South Slough
National Estuarine Research Reserve
Wasson Uplands Restoration Plan

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Charleston, Oregon
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1 Introduction

The Wasson Creek Watershed Project Area (PA) is 530 acres of forested uplands, palustrine wetlands, and remnant pasturelands within the South Slough of the Coos Estuary (Figure 1). The eastern half of the PA has been part of the South Slough National Estuarine Research Reserve (Reserve) since 1974, while the western portion of the PA was acquired by the Reserve in 2011. The entire Wasson PA is managed under the same management directives as all Reserve lands (ORS 273.553 through 273.558 and OAR 142-001 through 142-015); which are to maintain the integrity of the estuary, protect its natural dynamic processes, and preserve the area for long-term scientific and education uses.

This plan details upland ecological conditions and restoration activities for habitat restoration implementation in the PA. Restoration actions described here will be implemented to achieve site-specific restoration needs as well as Reserve-wide goals for landscape management. To inform this plan, an upland ecological inventory was conducted by collecting field data in 2015. The restoration actions detailed in this plan are based on an analysis of the site data and current restoration and ecological research.
Site-Specific Upland Goals Addressed in this Plan

- Conduct an inventory of upland ecological attributes in the Wasson PA, including tree species and general size, understory, and dead wood characteristics
- Prioritize upland stands in need of active restoration
- Develop stand-specific treatments to improve forest health and heterogeneity
- Incorporate the Wasson watershed into ongoing Port-Orford-cedar (*Chamaecyparis lawsoniana*) conservation actions
- Determine road/access needs for upper watershed restoration prescriptions and evaluate the potential for eliminating remnant logging roads
- Incorporate wildfire risk planning and identify strategies to support resilient ecosystems in the case of a fire disturbance
- Determine the potential for improving spawning habitat in Wasson Creek headwater tributaries

Reserve-Wide Goals & Objectives Addressed in this Plan

- Continue to build the ridgetop to estuary habitat restoration program at the Reserve
- Develop a ridgetop to estuary restoration plan for the Wasson Creek Watershed
- Assess and monitor habitats in the Coos Estuary in order to characterize conditions and changes in habitat use and availability
  - Increase public awareness of Reserve stewardship practices, habitat-related research, and habitat protection
  - Contribute to the scientific community in habitat restoration techniques
  - Evaluate, manage, and restore habitats and ecosystem processes

In addition to these site-specific and Reserve-wide goals, this plan will augment regional restoration and planning efforts such as the 2009 Upper Watershed Restoration Action Plan, the 2017-2022 Reserve Management Plan, and the 2010 Oregon Watershed Enhancement Board’s Strategic Plan.

The Wasson Uplands Restoration Plan is part of a larger planning effort to provide for holistic ridgetop to estuary restoration in the Wasson Creek Watershed. Together with the Wasson Creek Channel Design and the Wasson Creek Vegetation Restoration Plan, this plan functions to compose the ridgetop to estuary ecological restoration plan for the Wasson Creek Watershed.
2 Description of the Wasson Creek Project Area

Location
The Wasson Creek Watershed is located on the South Slough inlet of the Coos Estuary on the southern Oregon coast; near the fishing port of Charleston, Oregon. The watershed drains into Winchester Creek, the largest of the two main tributaries of the South Slough (Figure 2). The Wasson Project Area (PA) is approximately 530 acres and comprised primarily of upland forest (Table 1). Within Township 26S Range 14W, Sections 34 and 35; the center of the parcel is at approximately 43.16°N, 124.20°W.

Table 1: Location, size, and zoning determination of Wasson Project Area

<table>
<thead>
<tr>
<th>Township, Range and Section</th>
<th>T 26S, R 14W, S 34 &amp; 35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parcel Center Latitude / Longitude</td>
<td>43.16° N, 124.20° W</td>
</tr>
<tr>
<td>Total Acres</td>
<td>530</td>
</tr>
<tr>
<td>Acres of Forested Uplands</td>
<td>507</td>
</tr>
<tr>
<td>Zoning</td>
<td>Forest</td>
</tr>
</tbody>
</table>
Access and Use

The PA is in the southwestern corner of the South Slough Reserve and is bounded by Seven Devils Road and Hinch Road to the north, West Beaver Hill Road to the west, Winchester Creek to the east, and a forested ridgeline to the south (Figure 3). Remnant roads from previous timber harvests provide access into the PA from these established roads, but they are in varied states of functionality. Beginning near the confluence of Wasson Creek with Winchester Creek there is a 0.5-mile loop trail that receives moderate human use. The entire watershed is open to hunting.

