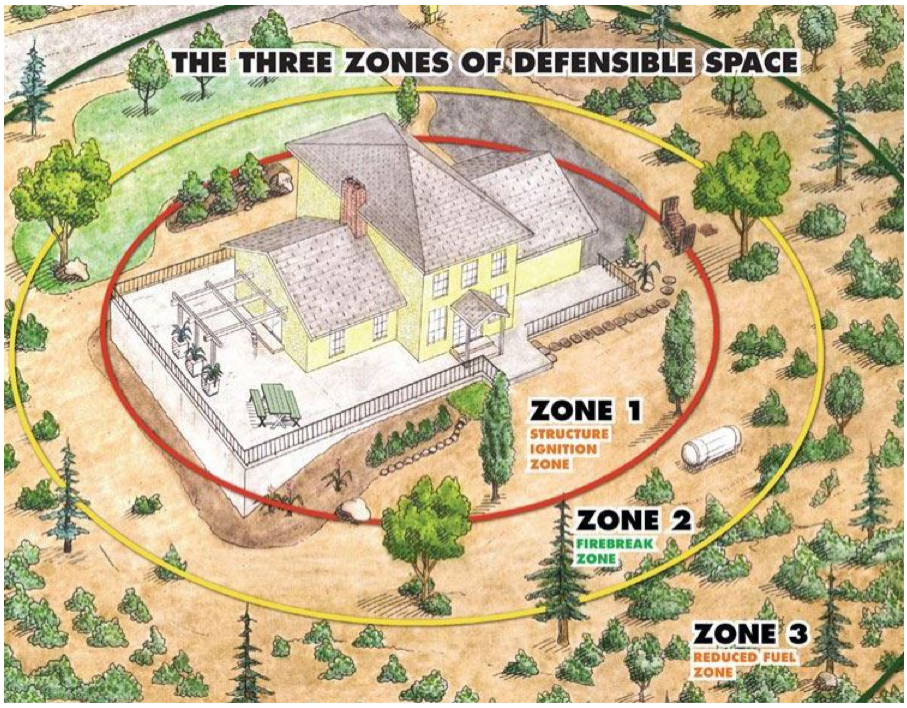


Image 11: *Zones of Defensible Space Around the Home*
Source: Oregon Department of Forestry

B. <u>Promote fire-resistance at the landscape level</u>

Outside of the developed zones and gathering areas, resistance to fire will be promoted at the landscape scale through creating horizontal and vertical fuel fuel gaps.

Each of the following strategies will break up continuous layers of fuel and will greatly assist in gaining footholds on landscape level fires when they occur. These actions also emulate, to an extent, the role fire plays in maintaining mosaics in vegetation and therefore increased overall resilience at the landscape level.

Utilize roads and trails as firebreaks and shaded fuel breaks

Firebreaks are areas where all vegetation is removed down to mineral soil, thereby completely removing the potential for fuel combustion across a given area. Firebreaks are typically designed to be 12-15 feet in width or two to three times the width of the nearest *surface* vegetation such as herbaceous plants and shrubs.

Shaded fuel breaks differ from firebreaks in that they reduce combustible vegetation both vertically and horizontally while not completely clearing all vegetation from the area. This action reduces the chance of fire spreading while also maintaining a shaded and moist understory microclimate and consequently more green vegetation into the dry season. Within the shaded fuel break, overstory trees should be thinned to reduce crown overlaps of conifers. Canopy hardwoods should be maintained and even planted in shaded fuel breaks.

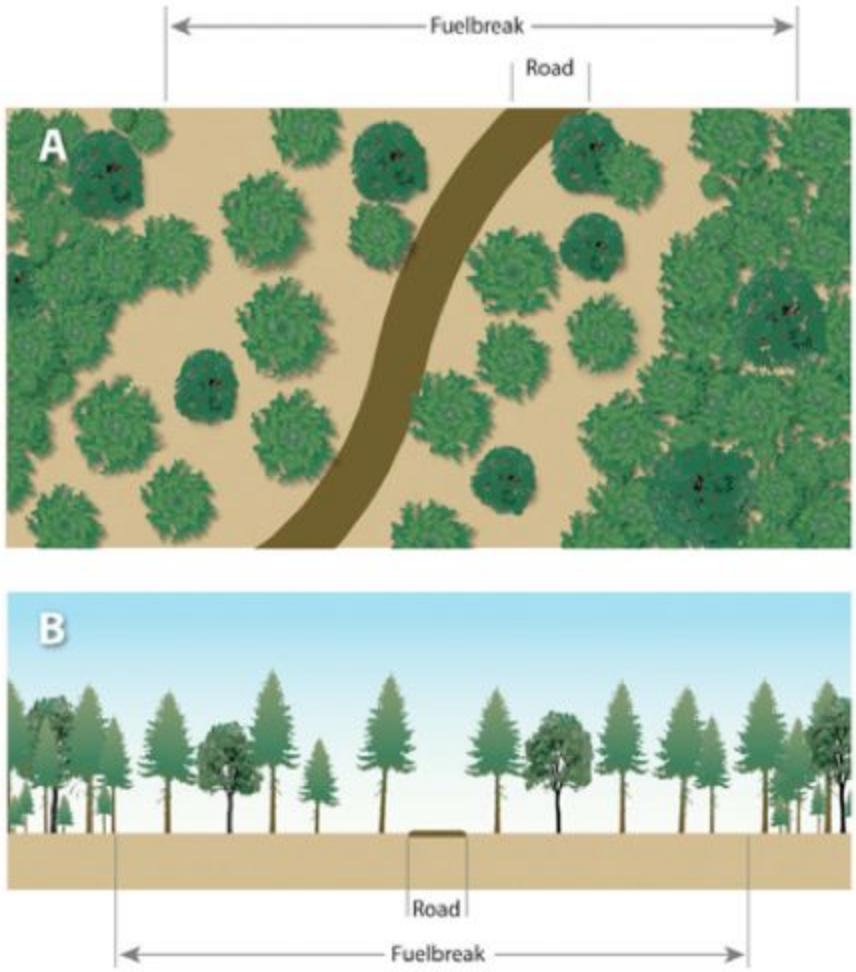


Image 12: *Fuel break a) Bird's Eye View & b) Ground Level View*

Source: Oregon Department of Forestry

The width of shaded fuel breaks depends on the type of forest, fuel loading, and terrain steepness. Flammable fuel load will be the most determining factor across this site given its lack of topography. *The recommended fuel break distance on either side of a firebreak is 100 feet on sites with less than 10% slope.*

Utilize leverage points to reduce fire movement through the landscape.

