Barneston Forest Habitat Restoration Project

AS-BUILT

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1.0 PROJECT SUMMARY

The Barneston Forest Habitat Restoration Project covers 88 acres in the "lower" Cedar River Municipal Watershed (CRMW) and was installed in two phases. The ecological thinning phase took place between June and September, 2015, with the final yarding/hauling of logs being completed in January, 2016. The planting phase of the project was completed on February 25-26, 2016.

The 30-year-old forest in the project area was thinned to two densities (50 and 100 trees per acre (TPA)), in addition to 12 quarter-acre "gaps", where all trees were harvested, and six "skip" areas totaling 22.6 acres where no trees were harvested (Table 1). The thinning was contracted to Northwest Renewable Energy Group (NWREG), who used a wheeled harvester and forwarder system to cut trees and bring logs to the road. They paid Seattle Public Utilities (SPU) $7,174.47 for the wood that they removed and sold to two mills (logs went to Rainier Veneer in Spanaway, WA, and pulp went to Edman in Tacoma, WA).

Table 1. Tree thinning treatment acres for the Barneston project.

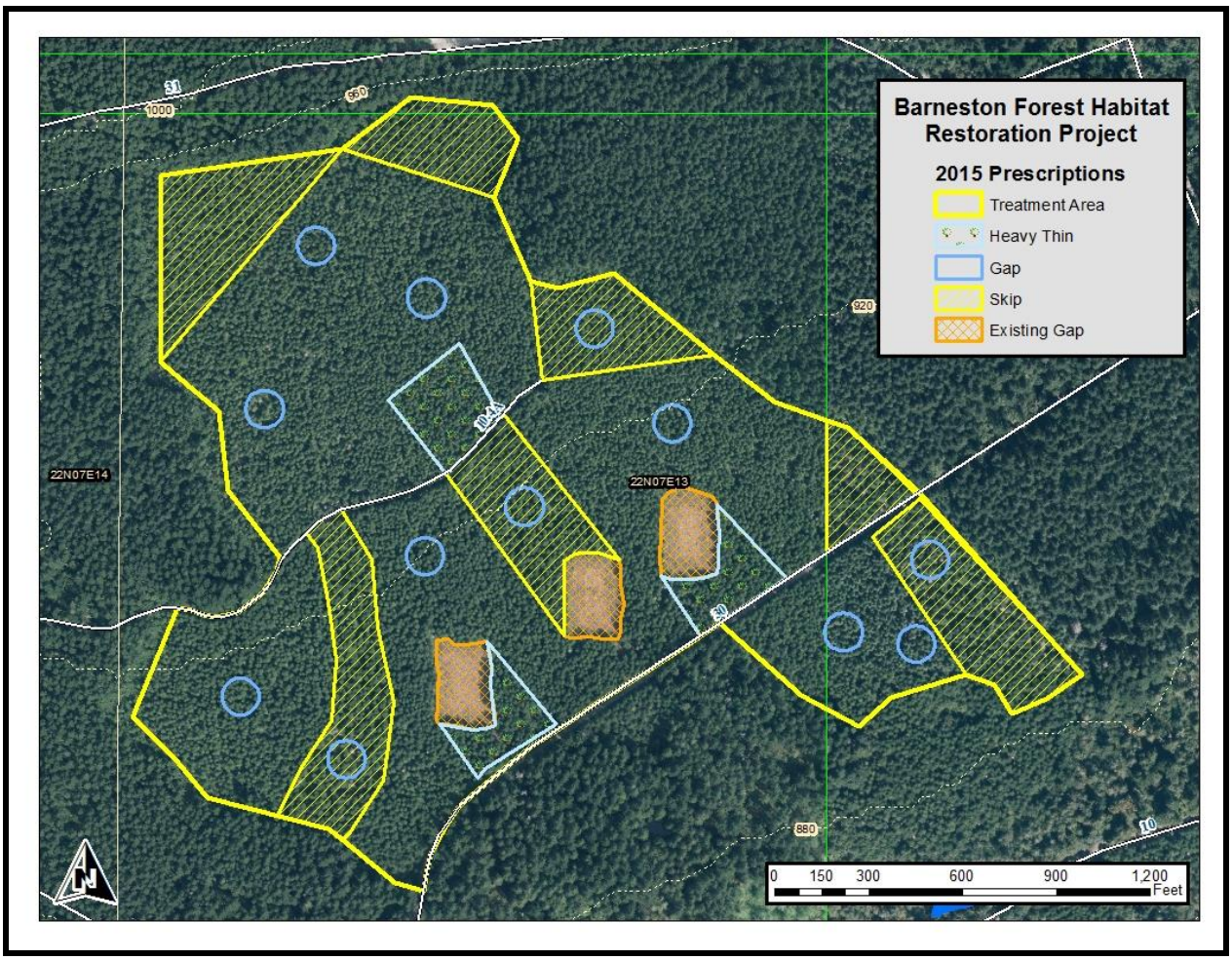
Treatment		Acres
Thin	Heavy	4.4
	Light	54.5
Gap	New	3.1
	Existing	3.3
Skip		22.6
Total Area		**87.9**