Figure 3: Road access to the Wasson Project Area

Forest Conditions

Historically, the floodplain was composed of tidal and forested wetlands before conversion to pasture in the early 1900s. The uplands were once dominated by Sitka spruce, Port-Orford-cedar, and western hemlock, with heterogeneous stand structure and diverse understories. Successive timber harvests over the last century, without follow-up forest management (e.g. thinning), have caused the upland forests of the PA to become overly dense, closed canopy forests with few large trees and sparse understories.
Streams
The upland reaches of the Wasson Creek Watershed include numerous fish and non-fish bearing streams. Fish bearing streams support populations of several estuarine-dependent fish species such as sea-run cutthroat trout (*Oncorhynchus clarki clarki*), Pacific Lamprey (*Entosphenus tridentatus*) and Western book lamprey (*Lampetra planeri*) (Figure 4). This watershed has the potential of supporting coho salmon (*Oncorhynchus kisutch*) and winter steelhead (*Oncorhynchus mykiss*), which are both present in Winchester Creek.

![Figure 4: Fish bearing and non-fish bearing streams in the Wasson Project Area (red outline)](image)

Soils and Slope
Soils in the project area are comprised predominately of Templeton silt loam (Figure 5). These are deep, well drained soils present at benches, broad ridgetops and side slopes of mountains. These soils are characteristic of the western slopes of the Coast Range in the region. Slopes in the Wasson uplands range from flat to 75% or greater in some headwater regions. Information derived from digital elevation models shows there are several areas in the upper watershed of the PA that have a high likelihood of shallow landslides (Figure 6).
Appendix D.

Figure 5: Soils in the Wasson Project Area

Figure 6: High landslide hazard areas in the Wasson Project Area
3 Overview of Reserve Uplands

The Wasson Project Area (PA) is in the Sitka spruce zone; a variant of the Western hemlock coastal forest type (Franklin and Dyrness, 1973). The Sitka spruce zone is characterized by its proximity to the ocean, with significant moisture delivered to uplands in the form of summer fog. Plant communities are typical of nutrient-poor, well-drained soils (Franklin and Dyrness, 1973; Schultz, 1990). Disturbance regimes in the Sitka spruce zone are characterized by infrequent stand replacing fires on intervals ranging from 200-1,000 years (Agee, 1993) and patch mortality caused by windthrow (Harcombe, 1986).

The environmental setting of the South Slough Reserve and its uplands is well summarized in other documents, namely the Site Profile of the South Slough National Estuarine Research Reserve (Rumrill, 2006) and the Upper Watershed Restoration Action Plan (Robinson, 2009). While the Reserve has acquired over 1,000 acres (including part of the PA) since these plans were completed, the overall upland assessments are still applicable and now augmented by this plan.

Upland forests comprise ~77% of the Reserve and have not been actively managed since the inception of the Reserve in 1974 (Cornu et al., 2012; Graybill, 2006). Prior to 1974, the uplands experienced significant overstory removal (Carey et al., 1991), with virtually all areas having been harvested at least once and up to three times in the past 100 years. Most uplands acquired since 2011 are less than 30 years old. Many stands were homogenously replanted, especially those acquired since 2011, and are consequently densely stocked. Overall, the uplands in the Reserve are dominated by 15-40-year-old mixed conifer trees with brushy slopes, and there are relatively few isolated stands greater than 80 years old (Figure 7). No unmanaged old growth stands remain (Graybill, 2006; Rumrill, 2006). Much of the upland forests in the Reserve need restoration thinning due to the density of remnant plantations (Sheridan, 2001).

The management directive of the Reserve is to develop late-seral stage forest habitat in the uplands (Robinson, 2009). In the Sitka spruce zone, late-seral habitats have several key components: high numbers of large trees, elevated levels of horizontal and vertical heterogeneity, foliage distributed along the boles of large trees, well-developed understory shrub and herb communities, one or more codominant tree layers, mortality caused gaps in the canopy and substantial amounts of snags and downed woody debris (Deal, 2002; Franklin et al., 2002; Muir et al., 2002; Peet and Christensen, 1987). This plan is focused on prioritizing stands for restoration actions that will promote the development of these desired forest conditions.
4 Methods

Stand Delineation
An initial stand delineation was done using LiDAR data, Google Earth aerial imagery, and data from field assessments in the PA conducted in 2008 and preliminary data collected in early 2015 as a pilot study for this project. The imagery and LiDAR were used to characterize canopy height and age of last harvest, resulting in the delineation of 21 forest stands (Figure 8).

Forest Inventory and Baseline Data Collection
A forest inventory was conducted in the PA from May through September 2015. Data were collected in 207 plots (Figure 9). Each plot was 0.05 acre with a fixed radius of 26.3 feet. Plots were spaced evenly across the PA, with one plot per 2.5 acres. In each plot, trees were recorded by species, diameter at breast height (down to 1 inch), height, position in canopy, and percent live crown.

Snag data (diameter, height, decay) was collected in each plot, along with percent cover of the top three dominating understory species. Downed woody debris was noted along a 100’ transect from plot center, directionally to the next plot. Downed woody debris diameter, length and decay class were noted.