- Maintain areas of relatively light fuels, such as grasslands, hardwood glades, and open woodland areas by removing encroaching brush and conifers.
- Thin more heavily next to a natural feature such as a meadow opening, wetland, or rock outcroppings.
- Hedgerows and windbreaks in the agricultural zones will reduce wind speed during the dry season.

Promote the establishment of more fire-resistant tree species in the forest canopy and sub-canopy.

Fire kills trees by killing the cambium (the living cellular layer of the tree just below the bark), scorching the foliage, and killing buds and roots. By leaving larger trees in the

forest, we can increase the likelihood of the bark protecting the cambium from severe heat and deep ground insulated root systems. Ponderosa pine, sugar pine, and Douglas fir all develop thick bark and deep roots. Pines also have other features that help it survive fire, including an open crown, high moisture content in the foliage, and thick bud scales. Grand firs and hemlock have more thin bark and shallow roots and are therefore more likely to be killed in a fire.

Some hardwoods, especially deciduous species such as red alder, Oregon white oak, and Big Leaf Maple have higher moisture content than conifers and therefore burn at lower intensities. It takes a lot of heat to drive water out of a hardwood trees canopy, and the biomass left in shriveled leaves does not contribute much to addition fire fuels. A hardwood canopy is also better at absorbing and deflecting radiant heat. Evergreen hardwoods like madrone and chinquapin have intermediate flammability.

Although a hardwood may be killed in a fire, it is likely to sprout back from the root following the death of the stem. This tendency can be utilized for the production of high quality basketry and weaving materials. Only fire can produce truly straight resprouted stems on shrubs like hazel, willow, and ocean spray.

C. Implement an emergency fire access strategy for the property.

1. Make it easy to find and access the property.

Posting address and directions to the site on non-flammable material at junction points of the main road will ensure time is not lost in the event of a fire.

2. Maintain an alternate back-door rout for emergency evacuation.

3. Maintain a good road system for firefighting vehicles.

The following Oregon fire vehicle minimum road design standards will be followed for all roads.

Item	Structural Fire Vehicles	Wildland fire/initial attack vehicles
Road width	20-24 feet	12 feet
Road grade	<5-10%	<15%
Surfacing	Packed gravel or asphalt	Gravel or dirt
Turnarounds	45-55 foot radius	45-55-foot radius
Bridges (weight limits)	40-70,000 lbs.	40-70,000 pounds

4. Clear vegetation along dirt roads to allow for adequate fire fighting vehicle access.

This work also helps prevent the spread of fire by creating fuel breaks as described in the above section. Oregon's Senate Bill 360 outlines the following requirements for vehicle access.

- Create a fuel break that extends 10 feet from the centerline of the roadway. Ensure the groundcover adjacent to the road is substantially reduced.

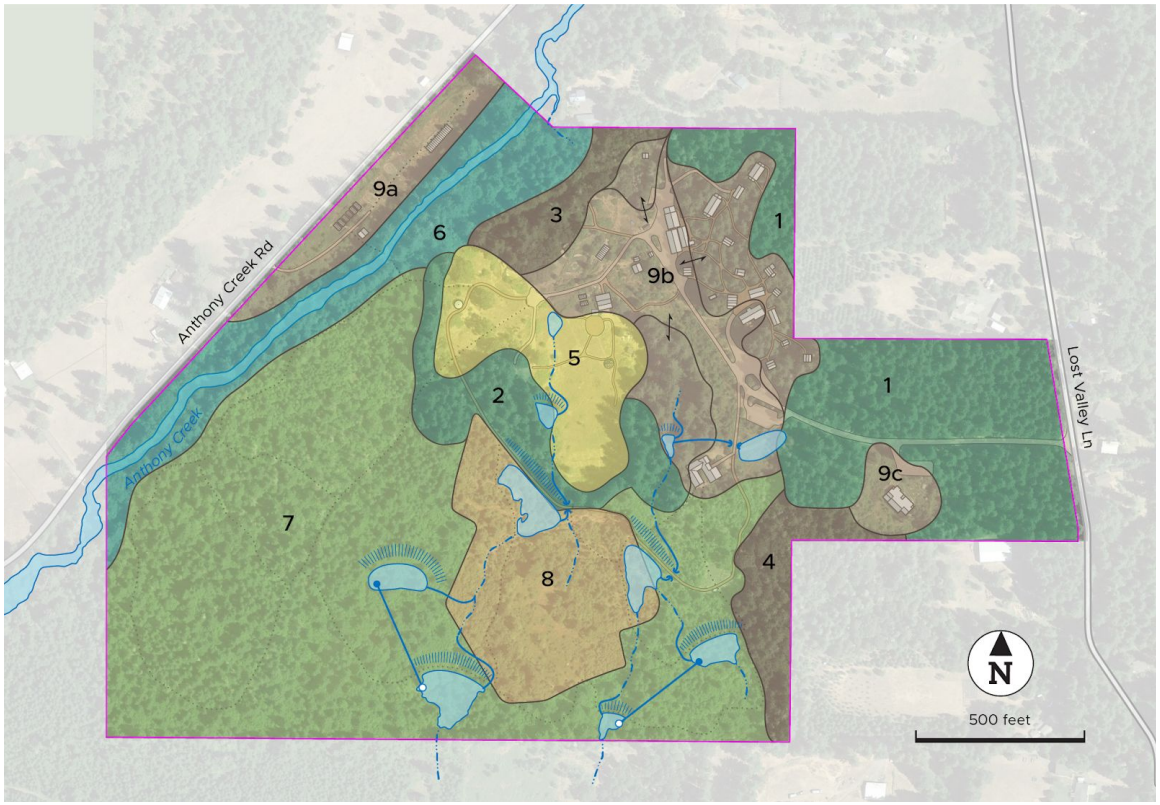
- Provide minimum vertical clearance of 13.5 feet in the driving area. This provides an unobstructed view for firefighters and clears the road of potential obstructions to access.
- Provide a minimal horizontal clearing distance of 12 feet in the driving area.
- Thin and prune trees and shrubs adjacent to the road.

D. Comply with All Fire Regulations

All operations must comply with Oregon Department of Forestry and fire district regulations. Refer to the Oregon Department of Forestry Industrial Fire Precaution Levels for regulations around forest operations during fire season and Public Fire Restrictions for all non-harvest related operations on the site.

16. Management Prescriptions

Map 9 Master Plan



Stewardship Units Key					
1, 2	**Mixed Conifer** (4.8 acres from 1 & 2 to 9b)	15.0 ac	7	**Mixed Hardwood**	32.5 ac
3, 4	**Oak Woodland** (0.5 acres from 3 to 9b)	4.3 ac	8	**Agroforestry**	7.2 ac
5	**Meadows & Oak Savanna**	5.0 ac	9a–c	**Agricultural & Residential** (Added 5.3 acres to 9b)	15.1 ac
6	**Riparian Forest**	7.4 ac			

Unit 1.

