Douglas-fir Pre-commercial Thin

NORTHWEST NATURAL RESOURCE GROUP

Site Summary

Stand type	Douglas-fir plantation
Location	Chehalis, WA
Soils	Prather Silty Clay Loam Site Class II Site Index 120 (DF)
Aspect	Flat
Elevation	500’

Treatment Variables

Design	Three 2.0-acre treatment sites. Eight 1/20th-acre plots per site.
Type of labor	Four-person crew with chainsaws
Invasive species	Himalayan blackberry, English holly
Other species	Western hemlock, bigleaf maple, red alder, grand fir, western red cedar.

Funding for this project was provided by the USDA’s Western Sustainable Agriculture and Research Education (SARE) program.

SARE Sustainable Agriculture Research & Education

STAND DESCRIPTION

This project was implemented in a 15 year old Douglas-fir plantation that was established in 2004 following the final harvest of the previous forest. The Douglas-fir were planted at an unconventionally high density of 600 TPA in order to rapidly colonize the site. Survival was high across the stand, and consequently the stocking density prior to pre-commercial thinning ranged from 340—720 TPA. Natural regeneration of other tree species, including maple, alder, and other conifer species, factored into this high stocking density. Diameters of the fir at breast height (DBH) ranged from 4”-8”, averaging 5”-6”. Live crowns across most of the dominant and co-dominant trees exceeded 40%, but were quickly diminishing. Storm damage, resulting in forked or broken tops, affected approximately 15% of the trees. Himalayan blackberry was present in small gaps and along forest edges. English holly was common throughout the understory.

Species Per Acre
Pre-treatment, 2020

Site	DF	RC	PP	WH	GF	BM	RA	CA	All
1	505	0	7	3	0	25	0	0	540
2	488	3	3	0	3	20	35	0	552
3	338	0	0	0	0	0	8		446

DOUGLAS-FIR PRE-COMMERCIAL THIN

TREATMENT GOALS

The primary objective of the thinning treatments was to improve the growth of the most dominant and highest timber quality trees. A secondary objective was to conserve biodiversity and improve climate resilience by retaining trees of all species present in the stand, in particular cedar, maple, and pine, as these are drought tolerant species.