Figure 8: Delineated forest stands in Wasson Project Area
The total number of trees per acre (TPA) was calculated for each stand as follows:

\[(0.05 \text{ acre}) \times \text{number of plots in stand} = \text{total area sampled} \]
\[\frac{\text{Number of trees in area sampled}}{\text{total area sampled}} = \text{Trees Per Acre (TPA)}\]

**Restoration Prioritization**

Data from the forest inventory were used to characterize the overall diversity and composition of each upland forest stand in the PA. Stands were then ranked by TPA (descending), average DBH (ascending), and maximum DBH (ascending). Land use history and aerial imagery were used to estimate the age of each stand. These parameters were then used to rank the priority level (high, mid, low) for each stand. Stands in riparian areas were classified as Riparian Management Areas and therefore excluded from prioritization. In general, young, densely stocked stands with a high TPA and relatively small DBH were classified as high priority.

![Forest inventory plots in the Wasson Project Area](image)
Appendix D.

**Upland Forest Modeling**

The United States Forest Service Forest Vegetation Simulator (FVS) was used to model forest thinning scenarios to evaluate different thinning prescriptions (Figure 10). Data from the forest inventory were used to inform the model of current average trees per acre, species composition, and size of stand (acreage). General constraints were placed on the model to not cut big leaf maple or all of one species and to reduce levels of cascara.

Three scenarios were modeled:

1. No Action
2. Thin from below to 250 trees per acre, no species constraints (out to the year 2050)
3. Thin to 100 trees per acres, focusing on Douglas-fir removal (out to the year 2050)

*Figure 10: Example of Forest Vegetation Simulator modeling for Stand 2*
5 Current Ecological Conditions of Wasson Project Area

Dominant Overstory and Understory Species
The overstory plant community, across the Wasson Project Area (PA), is largely occupied by Sitka spruce and Douglas-fir. The remaining overstory community consists largely of cascara, Port-Orford-cedar and western hemlock, with very little representation of western red cedar and willow (Figure 11). The dominant understory species (incl. salmonberry, red elderberry, salal, evergreen huckleberry and sword fern) on average cover around 30% of the survey area (Figure 12).
Stand Canopy Characteristics
One indicator of tree vigor is the percentage of tree height occupied by live crown (percent live crown). Greater percent live crown values indicate greater vigor. Average percent live crown in the PA ranged from 17-65% per stand, with over half of the stands averaging <30% (Figure 13).

![Figure 13: Average percent live crown by stand in the Wasson Project Area](image1)

Tree Size: Diameter at Breast Height (DBH)
One measure of tree size is the stem diameter at 4.5-feet (diameter at breast height or DBH). Maximum DBH per stand ranged from 6.5-in (stand 4) to 72.1-in (stand 18), with 51% of the plots in the 12.1-24-in range (Figure 14). For 50% of the plots average DBH was in the 5.1-10-in range (Figure 15 & 16).

![Figure 14: Maximum tree DBH at each survey plot in the Wasson Project Area](image2)
Appendix D.

Figure 15: Average tree DBH at each survey plot in the Wasson Project Area

Figure 16: Average DBH in inches of stands in the Wasson Project Area
Appendix D.

**Age of Stand**

Approximate age of stands ranged from 15 to over 50 years (Figure 17). Older stands occupy the eastern portion of the PA, which has been under Reserve management since its inception.

![Figure 17: Estimated age of stands in the Wasson Project Area](image1)

**Density: Trees Per Acre (TPA)**

High tree density dominate the western portion of the PA, with stand averages up to 395 TPA (Figure 18&19). As stem diameters <4-in DBH were excluded from analysis some stands may have much greater densities.

![Figure 18: Trees per acre at each survey plot in the Wasson Project Area](image2)
6 Case for Variable Density Thinning (Drop and Leave)

The stands targeted for restoration actions in the Wasson Watershed were planted for timber production - with high densities of merchantable conifer species. These stands were planted densely with the assumption that thinning would take place before the stand was harvested. It is clear based on field surveys that thinning is needed not only to release the planted trees from being overstocked, but to reintroduce heterogeneity, promote biodiversity and increase the overall ecological function of the landscape.

Timber management in the Pacific Northwest has simplified forest ecosystems since the arrival of Europeans (Franklin, 1993a, 1993b; Carey et al., 1999a, b). This shift has led to the rise in exotic species (Hobbs and Humphries, 1995; Halpern et al., 1999; Thysell and Carey, 2001), an imbalance in biotic communities (Aubry, 2000; Carey, 2000; Haveri and Carey 2000; Wilson and Carey 2000; Carey and Harrington, 2001), reduced prey availability for predators (Carey et al., 1992) and poorly functioning food webs (Carey et al., 1996, 1999a, 2002; Colgan et al., 1999). Forest stands managed exclusively for timber production have also been shown to lack various structural attributes associated with late-seral forests such as large canopy trees, a diversity of tree size-classes, a lack of coarse woody debris such as snags and downed wood, variation in crown structure and a shade-tolerant mid story (Franklin and Spies, 1991; Spies, 2004; Zenner, 2004; Bauhus et al., 2009).

The management direction of the South Slough Reserve is to develop late-successional forest ecosystems (Robinson, 2009). To this end, forest management can promote the biocomplexity associated with these ecosystems (Carey et al., 1999a, b) and promote biodiversity on the landscape, the fundamental guiding principle of ecologically sound forest practices (Larsson and Danell, 2001; Lindenmayer and Franklin, 2002). Generally, forest management practices that restore structural
heterogeneity and species diversity will help the Reserve meet its objectives for the development of late-seral forests on the Reserve.