This unit has approximately 95 trees per acre with an average stand diameter of 16.5 inches. Stand density was calculated using Douglas fir stand density tables developed at Oregon State University (Withrow-Robinson, 2018). Stand density is a measure of the relative density of a forest on a scale from 0 to 100. Zero being a completely open stand and 100 being maximum stocking. As trees grow from uncrowded seedlings toward a group of larger trees approaching maximum stocking level without a major disturbance, the stand passes through certain stages along the way. These stages correspond with predictable levels of competition at anticipated relative densities that have been identified through years of forestry research. Relative density is our best measure of crowding and competition in a stand of trees. The relative density of this stand is approximately 40%. This puts the forest in the middle "Goldilocks Zone". This zone is generally seen as "just right" when it comes to optimizing timber quality and quantity. However, as the stand continues to grow, and advances to 45-50% density, dense shade limits the type and growth of understory vegetation and subdominant trees with smaller crowns begin to be excluded from light. The unit is to be thinned of no more than ¼ of its trees in the next ten years. This will bring the relative density of the stand down to approximately 35% a density considered optimal for understory regeneration and continued canopy tree growth. Tree selection will follow the protocols outlined in section 13.1 above. There are approximately 8 snags per acre in this unit. A target of 2 snags per acre will be set for this and all other forest units on the property.

As a fire prevention measure, the forest will be cleared to 100 feet of the eves of all buildings following the guidelines outlined in section 15 above. All remaining conifers will be located more than 50 feet from all buildings and be spaced to have more than 15 feet between all tree crowns. Forest within this section of the unit will be considered outside of the relative density prescriptions described above. As this section transitions out of the forest, the agricultural activities and intensive landscaping in Unit 9b will expand into this zone. This will lead to more irrigated and less fire prone areas immediately adjacent to the residential zone and its buildings. A 100 foot shaded fuel break will be established on either side of the access road at the entrance to the site. This road will be maintained to provide clearance for firefighting vehicles following the guidelines in section 15 above.

Unit 2

This unit has a significant number of dying and dead conifers and will be thinned of these trees simultaneous to the timber harvest in unit 1. The eastern edge of the forest will be cleared in order to allow more light to gardens while reducing the potential for fire to transfer between this forest and the residential zone. Orchard and garden will expand into this area. The eastern edge of the forest will become part of a rotational grazing system integrated into the meadow and woodland units. One of the quality of this unit is that it functions as a sheltered corridor for wildife moving between the riparian forest to the eastern sections of the property including the oak woodland and upland conifer forests. This functional quality should be maintained for the sake of habitat connectivity across the site.

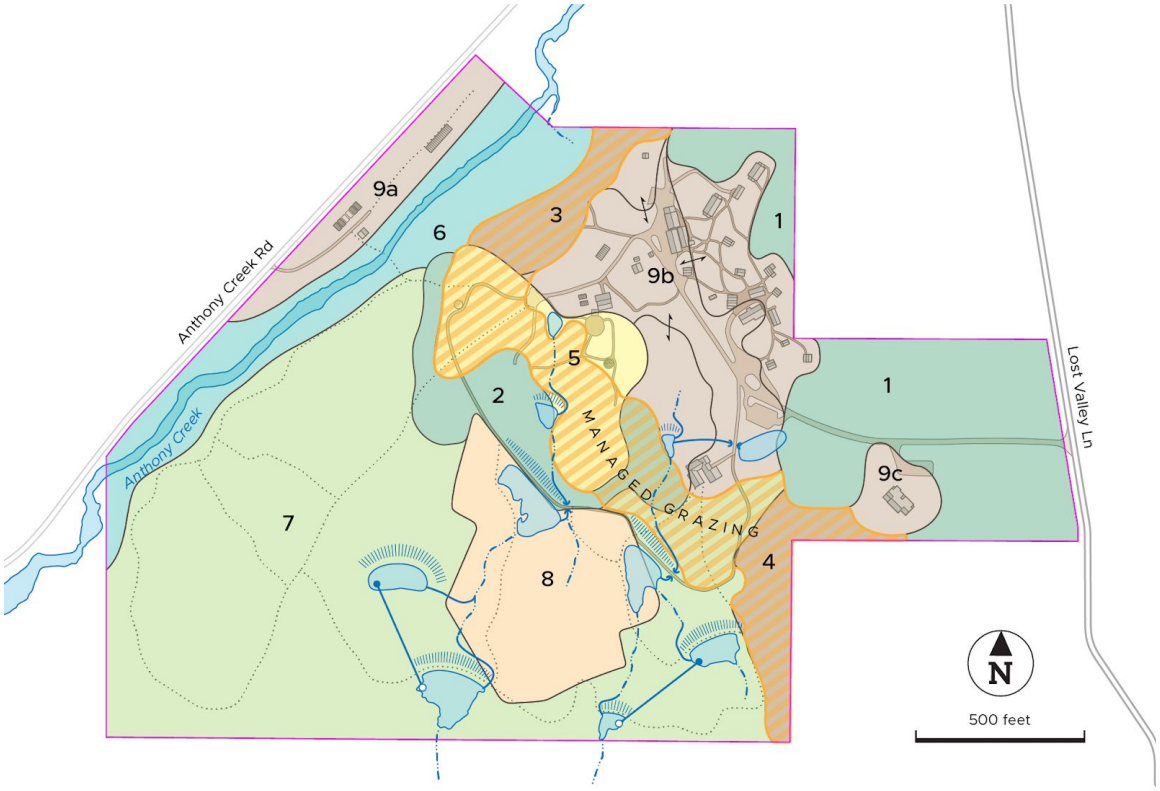
Unit 3

This unit has a total of 85 oak and 35 Douglas fir trees. It has a relatively high amount of larger oak trees. with 20 trees having 20" DBH or greater. This woodland will be cleared following the oak woodland thinning protocols outlined in section 13.2 above. The target canopy opening is to be approximately 50% across the site while individual legacy oaks will be cleared to within a 30

foot radius of their driplines. A trail network between legacy oaks will be established to provide access for upkeep and mowing.