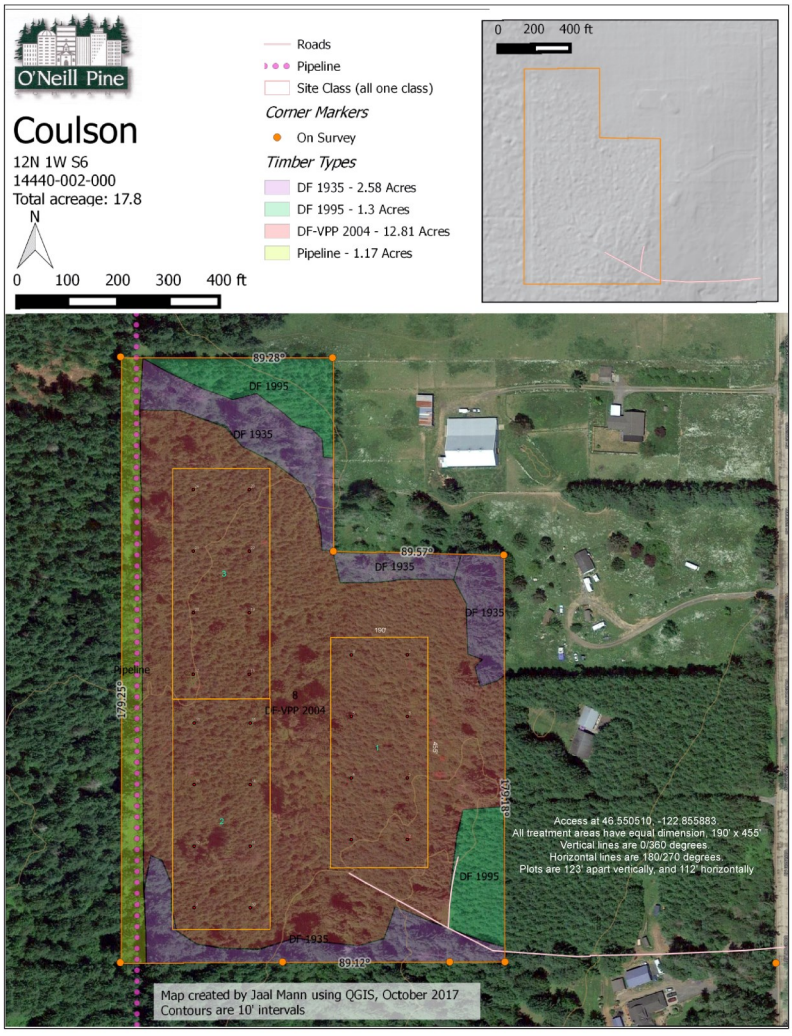
TREATMENT CONSIDERATIONS

1. This project was part of a larger, 15-acre thinning unit that was conducted by a four-person crew using chainsaws over a two day period.
2. The treatment site boundaries were flagged and permanent plots were installed using rebar and PVC pipe.
3. Trees within a sample plot were marked for thinning in the two thinning units to help calibrate the contractors.
4. Trees were not thinned to an even spacing, but instead thinned using a best tree selection approach resulting in a more heterogeneous and variable density.
5. Defective trees of low timber quality were removed first, then the stand thinned to the desired spacing.
6. Cull trees were “cut-and-dropped” and only bucked to the extent necessary to ensure they were on the ground and not leaning on standing trees.
7. Naturally regenerating seedlings, native shrubs and low trees, shade tolerant understory trees, native hardwoods that were not competing with the fir, and underrepresented conifer species were retained during thinning.
8. Himalayan blackberry that occurred in small gaps in the stand, or along stand edges, were not treated, as shade from the dense canopy was assumed to be sufficient for long-term control.

TREATMENT PRESCRIPTIONS

In order to study growth rates of trees at varying densities, the stands were thinned to the following three densities. Thinning occurred primarily from below, releasing the most dominant trees with the highest timber quality and largest live crown of each species. Douglas-fir was the preferred crop tree. Underrepresented species and tree seedlings were retained where they did not interfere with the growth of Douglas-fir.

1. 220—240 TPA (13’x15’
2. 280—320 TPA (11’x13’)
3. 350 TPA (10’ - 11’) - no treatment



LABOR & OTHER COSTS

The pre-commercial thinning was conducted in February 2020 by a contracted professional four-person crew using chainsaws over the course of two days.

	Treatment Site #1 2.0 acres PCT from 505 to 220—240 TPA	Treatment Site #2 2.0 acres PCT from 488 to 280—320 TPA	Treatment Site #3 2.0 acres No treatment
Labor	4 workers, 1.75 hours 7 person hours	4 workers, 1.5 hours 6 person hours	0
Cost	$150/acre	$150/acre	0
Fuel	2.3 gallons+	2.0 gallons+	0
CO2 Emissions	45 lb CO2++	39.28 lb CO2++	0

+ assumption: 0.25 gallons of gas/45 minutes/worker

++ assumption: 19.64 lbs CO_2/gallon

TREATMENT PLOT DATA

Pre-Treatment Stand Summary (2020)							
Site	# of plots	TPA (All spp)	TPA DF	Avg DBH (DF)	Avg Ht (DF)	Avg LCR (DF)	Avg % Defect (DF)
1	8	540	505	5.6”	40’	44%	23
2	8	560	488	5.5”	42’	47%	14
3	8	345	338	5.9”	42’	53%	8
Pre-Treatment Other Trees Per Acre (2020)							
Site	RA	BLM	CAS	RC	PP	GF	WH
1	0	25	0	0	8	0	3
2	35	20	0	3	3	3	0
3	8	0	0	0	0	0	0

Post-Treatment Stand Summary (2022)							
Site	# of plots	TPA (All spp)	TPA DF	Avg DBH (DF)	Avg Ht (DF)	Avg LCR (DF)	Avg % Defect (DF)
1	8	310	242	7.6”	47’	40%	12
2	8	430	285	7.0”	45’	42%	5
3	8	345	335	6.6”	44’	48%	17
Post-Treatment Stand Summary (2022)							
Site	RA	BLM	CAS	RC	PP	BC	WH
1	38	5	3	3	18	0	3
2	40	8	0	3	5	8	0
3	10	0	0	0	0	0	0

ANALYSIS

Analysis of this project focused on both labor practices and growth data. Since it is difficult to draw definitive conclusions from only two years of growth data, some inferences had to be made from both subjective observations of seedling growth and analysis of data.

1. Although Douglas-fir were thinned to within their target densities, retention of hardwoods and other underrepresented species resulted in post-thinning stocking densities that often exceeded 30 percent of the target density.
2. Live crowns of Douglas-fir continued to decline, potentially indicative of continuing competition from other trees retained in the stand during PCT.
3. The stand within Treatment Site 1, which was thinned to the lowest density, experienced both the largest diameter and tallest height growth as compared to the stands that were retained at higher densities.
4. Defective and low quality trees were significantly reduced in the two stands that were thinned. However, defect increased in Treatment Site 3, which was not thinned.
5. Treatment Site 1, which was thinned to a lower density (more open canopy) experienced a higher rate of natural regeneration in the understory than stands retained at higher densities.

KEY LESSONS LEARNED

1. Retaining excessive numbers of hardwoods and other trees reduced the effectiveness of the pre-commercial thinning on stimulating Douglas-fir growth.
2. Thinning to lower densities (e.g. <240 TPA) improved both diameter and height growth.
3. Retaining the most dominant trees may increase a stand's resilience to continued storm damage.
4. Thinning to lower densities, and thereby opening the canopy, may stimulate more natural understory tree regeneration than would occur under denser canopies.
5. Contractor rates for this project were low compared to rates of other contractors working on similar projects (averaging $250/acre). Regardless, given the EQIP payment rate for pre-commercial thinning of $316/acre, this is an economically viable option for small woodland owners.

Releasing trees with >40% live crowns.

6. A follow-up herbicide treatment on holly may be advisable to prevent the invasive species from colonizing the understory of the plantation.