Variable density thinning is an emerging forest practice that restores heterogeneity in dense second growth stands by creating “skips and gaps” within a stand. By creating more availability to resources such as light, water, nutrients and space to understory vegetation, this thinning method reintroduces the variability associated with old-growth forests into a regenerating stand (Carey, 2003; Carey and Johnson, 1995; Carey et al., 1999a; Comfort et al., 2010). “Skips” are patches that receive no treatment; “gaps” are areas that are cleared of overstory trees. Generally, a matrix of lightly thinned forest is left between skips and gaps that comprises much of the remainder of the stand (Figure 20).

This thinning practice has been applied in a wide variety of applications in the Olympic Peninsula since the 1990s. The US Forest Service has found that the practice was easy to apply, resulted in insignificant damage to residual trees, induced a positive response in tree growth rates of all size classes in as little as five years and increased the variation in plant cover and tree regeneration (Harrington, 2009). To mitigate risk to upland forests from wind damage, it is recommended that gaps not be created in wind-prone areas such as ridgetops. Additionally, created gaps should be smaller than the height of the tree canopy to avoid wind funneling.

Figure 20: Example of variable density thin. Source: Leslie Brody, USFS

7 Restoration Actions for the Wasson Uplands by Stand

Stand Prioritization and Prescriptions
Stands were prioritized for restoration based on the number trees per acre (TPA), tree size, and age of stand (Table 2 & Figure 21). The densest stands (i.e. highest TPA) and smallest trees (i.e. lowest DBH) were identified as the highest priority stands for thinning. Stands in riparian areas were not ranked and left as Riparian Management Areas (RMAs).
Table 2: Ranking and prioritization of forest stands in the Wasson Project Area. TPA=Trees Per Acre, DBH = Diameter at Breast Height and RMA = Riparian Management Area.

<table>
<thead>
<tr>
<th>Stand Rankings - Priority Stands with Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
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<td>20</td>
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<tr>
<td>21</td>
</tr>
</tbody>
</table>

Figure 21: Prioritization of numbered forest stands in the Wasson Project Area
Restoration prescriptions for the high and mid priority stands were determined based on existing TPA, species diversity, and composition. Modeling results indicated most high and mid priority stands should be initially thinned to 150 TPA, with some stands requiring a secondary thinning 20-25 years later. Stand descriptions and detailed prescriptions are included in subsequent pages.

Planting and regeneration
Variable density thinning allows for the natural recruitment of species already within the system, it also provides an opportunity to facilitate recruitment of species that are underrepresented, have been disproportionately impacted (e.g. by disease) or that are culturally important. Several species, including the disease resistant Port-Orford-cedar, are recommended for planting in thinned areas and gaps following treatment (Table 3).

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port-Orford-cedar</td>
<td><em>Chaemecyparis lawsoniana</em></td>
<td>Drier sites</td>
</tr>
<tr>
<td>Western red cedar</td>
<td><em>Thuja plicata</em></td>
<td>Moist to wet seepage and alluvial</td>
</tr>
<tr>
<td>Big leaf maple</td>
<td><em>Acer macrophyllum</em></td>
<td>Dry to moist gaps at lower elevations</td>
</tr>
<tr>
<td>Vine maple</td>
<td><em>A. circinatum</em></td>
<td>Moist to wet forest gaps</td>
</tr>
<tr>
<td>Beargrass</td>
<td><em>Xerophyllum tenax</em></td>
<td>Well drained, sunny hillside, dappled light</td>
</tr>
<tr>
<td>Giant chain fern</td>
<td><em>Woodwardia fimbriata</em></td>
<td>Moist areas, springs</td>
</tr>
<tr>
<td>Beaked hazelnut</td>
<td><em>Corylus cornuta</em></td>
<td>Moist but well drained gaps and stream edges</td>
</tr>
<tr>
<td>Black gooseberry</td>
<td><em>Ribes lacustre</em></td>
<td>Stream banks or forested slopes, rotting wood</td>
</tr>
<tr>
<td>Trailing black current</td>
<td><em>Ribes laxiflorum</em></td>
<td>Moist forest gaps at low to mid elevations</td>
</tr>
</tbody>
</table>

Wood and slash management
The Oregon Administrative Rules, that govern the South Slough Reserve, prohibit commercial timber harvesting; therefore, trees felled during restoration thinning are unable to be sold. Several factors are considered when determining the fate of materials from the thinning prescriptions, including fuel and wildfire risk, habitat value, nutrient cycling, carbon sequestration and output, and use within the stream restoration component. Materials from the thinning will be processed in the following ways:

**Lop and scatter:** trees limbed, to accelerate decay, and left in place. Due to fuel loading any material left on site will be spaced to avoid continuous high fuel areas

**Habitat piles:** trees limbed and piled within gaps

**Biochar:** use biochar kilns to lock up carbon, products can be scattered on site or used in wetland restoration plantings