This unit as well as units 3, 4, 5 and parts of units 2 and 9b (See map below) would be an ideal areas to to implement a grazing system on the site. Animals can be utilized to play a vegetation management role in the woodland and savanna zones. This grazing area will define a boundary between the more intensively managed garden and residential landscaping zone and the less intensive agroforestry, riparian forest and forest regeneration areas on the other side of the fence. One benefit of this grazing block is that it will reduce fuel loads and thereby reduce the strength of fire emanating from the North, South, and West toward the residential areas. The areas would need to be perimeter fenced and livestock exclusion fencing and off channel watering systems would need to be installed in order to prevent open grazing in the riparian forest.

Map 10 Managed Grazing Zones



Unit 4

This unit has a total of 82 white oaks and 65 Douglas fir trees. The fir are mostly smaller trees having spread from adjacent forest over the past few decades or grown in as seedlings from a series of larger trees in the unit. The unit will be managed following section 13.2 above.

Unit 5

Managed grazing and fire will be utilized for meadow regeneration following the protocols outlined in section 13.2 above. The western seasonal drainage will be augmented with a series

of small ponds and sets of beaver dam analogue structures and planted to an upland forest buffer following the guidelines in section 13.4 above.

Unit 6

The riparian forest will be maintained following the guidelines in section 13.3 above. Livestock exclusion fencing will be installed along its perimeter where it adjoins future managed grazing paddocks.

Unit 7

This unit will be managed toward a young mixed forest character following the management protocols outlined in section 13.1 above. Principles of tree selection and management apply to young trees, seedling, and woody and herbaceous brush as well. Management will favor a diverse mix of species by favoring the healthiest specimens and maintaining desired trees and shrubs in a free-to-grow condition. Cascara can be coppiced for biochar in order to reduce competition with adjacent trees and shrubs. Routine chop and drop will make use of the nitrogen fixing qualities of this small tree and support the growth of other trees and shrubs. Blackberries and scotch broom will be controlled utilizing the protocols outlined in section 13.5 above.

A series of large ponds will be constructed in this unit. Being located at the highest points in the property they will be outfitted with siphons or baffled pipes through the dam to provide drip irrigation and livestock water to garden and grazing sectors greater than 20 feet in elevation drop. Flood irrigation by trickle tube into swales can supply nearby agroforestry plantings that have too little elevation drop for even drip irrigation. Access trails will be adjusted to correspond with swales and pond dams - thereby creating a walking network that allows for easy maintenance and brush management across the unit.

The septic fields should be maintained to be clear of trees. These will be maintained as small meadows and periodically grazed or burned in order to prevent woody plant establishment

Unit 8

Two large ponds and a dry-season dirt access road will be integrated into this unit. The ponds and road, whose primary purpose will be for fire control will also serve microclimate, irrigation, and access roles in this more intensively managed zone. The ponds may also be utilized for aquaculture production as part of the agroforestry systems. Existing swales with their planted tree/shrub corridors can be incorporated into the future earthworks by designing their overflows to attach to these two ponds. The swales may also be fed by trickle tube from other ponds further uphill in unit 7.

This unit will be integrated into the grazing system. Tree and brush management, coppice, and invasive species control will follow the guidelines outlined in section 13.1 and 13.5 above. Biochar produced from the woodland thinning projects and coppice management in unit 7 and 8 can be incorporated around tree crops in this unit.

Unit 9

The three agricultural units will be maintained following the protocols outlined in section 13.4 above. Unit 9 b will expand to create greater defensible space around all buildings and the well.

The conversion from forest to open landscaping and forest garden will increase the light for food production and bring more production capacity to the zone 1 area around the campus.

17. Timeline

2020

- Hold conversations with NRCS, Watershed Council, BLM, Soil & Water Conservation Service, and Oregon Department of Fish and Wildlife about cost share opportunities and partnerships in forest regeneration, oak savanna, pasture improvement, hedgerow systems, riparian, and in-stream restoration. Begin to apply for grants and cost share funding to achieve the relevant management objectives.
- Seek financial support for the implementation of the water and access systems.
- Plan silvopasture and prescribed grazing systems.
- Carry out timber harvest by expanding defensible space around buildings, implementing thinning in all woodland and forest units, and developing firebreaks and shaded fuel breaks along roads and trails.
- Carry out brush control from all forestry projects
- Seed grass and forbs in woodland and savanna units

2021

- Begin greywater installations from all structures within expanded defensible space.
- Begin forest garden development around all structures within expanded defensible space.
- Install Ponds and Firebreak Access Road
- Begin to install check dams and beaver dam analogue structures
- Install cross fencing, riparian exclusion fencing, and animal shelters for all silvopasture and grazing zones.

2022

- Begin planting upland buffers along seasonal waterways
- Continue check dam and BDA construction
- Introduce grazing animals

2023-2030

- Continue brush management, individual/group tree selection, and tree planting within all forested units.
- Begin monitoring of all relevant units.
- Continue to adapt the grazing and forestry plan.

18. Monitoring Plan

Four monitoring projects will be undertaken. The first monitoring project will involve tracking the growth of all forest units under the individual and group selection processes described above. This will happen in the context of permanent plots surveyed every 5 years and unit level timber cruises, plant inventories, and animal surveys conducted every ten years. A second monitoring project will take place during the oak restoration project. Permanent photo-points will be utilized following the "OWEB Guide to Photo-point Monitoring". A third photo-point monitoring project will take place during the check dam and Beaver Dam Analogue project. Finally, all silvopasture zones will be monitored as a component of a planned grazing system.

19. Sources of Assistance

Lost Valley will reach out to the Lane County Chapter of the NRCS as a potential participant in the following programs:

A. Conservation Stewardship Program (CSP)

The CSP is designed to pay landowners for improving environmental issues on their land. It applies to cropland, grassland, prairie land, improved pastureland, rangeland, non-industrial private forestland, and agricultural land under tribal jurisdiction. CSP payments to a person or legal entity may not exceed $40,000 in any year and $200,000 during any 5-year period. There are two possible types of payments: An annual payment for installing new conservation activities and maintaining existing activities and a supplemental payment for the adoption of a resource-conserving crop rotation.