**Used in stream restoration:** medium-large trees (>12” DBH and >40’ length) can be used as large wood structures, while smaller trees (<8” DBH) can be used for nurse cribs and beaver dam analogs

**Mulching and chipping:** Where on ground machinery is accessible smaller trees and limbs can be chipped and scattered on site. To reduce fire risk chip lays will not exceed 2” depth

**Burn piles:** Burn piles will be used only when necessary and limited to fine fuels

**Stewardship contracting:** offset costs by trading wood for services. This will be limited by availability of merchantable trees and will depend on regulatory allowances.
Mid and high priority stands

**Stand 2 – 56.8 Acres, High Priority (Figure 22)**

This stand was clear cut in approximately 1994. The stand of replanted Douglas-fir and likely naturally regenerated Sitka spruce (Figure 23) is now 20-25 years old, with an average DBH of 8” and 339 TPA. There is a predominantly northern and western aspect, with a northeastern aspect on the east side of the stand. A narrow, steep drainage is on the west of the stand, which will need to be considered during thinning (Figure 6). Further buffering of the two narrow drainages on the east side of the stand is also recommended. Remnant logging roads exist along the southern and eastern boundaries with one remnant spur into the center of the stand which may be reopened temporarily for operational use (Figure 3). Stewardship contracting may be an option due to the ease of access and merchantability of trees but a stand exam to establish volume estimates in treatment areas would be needed to determine the viability of the project.

**Stand 2 – Description**

![Figure 22: Location of stand 2 within Wasson project area](image)

![Figure 23: Species composition of trees in Stand 2. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = willow, TSHE = western hemlock](image)
Appendix D.

Stand 2 – Prescription

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 6 acres total), ½-acre to ¼-acre gaps (up to 9 acres total) and a thinning matrix between the skips and gaps. Gaps should be located strategically to minimize wind damage (i.e. not on ridgetops) where possible and skips could include areas within the steep ravine. Treatments will preferentially remove Douglas-fir, leave trees over 12” DBH and leave allsnags over 12” DBH. Underplanting of disease-resistant Port-Orford-cedar seedlings in thinned areas and gaps following treatment is encouraged, especially in relatively flat areas or in higher elevations. In areas of higher moisture, underplanting of western red cedar is recommended. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 15-20 years. Re-entry will likely involve commercially viable thinning.

Stand 3 – 52.4 Acres, High Priority (Figure 24)

This stand was clear cut in approximately 2000. The stand of replanted Douglas fir and likely naturally regenerated Sitka spruce is now 17-20 years old, with an average DBH of 8” and 294 trees per acre. There are many small (<4” DBH) Cascara (Rhamnus purshiana) in the stand which are not expected to persist following treatment (Figure 25). There is a predominantly southern aspect. Two narrow steep drainages in the center of the stand and one creek on the west side of the stand will need to be buffered to mitigatedebris flow risk following thinning (Figure 6). There are no remnant roads into this stand, access will be by foot. This stand is adjacent to the Spruce Ranch and shop buildings, making it an attractive option for recreation or education development such as an interpretive trail to demonstrate restoration forestry practices at the South Slough Reserve. Based on soil type, aspect, and accessibility this stand may be suitable for establishing a population of beargrass (Xerophyllum tenax).
Appendix D.

Figure 25: Species composition of trees in Stand 3. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara

**Stand 3 – Prescription**

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 6 acres total), ½-acre to ¼-acre gaps (up to 9 acres total) and a thinning matrix between the skips and gaps. Gaps should be located strategically to minimize wind damage (i.e. not on ridgetops) where possible. Treatments will preferentially remove Douglas fir, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar seedlings in thinned areas and gaps following treatment is encouraged. This stand should be assessed for planting beargrass in a gap with dappled sunlight, potentially amongst sparse cascara trees. Fire breaks and education trails should be considered for this site. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 15-20 years. Re-entry will likely involve commercially viable thinning.

**Stand 10 – 39.2 Acres, High Priority (Figure 26)**

Figure 26: Location of stand 10 within Wasson project area
Appendix D.

Stand 10 – Description

This stand was clear cut in approximately 1994. The stand of replanted Douglas fir with lesser amounts of native tree regeneration mixed throughout is now 20-25 years old, with an average DBH of 9” and 395 trees per acre. There are many small (<4” DBH) Cascara in the stand which are not expected to persist following treatment (Figure 27). There is a predominantly northwestern aspect, with a small portion of southeast segment on the northern end of the stand. There is a small stream running through the middle of the unit that may need to be buffered to mitigate debris flow risk following thinning, as well as most of the northern section of the unit (Figure 6). There is a remnant logging road running down the ridge on the southern boundary of this unit which may be temporarily reopened for operational access (Figure 3). Stewardship contracting may be an option due to the ease of access and merchantability of trees but a stand exam to establish volume estimates in treatment areas would be needed to determine the viability of the project. Re-entry will likely involve commercially viable thinning.

Figure 27: Species composition of trees in Stand 10. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = willow, TSHE = western hemlock

Stand 10 – Prescription

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 5 acres total), ½-acre to ¼-acre gaps (up to 6 acres total) and a thinning matrix between the skips and gaps. Gaps should be located strategically to minimize wind damage (i.e. not on ridgetops) where possible. Treatments will preferentially remove Douglas fir, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar in drier areas and western red cedar in wetter areas is recommended. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 15-20 years.
**Stand 7 – 4.83 Acres, Mid Priority (Figure 28)**

![Figure 28: Location of stand 7 within Wasson project area](image)

**Stand 7 - Description**

This stand was clear cut in approximately 1994. The stand is mixed with replanted Douglas fir and native tree regeneration ranging from 20-60 years old, with an average DBH of 7” and 300 trees per acre. There are many small (<4” DBH) Cascara in the stand which are not expected to persist following treatment (Figure 29). There is a very slight northeastern aspect on the eastern edge of the stand, but otherwise it is relatively flat. There is a short remnant spur road into southern boundary of this unit which may be temporarily reopened for operational access (Figure 3). Stewardship contracting may be an option due to the ease of access and merchantability of trees but a stand exam to establish volume estimates in treatment areas would be needed to determine the viability of the project. Re-entry will likely involve commercially viable thinning.

![Figure 29: Species composition of trees in Stand 7. PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = willow, TSHE = western hemlock](image)
Appendix D.

Stand 7 – Prescription

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing one ½-acre skip, two ¼-acre gaps and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of creating skips within the stand itself. Treatments will preferentially remove Douglas fir, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar is encouraged. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 15-20 years.

Stand 6 – 20.0 Acres, Mid Priority (Figure 30)

![Figure 30: Location of stand 6 within Wasson project area](image)

Stand 6 – Description

This stand was clear cut in approximately 2003. This 15-year-old stand is mixed with replanted Sitka spruce and diverse native tree regeneration (Figure 31), with an average DBH of 8” and 260 trees per acre. Our analysis excluded saplings under 4” in calculations of trees per acre – but due to the age of this stand there will likely need to be thinning of the many young trees to accelerate development of late seral conditions and avoid the stand developing into a dense plantation. The southwestern portion of the stand contains steep slopes along the headwaters of two small streams (Figure 3) and may need to be buffered to mitigate debris flow risk following thinning (Figure 6). There is a remnant logging road through the middle of the unit which may be temporarily reopened for operational access (Figure 3).
Appendix D.

Stand 6 – Prescription

Due to age of stand and ease of access, this will be one of the first stands to implement forest management. On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 2 acres total), ½-acre to ¼-acre gaps (up to 3 acres total) and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of or in addition to creating skips within the stand itself. Treatments will preferentially remove Sitka spruce, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar is encouraged. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 20-25 years.

Stand 11 – 54.8 Acres, Mid Priority (Figure 32)

Figure 32: Location of stand 11 within Wasson project area


Appendix D.

Stand 11 – Description

This stand was clear cut in approximately 1994. This 20 to 25-year-old stand is mixed with replanted Sitka spruce and Douglas fir and limited native tree regeneration (Figure 33), with an average DBH of 10” and 347 trees per acre. The center of the stand is on a bench, with steep slopes falling off to the west, south and east sides of the stand. The southwestern portion of the stand and the drainage in the northeastern portion of the stands may need to be buffered to mitigate debris flow risk following thinning (Figure 6). There is a remnant logging road through the middle of the unit which may be temporarily reopened for operational access (Figure 3). Stewardship contracting may be an option due to the ease of access and merchantability of trees but a stand exam to establish volume estimates in treatment areas would be needed to determine the viability of the project. Re-entry will likely involve commercially viable thinning.

![Species Composition Chart]

Figure 33: Species composition of trees in Stand 11. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, THPL = western red cedar, TSHE = western hemlock

Stand 11 – Prescription

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 6 acres total), ½-acre to ¼-acre gaps (up to 8 acres total) and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of or in addition to creating skips within the stand itself. Treatments will preferentially remove Sitka spruce, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar in drier areas and western red cedar in wetter areas is recommended. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 20-25 years.
Appendix D.

Stand 5 – 15.8 Acres, Mid Priority (Figure 34)

Stand 5 – Description

This stand was clear cut in approximately 2003. This 15-year-old stand is mixed with replanted Sitka spruce and diverse native tree regeneration (Figure 35), with an average DBH of 7.5” and 335 trees per acre. Our analysis excluded saplings under 4” in calculations of trees per acre – but due to the age of this stand there will likely need to be thinning of the many young trees to accelerate development of late seral conditions and avoid the stand developing into a dense plantation. The seasonal stream along the eastern boundary of the stand and the steep slopes in the northeastern area of the stand will need to be considered during thinning (Figure 6). Most of the stand has a southeastern aspect. There is a remnant logging road along the western boundary of the unit which may be temporarily reopened for operational access (Figure 3).

Figure 35: Species composition of trees in Stand 5. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, THPL = western red cedar, TSHE = western hemlock
Appendix D.