B. Environmental Quality Incentive Program (EQIP)

EQIP has become the program of choice for a lot of projects. Current cost share payments applicable to this site may include:

- Forest Slash Treatments
- Forest Stand Improvement
- Forest Trails and Landings
- Prescribed Burning on Woodlands
- Tree/Shrub Establishment
- Tree/Shrub Site Preparation
- Upland Wildlife Habitat Management
- Windbreaks/Shelterbelts
- Riparian Forest Buffer Design and Installation
- Hedgerow and Pollinator Plantings
- High Tunnel Installation
- Prescribed Grazing Plan
- Cross Fencing
- Off-channel Livestock Watering System
- Microirrigation

The program can be modified by a state agency depending on regional needs and priorities. Currently, Lane County has two priority funding projects:

Forest Resistance and Resilience Improvement Strategy

The forestland in the foothills of the Cascade Range and the Coast Range that ring the Willamette Valley has a limited capability for forest resistance and resilience to disturbance measures due to recent management that has reduced structure and complexity. These monoculture forests are particularly susceptible to risks for fire, insect pest and disease outbreak, and drought events that have severe effects that compromise the capability of the system to maintain or return to a functioning ecological state. These risks are expected to be further elevated with projected climate variability over the next century. The Forest Resistance and Resilience Strategy will improve forest diversity that gains resistance and resilience to disturbance events, thus reducing the susceptibility to effects that impair the long-term function and lessen the ecosystem services provided by forests in priority areas. Conservation funding includes:

- Forest Stand Improvement
- Woody Residue Treatment
- Brush Management
- Herbaceous Weed Control
- Tree/Shrub Site Preparation
- Tree/Shrub Establishment
- Tree/Shrub Pruning
- Conservation Cover
- Forest Management Plan - Written
- Structures for Wildlife

Lane Oak Habitat Enhancement Project

The goal of the project is to enhance 1,000 acres of threatened oak habitats within ODFW Conservation Opportunity Areas. In order to restore and expand oak woodlands and savannas, invasive weed species must be suppressed, trees that compete with oaks must be controlled, and new plantings of oaks must be established and maintained to ensure their prosperity. These tasks will be the focus of the implementation plan, with the ultimate intention of revitalizing current oak populations and creating corridors to unite oak habitats that have previously been isolated. This will not only prevent the disappearance of Oregon White Oaks from their historic occupancy, but will improve the prospect of survival for many species that thrive in oak habitats. Conservation funding includes:

- Forest Stand Improvement (666)
- Woody Residue Treatment (384)
- Conservation Cover (327)
- Brush Management (314)
- Fence (382)
- Heavy Use Area Protection (561)
- Pipeline (516)
- Watering Facility (614)
- Herbaceous Weed Control (315)

C. Wildlife Habitat Incentive Program (WHIP)

WHIP offers incentives for planting habitat composed of beneficial species. Funding changes every year based on what is deemed important, what money is available, and which regions and habitats are in priority.

- Forest Stand Improvement
- Forest Trails and Landings
- Prescribed Burning in Woodlands
- Tree Shrub Establishment, Site Preparation, and Pruning
- Upland Wildlife Habitat Management
- Windbreak/Shelterbelt Management

D. Sustainable Agriculture Research and Education (SARE)

This grant-based program typically administers 3-year grants.

- Farmer/Rancher Grants ($6,000 per individual and up to $18,000 for groups of 3 or more)
- Research and education grants (up to $10,000) in which researchers partner with landowners.
- Professional development grants
- Graduate student grants (up to $10,000)
- Youth and Youth Educator Grants ($400 for youth and $2,000 for youth educators)

Lost Valley will reach out to the Oregon Water Enhancement Board and the Siuslaw Watershed Council to participate in the OWEB small and large grant programs for the following projects:

- Culvert Installations
- Anthony Creek Check Dam Placement and Seasonal Waterway BDAs

Additional Assistance

Resilience Permaculture Design
Abel Kloster and Tao Orion
abelkloster@gmail.com, taoorion@gmail.com
541-556-1426

Natural Resource Conservation Service
Lane County Chapter
780 Bailey Hill Rd, Eugene, OR 97402
541-465-6443

Oregon Small Woodlots Association
Lane County Chapter
Gary Jensen
541-935-8653
treegary@aol.com

Oregon Department of Forestry

ODF Stewardship Forester: Brian Peterson
Veneta Office
87950 Territorial Hwy
Veneta, OR 97487
541-935-2283 ext. 228
Brian.M.Peterson@oregon.gov

Oregon State University Extension Service
Lane County Office
996 Jefferson Street, Eugene, OR 97402-5225
541-344-5859
Lane County Agent: Lauren Grand
541-579-2150
lauren.grand@oregonstate.edu

Upper Willamette Soil and Water Conservation District
780 Bailey Hill Road, Suite 5, Eugene, Or 97402
541 465-6443 Ext. 102
www.uwswcd.org
office@uwswcd.org

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301
503-986-0900
webmaster@wrd.state.or.us
http://www.oregon.gov/owrd/Pages/index.aspx

Oregon Watershed Enhancement Board
775 Summer St NE
Salem OR 97301
darika.barnes@oregon.gov
503-986-0178
http://www.oregon.gov/OWEB
http://www.oregon.gov/OWEB/GRANTS/pages/index.aspx
Small grant administration, watershed monitoring and reporting

Middle Fork Willamette Watershed Council
(458) 215-8200
www.middleforkwillamette.org/

20. Aesthetic Resources and Recreation

Management actions should be undertaken in a way that protects the aesthetic and recreational capacity of the site. Open vistas, meadows, hardwood openings, and diverse and complex forests all contribute to the aesthetics of a site. Most harvest operations will cause temporary impacts; therefore all work should be undertaken with aesthetic consideration in mind.

21. Tax and Business Management

Good record keeping can help landowners manage their assets, increase their revenues, and minimize their tax liability. Timber harvest and other revenue generating activities generally produce a federal and state income tax liability. Tax credits are available for some management activities. *(See www.timbertax.org)* Good estate planning can help to lessen tax liability when passing land to heirs.

Incentive programs and tax deductions help landowners achieve greater returns on their projects. Different sections of the internal revenue code allow forestland owners to gain tax advantages through reforestation incentives, business investment incentives, conservation tax incentives, and long-term capital gains. The following incentives may apply. Landowners should seek professional planning and tax advice.

A. Reforestation Incentives

Section 194: Reforestation Deduction and Amortizable Basis Deduction for "Commercial Timber Production"

This section allows taxpayers to deduct expenses up to $10,000 ($5,000 if married and filing separately) per qualified property per year of reforestation expenditures and amortize the remaining expenditures over an 84-month period. The reforested area must be at least 1 acre in size and costs paid or incurred must be after October 22, 2004. Both owned and leased lands are eligible for deductions. Qualifying costs include site preparation, seed or seedlings, and for labour and tools including depreciation of equipment such as tractors and tree planting implements. The goal of this program is timber production and does not apply to Christmas tree production, ornamental tree production, trees planted for only fruit or nuts, or windbreaks. Timber stand improvement costs also do not qualify. Tree species that have timber value and serve a long-term timber purpose must be incorporated into the system for an agroforestry practice to qualify. Typically, the primary planting intent is the determinant of the validity of a planting. The IRS recognizes a "forest management plan" as a valid way of documenting commercial timber production.