Stand 5 – Prescription

Due to age of stand and ease of access, this will be one of the first stands to implement forest management. On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 2 acres total), ½-acre to ¼-acre gaps (up to 3 acres total) and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of or in addition to creating skips within the stand itself. Treatments will preferentially remove Sitka spruce, leave trees over 12” DBH and leave all snags over 10” DBH. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 20-25 years.

Stand 4 – 9.2 Acres, Mid Priority (Figure 36)

Figure 36: Location of stand 4 within Wasson project area

Stand 4 – Description

This stand was clear cut in approximately 2003. This 15-year-old stand is mixed with replanted Sitka spruce and diverse native tree regeneration (Figure 37), with an average DBH of 5” and 140 trees per acre. Our analysis excluded saplings under 4” in calculations of trees per acre – but due to the age of this stand there will likely need to be thinning of the many young trees to accelerate development of late seral conditions and avoid the stand developing into a dense plantation. The stand is flat and has very low risk of debris flow following treatment (Figure 6). There is a remnant logging road along the eastern boundary of the unit which may be temporarily reopened for operational access (Figure 3). This stand has easy access and would make a good location to develop recreational or educational resources such as interpretive signs and trails to demonstrate restoration forestry practices at South Slough.
Appendix D.

Figure 37: Species composition of trees in Stand 4. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = willow, TSHE = western hemlock

Stand 4 – Prescription

Due to age of stand and ease of access, this will be one of the first stands to implement forest management. On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing a 1-acre skip, two ¾-acre gaps and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of or in addition to creating skips within the stand itself. Treatments will preferentially remove Sitka spruce, leave trees over 12” DBH and leave all snags over 10” DBH. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 20-25 years.

Stand 9 – 34.8 Acres, Mid Priority (Figure 38)

Figure 38: Stand 9 within Wasson project area

Stand 9 – Description

This stand was clear cut in approximately 1994. This 20 to 25-year-old stand is mixed with replanted Sitka spruce and Douglas fir and limited but diverse native tree regeneration (Figure 39), with an average DBH of 8” and 316 trees per acre. The aspect is northern with two steep drainages making up the middle of the stand (Figure 3), parts of which will need to be buffered to mitigate debris flow risk following thinning (Figure 6). There are three short spur roads reaching to the top of the ridge in the middle of the stand which may be temporarily reopened for operational access (Figure 3). Stewardship
contracting may be an option due to the ease of access and merchantability of trees but a stand exam to establish volume estimates in treatment areas would be needed to determine the viability of the project. Re-entry will likely involve commercially viable thinning.

![Species composition of trees in Stand 9. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = willow, TSHE = western hemlock](image)

**Stand 9 – Prescription**

On the initial entry, thin to 150 trees per acre (17 ft spacing between leave trees), utilizing ½-acre to 1-acre skips (up to 4 acres total), ½-acre to ¼-acre gaps (up to 6 acres total) and a thinning matrix between the skips and gaps. Due to the proximity to West Beaver Hill Road, a 100 ft buffer strip may be placed along the road instead of or in addition to creating skips within the stand itself. Treatments will preferentially remove Sitka spruce, leave trees over 12” DBH and leave all snags over 10” DBH. Underplanting of disease-resistant Port-Orford-cedar in drier areas and western red cedar in wetter areas is recommended. Restoration actions and timing for a second entry should be determined with follow-up monitoring, but further thinning to roughly 70 TPA (25 ft spacing) and creation of snags and downed woody debris will likely be needed in 20-25 years.

**Low priority stands**

**Stand 19 – 23.9 Acres, Low Priority**

Stand 19 was harvested prior to 1974 and is currently mixed conifer with 133 TPA which (Figure 40). Survey data is based on 11 plots of data. Comprises a flatter area above drainage on the north side of the Wasson Watershed, while the main component of the stand is predominantly an eastern aspect and sloped. The northeastern tip of the stand joins up with Hinch Road, which provides good access to the stand.

![Stand 19 location and species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)
Appendix D.

Stand could be thinned for demonstration purposes. Remove up to 20% of conifer trees (down to ~150/acre, considering cascara component). Leave all trees over 20” DBH and all snags over 10” DBH. Cable operation likely needed in steep drainages; creation of 12’ corridors needed for extraction, with minimum spacing of 150’. Merchantable wood could be used for stewardship contracting. Skips in patches of larger trees (3 acres remain untouched) and gaps in densest areas (total not to exceed 3.5 acres).

Stand 20 – 35.9 Acres, Low Priority
Stand 20 was harvested prior to 1974 and is currently mixed conifer with 296 TPA which (Figure 41). Survey data is based on 12 plots of data. This stand is relatively flat and includes the head of multiple smaller creeks that drain into the northern part of the Wasson drainage. Hinch Road borders the stand to the north and provides good access. Generally, a southern aspect.

![Figure 41: a) Stand 20 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)

Stand 20 – Prescription
Stand could be thinned for demonstration purposes. Remove up to 45% of trees (down to ~200/acre), half in the 5-12” DBH class, half in the 12-24” DBH class. Leave all snags over 10” DBH. Cable operation likely needed in steep drainages; creation of corridors needed for extraction. Merchantable wood may be used for stewardship contracting. Skips should be located in patches of larger trees (4 acres remain untouched) and gaps in densest areas (total not to exceed 5.5 acres). Port-Orford-cedar thickets are present.