B. Business Investment Incentives

Section 179: Deduction for personal property used in an active trade or business

Personal property that is used greater than 50% for farming or forestry may deduct the cost of the property up to $105,000 in the year it was placed in service instead of taking the annual depreciation deduction. Qualifying property includes agricultural fences, machinery, and equipment, business property (printers etc.), livestock, single purpose livestock or horticultural structures (mushroom structures, drying sheds, etc.). Most buildings do not qualify for this deduction.

C. Conservation Incentives

Section 175: Deductions for conservation and erosion control improvements on "productive farmland"

In general, all farm expenditures are considered capital expenses and are added to the basis of the land. Section 175 allows landowners to deduct expenses for conservation improvements in "productive farmland" at a rate of up to 25% of the gross farm income. Practices must be consistent with a plan approved by the Natural Resource Conservation Service and include earthworks construction and maintenance (such as levelling, grading,

terracing, contour furrowing, dams and ponds, drainage ditches, diversion channels and restoration of soil fertility), eradication of brush, and planting of windbreaks.

Section 126: Exclude payments received for qualified conservation projects from gross taxable income.

Section 126 of the IRC allows landowners to exclude all or a portion of cost-sharing payments received from conservation program from their gross income. This exclusion only applies to capital expenses for projects that do not substantially increase your annual income from the property The secretary of agriculture must certify that conservation, restoration, or habitat improvements has taken place. Excludable programs under section 126 include Forestry Incentive Program, Forest Stewardship Incentive Program, Forest Land Enhancement Program, Wetland Reserve Program, Environmental Quality Incentive Program, Wildlife Habitat Incentive Program, Conservation Reserve Program, and various state programs.

Oregon Riparian Lands Tax Incentive

The Riparian Tax Incentive Program offers a property tax incentive to property owners for improving or maintaining qualifying riparian lands. Under this program, property owners receive complete property tax exemption for their riparian property. This can include land up to 100 feet from a stream. A landowner and the Oregon Department of Fish and Wildlife must sign a riparian management plan and agreement. A management plan must detail measures the landowner will implement to preserve, enhance or restore the riparian area. For riparian land to qualify for this program, it must be outside adopted urban growth boundaries, and planned and zoned as forest or agricultural lands (including rangeland), or must have met these criteria as of July 1, 1997.

21. Regulatory Compliance

Most forest operations on non-federal land in Oregon require the filing of a Notification of Operations with the Oregon Department of Forestry (ODF). These activities include: timber harvest; road building and reconstruction; chemical application; site preparation for reforestation; converting forestland to another use; treatment of logging slash; pre-commercial thinning; cutting of commercially sold or bartered firewood and surface mining.

A 15-day waiting period for resource review applies to all submitted notifications. Certain operations near identified resources may require submission of a written plan that describes how the operation will be conducted to protect those resources (OAR 629-605-0170). Landowners can obtain a current copy of the Oregon Forest Practice Rules from a local ODF office or from the ODF web site. http://www.oregon.gov/ODF

22. Updates to This Management Plan

This management plan will be updated every 10 years. The next update will occur by 2030.

23. Literature Cited

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Lost Valley Soil Types Index

CODE	NAME	SUBCLASS
11C	Bellpine silty clay loam, 3 to 12 percent slopes	IIIe
11D	Bellpine silty clay loam, 12 to 20 percent slopes	IIIe
52B	Hazelair silty clay loam, 2 to 7 percent slopes	IIe
78	McAlpin silty clay loam	IIw
98	Noti loam	IVw
121B	Salkum silty clay loam, 2 to 8 percent slopes	IIe

11C	Bellpine silty clay loam, 3 to 12 percent slopes Capability subclass IIIe

This moderately deep, well drained soil is in convex positions on foothills and uplands in the Willamette Valley. It formed in colluvium and residuum derived from sandstone, siltstone, and volcanic tuff and breccia. Areas are irregular in shape and are 3–200 acres in size. The vegetation in areas not cultivated is mainly Douglas-fir, Oregon white oak, poison-oak, salal, and western sword fern. Elevation is 400–1,400 feet. The avg annual precipitation is 40–60 in, the avg annual air temperature is 50–52°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is dark reddish brown silty clay loam about 13 in thick. The subsoil is dark reddish brown and dark red silty clay about 21 in thick. Weathered tuffaceous sandstone is at a depth of 34 in. Depth to bedrock ranges from 20–40 in.

Included in this unit are small areas of Dupee, Jory, Nekia, and Ritner soils. Included areas make up about 15% of the total acreage.

Permeability of this Bellpine soil is slow. Available water capacity is about 3.5–6.0 in. Water supplying capacity is 17–24 in. Effective rooting depth is 20–40 in. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for timber production, hay and pasture, and homesites. It is also used for Christmas trees, small grain, orchards, recreation, and wildlife habitat.

If this unit is used for hay and pasture, the main limitations are low soil fertility, high acidity, high clay content, susceptibility to compaction when wet, and low precipitation in summer. Use of lime and fertilizer promotes good growth of forage plants. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil in this unit from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. In most years, supplemental irrigation is also needed.

This unit is suited to cultivated crops. In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen; legumes respond to phosphorus, boron, sulfur, and lime; and vegetables and berries respond to nitrogen, phosphorus, and potassium.

Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Christmas tree plantings need brush, weed, and rodent control and periodic shearing or shaping to ensure growth of a compact tree of uniform shape.

This unit is suited to the production of Douglas-fir. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 155. The potential production per acre is 9,840 cubic feet from an even-aged, fully stocked stand of trees 60 years old or 91,040 board feet (International rule, one-eighth-inch kerf) from an even-aged, fully stocked stand of trees 80 years old.

The main concerns in producing and harvesting timber are the susceptibility of the soil to compaction and slow permeability, which contribute to a high hazard of erosion during the wet season.

Surface methods of harvesting timber generally are suitable, but the soil may be compacted if heavy equipment is used while the soil is moist. Ripping skid trails and landing areas after logging helps to break up the compacted layer and improves seedling survival and growth. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Reforestation should be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees. Hand planting of nursery stock is usually necessary to establish or improve a stand. Douglas-fir is suitable for planting.

If this unit is used for recreational development, the main limitations are the high clay content, slow permeability, depth to rock, and slope. Drainage should be provided for paths and trails. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintaining adequate plant cover.

If this unit is used for homesite development, the main limitations are the high clay content, slow permeability, and depth to rock. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Cuts needed to provide essentially level building sites can expose bedrock. Roads for year-round use need heavy base rock.

Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If this unit is used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Absorption lines should be installed on the contour.

11D	Bellpine silty clay loam, 12 to 20 percent slopes Capability subclass IIIe

This moderately deep, well drained soil is on foothills and uplands adjacent to the Willamette Valley. It formed in colluvium and residuum derived from sandstone, siltstone, and volcanic tuff and breccia. Areas are irregular in shape and are 5–100 acres in size. The vegetation in areas not cultivated is mainly Douglas-fir, Oregon white oak, poison-oak, salal, and western swordfern. Elevation is 400–1,400 feet. The avg annual precipitation is 40–60 in, the avg annual air temperature is 50–52°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is dark reddish brown silty clay loam about 13 in thick. The subsoil is dark reddish brown and dark red silty clay about 21 in thick. Weathered tuffaceous sandstone is at a depth of 34 inches. Depth to bedrock ranges from 20–40 in.

Included in this unit are small areas of Dupee, Jory, Nekia, and Ritner soils. Included areas make up about 15% of the total acreage.

Permeability of this Bellpine soil is slow. Available water capacity is about 3.5–6.0 in. Water supplying capacity is 17–24 in. Effective rooting depth is 20–40 in. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for timber production, Christmas trees, and orchards. It is also used for small grain, pasture, homesites, wildlife habitat, recreation, and watershed.

This unit is suited to hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion and compaction.

This unit is suited to cultivated crops. In summer, irrigation is required for maximum production of most crops. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. If the soil in this unit is cultivated, a cover of grass or other vegetation protects the soil from erosion during the wet periods in winter. Christmas tree plantings need brush, weed, and rodent control and periodic shearing to ensure the growth of compact, well-shaped trees.

This unit is suited to the production of Douglas-fir. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 155. The potential production per acre is 9,840 cubic feet from an even-aged, fully stocked stand of trees 60 years old or 91,040 board feet (International rule, one-eighth-inch kerf) from an even-aged, fully stocked stand of trees 80 years old.

Surface methods of harvesting timber generally are suitable, but the soil may be compacted if it is moist when heavy equipment is used. Ripping skid trails and landing areas after logging helps to break up the compacted layer and improves seedling survival and growth. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Cuts and fills should be seeded or mulched.

Reforestation should be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees. Hand planting of nursery stock is usually necessary to establish or improve a stand. Douglas-fir is suitable for planting.

If this unit is used for recreational development, the main limitations are slow permeability, the clayey texture of the soil, and slope. Good drainage should be provided for paths and trails. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintaining adequate plant cover.

This unit is suited to homesite development. The deep cuts needed to provide essentially level building sites can expose bedrock. Roads for year-round use need heavy base rock. Wetness can be reduced by installing drain tile around footings.

This unit is poorly suited to septic tank absorption fields because of slope and depth to bedrock. In some areas of this unit where depth to bedrock is greater and that are less sloping, septic tank absorption fields may be suitable.

52B	Hazelair silty clay loam, 2 to 7 percent slopes Capability subclass IIIe

This moderately deep, moderately well drained soil is on convex foot slopes of the Coast and Cascade Ranges. It formed in colluvium overlying sedimentary rock. Areas are irregular in shape and are 5 to 100 acres or more in size. The vegetation in areas not cultivated is mainly Oregon white oak, poison-oak, Douglas-fir, ponderosa pine, Oregon ash, wild rose, and grasses. Elevation is 300–1,400 feet. The avg annual precipitation is 40–60 in, the avg annual air temperature is 50–54°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is very dark brown silty clay loam about 11 in thick. The subsoil is dark brown silty clay about 4 in thick. The substratum is dark brown and light olive brown, mottled clay about 21 in thick. Weathered bedrock is at a depth of 36 in. Depth to bedrock ranges from 20–40 in.

Included in this unit are small areas of Dixonville, Dupee, Panther, and Philomath soils. Included areas make up about 15% of the total acreage. The percentage varies from one area to another.

Permeability of this Hazelair soil is very slow. Available water capacity is about 4–7 in. Water supplying capacity is 18–22 in. Effective rooting depth is limited by a high water table that is at a depth of 1–2 feet from December to April. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for hay, pasture, small grain, and blackberries. Some areas are used as homesites.

If this unit is used for hay and pasture, the main limitations are the clayey surface layer, the seasonal high water table, very slow permeability, and restricted rooting depth. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from compaction and erosion. Fertilizer is

needed to ensure optimum growth of grasses and legumes. In most years, supplemental irrigation is also needed.

If this unit is used for cultivated crops, the main limitations are the clayey surface layer, wetness, and restricted rooting depth. The water table that builds up during the rainy period generally limits the suitability of this unit for deep-rooted crops. Tile systems are not efficient in lowering the water table because of the shallow depth to the claypan. Tile systems can be improved by installing them across the slope, which more efficiently intercepts water moving downslope above the claypan.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is a suitable method of applying water.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen; legumes respond to phosphorus, boron, sulfur, and lime; and vegetables and berries respond to nitrogen, phosphorus, and potassium.

If this unit is used for recreational development, the main limitations are wetness and slow permeability. Use is limited to picnic areas, paths, and trails during the of the year. Drainage should be provided for paths and trails.

This unit is poorly suited to homesite development. Drainage is needed if roads and building foundations are constructed. Cutbanks are not stable and are subject to slumping. Reinforced retaining walls with proper drainage are needed to minimize slumping.

If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Support and stability of buildings can be provided by placing footings below the claypan. Roads and streets require the maximum amount of base rock. Access roads should be designed to control surface runoff and help stabilize cut slopes. Landscaping plants that tolerate a seasonal high water table and droughtiness should be selected unless drainage and irrigation are provided.

78	McAlpin silty clay loam Capability subclass IIw

This deep, moderately well drained soil is on flood plains and alluvial fans. It formed in fine textured mixed alluvium. Slopes are 0–3%. Areas are elongated in shape and are 3–100 acres in size. The vegetation in areas not cultivated is mainly Douglas-fir, ponderosa pine, red alder, Oregon ash, shrubs, and grasses. Elevation is 300–1,000 feet. The avg annual precipitation is 40–60 in, the avg annual air temperature is 52–54°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is dark brown silty clay loam about 14 in thick. The upper 8 in of the subsoil is dark brown silty clay, and the lower 38 in is brown, mottled silty clay and clay.

Included in this unit are small areas of Abiqua and Waldo soils, Riverwash, and Fluvents. Included areas make up about 15% of the total acreage.

Permeability of this McAlpin soil is moderately slow. Available water capacity is about 8–20 in. Water supplying capacity is 18–24 in. Effective rooting depth is limited by a high water table that is at a depth of 2–3 feet from November to March. Runoff is slow, and the hazard of water erosion is slight. The soil is subject to rare periods of flooding.