Stand 15 – 12.1 Acres, Low Priority
Stand 15 was harvested prior to 1974 and is currently mixed conifer with 183 TPA which (Figure 42). Survey data is based on 7 plots of data.

![Figure 42: a) Stand 15 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, SALIX = Willow, TSHE = western hemlock](image)
**Stand 15 – Prescription**

Stands 15 and 16, will supply large wood to the stream restoration component of the project (Appendix B). Approximately 300 pieces of large wood (12-16” DBH and 40-60’ long) will be extracted across both stands. Small corridors, maximum width 12’ with minimum spacing of 150’, will be used to extract trees with minimal impact using a yarder and cable system. Seeps and wet drainages will be considered for planting giant chain fern.

**Stand 16 – 5.0 Acres, Low Priority**

Stand 16 was harvested prior to 1974 and is currently mixed conifer with 230 TPA which (Figure 43). Survey data is based on 4 plots of data.

![Figure 43: a) Stand 16 location and b) species composition. CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)

**Stand 16 – Prescription**

Stands 15 and 16, will supply large wood to the stream restoration component of the project (Appendix B). Approximately 300 pieces of large wood (12-16” DBH and 40-60’ long) will be extracted across both stands. Small corridors, maximum width 12’ and minimum spacing of 150’, will be used to extract trees with minimal impact using a yarder and cable system. Seeps and wet drainages will be considered for planting giant chain fern.
Stand 14 – 11.1 Acres, Low Priority
Stand 14 was harvested prior to 1974 and is currently mixed conifer with 124 TPA which (Figure 45). Survey data is based on 5 plots of data.

![Figure 45: a) Stand 14 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)

Leave stands

Stand 13 – 22.5 Acres, Leave
Stand 13 was harvested prior to 1974 and is currently mixed conifer with 160 TPA which (Figure 44). Survey data is based on 8 plots of data.

![Figure 44: a) Stand 13 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)

Stand 17 – 10.9 Acres, Leave
Stand 17 was harvested prior to 1974 and is currently mixed conifer with 185 TPA which (Figure 46). Survey data is based on 4 plots of data.

![Figure 46: a) Stand 17 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock](image)

Stand 12 – 13.2 Acres, Leave
Stand 12 was harvested prior to 1974 and is currently mixed conifer with 224 TPA which (Figure 47). Survey
Appendix D.

data is based on 5 plots of data.

Figure 47: a) Stand 12 location and b) species composition. ALRU = red alder, PISI = Sitka spruce, THPL = western red cedar
**Appendix D.**

**Stand 8 – 10.0 Acres, Leave – Riparian Management Area**

Stand 8 was harvested prior to 1994, likely left as buffer for ~1994 harvests, and currently has 164 TPA (Figure 48). Located deep in the lower parts of the upper watershed this stand buffers Wasson creek on both the north and the south (dual aspect based on side of creek). Not likely to need or be accessed for active management. Five plots were surveyed in this stand.

![figure 48](image)

*Figure 48: a) Stand 8 location and b) species composition. ALRU = red alder, PISI = Sitka spruce, PSME = Douglas-fir, THPL = western red cedar*

**Stand 1 – 40.9 Acres, Leave – Riparian Management Area**

Stand 1 was harvested prior to 1994, probably older than 1974 and consists of a relatively flat square stand of hardwoods (149 TPA; Figure 49) that borders Wasson Creek on both sides. Crosses Wasson Creek and consequently includes both northern and southern aspects. The remnant logging road, runs from the ridgeline through stand 2 accesses the southeast corner of the stand. Sixteen plots were surveyed in this stand.

![figure 49](image)

*Figure 49: a) Stand 1 location and b) species composition. ALRU = red alder, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, TSHE = western hemlock*

**Stand 18 – 27.0 Acres, Leave – Riparian Management Area**

Stand 18 was harvested prior to 1974 and is currently mixed conifer with 147 TPA which (Figure 50). Survey data is based on 11 plots of data.

![figure 50](image)

*Figure 50: a) Stand 18 location and b) species composition. ALRU = red alder, CHLA = Port-Orford-cedar, PISI = Sitka spruce, PSME = Douglas-fir, RHPU = Cascara, THPL = western red cedar, TSHE = western hemlock*
Appendix D.

Stand 21 – 3.4 Acres, Leave – Riparian Management Area
This small stand was harvested prior to 1974 and is currently dominated by Sitka spruce with 80 TPA which (Figure 51). Survey data is based on a single plot of data.

Figure 51: a) Stand 21 location and b) species composition. PISI = Sitka spruce
8 Literature Cited


Harcombe, P.A. 1986. Stand Development in a 130 year old Spruce-Hemlock Forest Based on Age Structure and 50 Years of Mortality Data. *For. Ecol. and Manage.* 14, 41-58


## Appendix D.

### 9 Supplementary Information A – Species List

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<th>Latin Name</th>
<th>Abbreviated Latin</th>
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