This unit is used mainly for cultivated crops. It is also used as woodland and for wildlife habitat and recreation.

This unit is suited to cultivated crops. In summer, irrigation is required for maximum production of most crops. Sprinkler irrigation is a suitable method of applying water. Tile drainage on this unit improves productivity and facilitates management. Good outlets generally are available.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen; legumes respond to phosphorus, boron, sulfur, and lime; and vegetables and berries respond to nitrogen, phosphorus, and potassium.

If this unit is used for hay and pasture, proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion and compaction.

This unit is suited to the production of Douglas-fir. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 159. The potential production per acre is 10,140 cubic feet from an even-aged, fully stocked stand of trees 60 years old or 94,400 board feet (International rule, one-eighth-inch kerf) from an even-aged, fully stocked stand of trees 80 years old.

The main concerns in producing and harvesting timber are the susceptibility of the soil to compaction and plant competition. Limiting use of heavy equipment for thinning and harvesting to periods when the soil is dry helps to prevent compaction and to maintain the permeability and productivity of the soil. Ripping skid trails and landing areas after logging helps to break up the compacted layer. Undesirable plants prevent adequate natural or artificial reforestation unless site preparation and maintenance are intensive. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings.

If this unit is used for recreational development, the main limitations are wetness and clay content.

If this unit is used for homesite development, the main limitations are the moderately slow permeability, high shrink-swell potential of the clayey subsoil, and the hazard of flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Roads for year-round use need heavy base rock.

78	Noti loam Capability subclass IVw

This deep, poorly drained soil is in swales and drainageways on terraces. It formed in mixed alluvium. Slope is 0–3%. Areas are long and narrow or are irregular in shape. They are 3–100 acres or more in size. The vegetation in areas not cultivated is mainly Oregon ash, rose, hazelnut, wild blackberry, sedges, and grasses. Elevation is 300–800 ft. The avg annual

precipitation is 40–50 in, the avg annual air temperature is 52–54°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is very dark grayish brown loam about 9 in thick. The subsoil is grayish brown, mottled loam about 7 in thick. The upper part of the substratum is light olive gray fine sandy loam about 18 in thick, the next part is pale brown loamy sand about 10 in thick, and the lower part is variegated, highly consolidated very gravelly loamy sand to a depth of 60 in or more.

Included in this unit are small areas of Dayton, Holcomb, Linslaw, Natroy, and Wapato soils. Included areas make up about 15% of the total acreage.

Permeability of this Noti soil is slow. Available water capacity is about 4–7 in. Water supplying capacity is 17–22 in. Effective rooting depth is limited by a high water table that is at the surface to a depth of 1 ft from October to May. Runoff is very slow, and the hazard of water erosion is slight. The soil is frequently flooded for brief periods from October to May.

This unit is used mainly for pasture and hay. It is also used for grass seed, wildlife habitat, and recreation.

This unit is suited to hay and pasture. The main limitations are wetness, the seasonal high water table, and the hazard of flooding. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Only those hay and pasture plants that tolerate periodic inundation and a seasonal high water table are suitable for use in undrained areas. Excessive water on the surface can be removed by open drains. Tile drainage can be used to lower the water table if a suitable outlet is available.

Irrigation water can be applied by the sprinkler and flood methods. Water needs to be applied at a slow rate to prevent runoff.

Fertilizer is needed for optimum growth of grasses and legumes. Grain and grasses respond to nitrogen; legumes respond to phosphorus, sulfur, and lime. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion

121B	Salkum silty clay loam, 2 to 8 percent slopes Capability subclass IIe

This deep, well drained soil is on the higher lying, old alluvial and glacial outwash terraces. It formed in mixed alluvium derived from glacial outwash material. Areas are irregular in shape and are 5–400 acres or more in size. The vegetation in areas not cultivated is mainly Douglas-fir, Oregon white oak, rose, wild blackberry, poison-oak, and grasses. Elevation is 500–1,000 ft. The avg annual precipitation is about 40–60 in, the avg annual air temperature is 52–54°F, and the avg frost-free period is 165–210 days.

Typically, the surface layer is dark brown silty clay loam about 13 in thick. The subsoil is dark reddish brown and reddish brown clay about 36 in thick. The substratum to a depth of 60 in or more is variegated silty clay loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Bellpine, Hazelair, Linslaw, and McAlpin soils. Included areas make up about 10% of the total acreage.

Permeability of this Salkum soil is slow. Available water capacity is about 8–10 in. Water supplying capacity is 17–24 in. Effective rooting depth is more than 60 in. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for hay, pasture, small grain, berries, homesites, orchards, and timber production.

This unit is suited to grasses and orchard crops. In summer, irrigation is required for maximum production of most crops. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff.

This unit can be protected from erosion by planting cover crops and properly managing crop residue. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the tillage pan. Maintaining a high level of organic matter is essential to ensuring good tilth in the silty clay loam surface layer.

Response of crops to fertilizer is good if adequate moisture is present. Grain and grasses respond to nitrogen; legumes respond to phosphorus, boron, sulfur, and lime; and vegetables and berries respond to nitrogen, phosphorus, and potassium.

This unit is suited to hay and pasture. Use of lime, nitrogen, and phosphorus promotes good growth of forage plants. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion and compaction. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. In most years, supplemental irrigation is also needed.

This unit is suited to the production of Douglas-fir. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 145. The potential production per acre is 9,095 cubic feet from an even-aged, fully stocked stand of trees 60 years old or 82,000 board feet (International rule, one-eighth-inch kerf) from an even-aged, fully stocked stand of trees 80 years old.

The major management concerns are control of erosion and compaction of the soil if equipment is used when the soil is moist. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Ripping skid trails after logging helps to break up the compacted layer. Undesirable plants prevent adequate natural or artificial reforestation unless site preparation and maintenance are intensive. Reforestation can be accomplished by planting Douglas-fir seedlings.

This unit is suited to many varieties of Christmas trees.

This unit is suited to recreational development during the dry periods of the year. Slow permeability, the hazard of erosion, and the clayey, sticky surface layer are the main limitations for year-round use.

If this unit is used for homesite or urban development, the main limitations are the moderate shrink-swell potential, low soil strength, and slow permeability. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling and the low soil strength. Roads for year-round use need heavy base rock.

Erosion is a hazard in areas that are barren of vegetation. Only the part of the site that is used for construction should be disturbed. Adequate culverts and ditches should be maintained to control erosion and prevent waterlogging of roads. Seeding cutbanks helps to control erosion and the siltation of ditches.

If this unit is used for septic tank absorption fields, the limitation of slow permeability can be overcome in most areas by increasing the size of the absorption field.