Planting took place in the 12 gaps, three "heavy" areas, three log landing sites (0.15 acres), and along selected forwarding corridors (~1,000') where the forest canopy was opened enough during thinning to plant underneath. Fifteen hundred trees were planted in the four types of areas, including six different species (Table 2). Seedlings of four of the species were protected from ungulate browse using plastic mesh tubes affixed by two bamboo stakes. The planting was contracted to Meduzia Reforestation. The total planting cost was $7,398.26 for labor, plants, and protection.

Table 2. Tree planting details for the Barneston project (*requires protection).

Species	#	Target Areas	Trees/ Gap	Trees/ Heavy Thin	Trees/ Corridor	Trees/ Landing
Western White Pine	350	Gaps	29	0	0	0
Western redcedar*	400	Gaps, Heavy Thin	0	80	80	0
Bigleaf Maple*	350	Gaps, Heavy Thin	15	57	0	0
Black Cottonwood*	200	Gaps	15	0	10	0
Red Alder	150	Gaps, Heavy Thin	5	10	30	0
Oregon Oak*	50	Landings	0	0	0	17
Total	**1,500**		**64**	**147**	**120**	**17**

2.0 PROJECT MAP



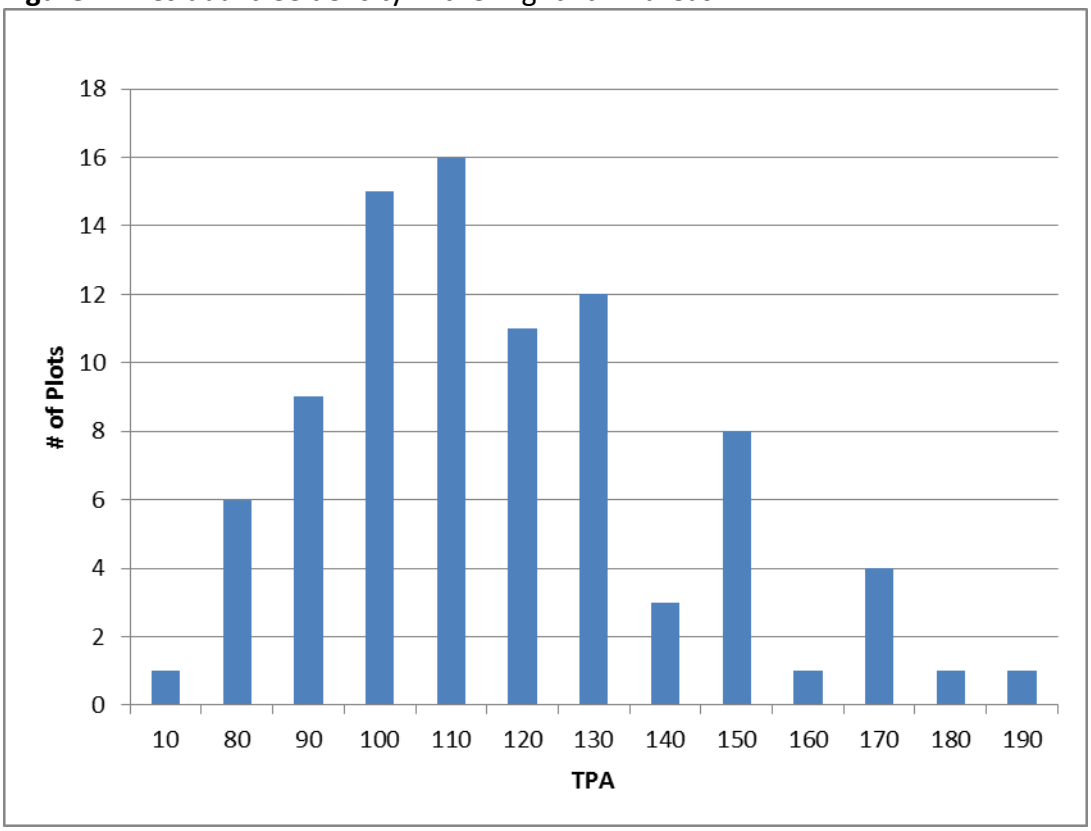
3.0 THINNING IMPLEMENTATION

A Forest Practice Application (FPA #2417879) to the Washington State Department of Natural Resources (WDNR) was approved for this project on May 21, 2015. The application process included outreach to five local tribes (Muckleshoot, Snoqualmie, Tulalip, Puyallup, and Squaxin) and a Cultural Resources Protection Plan (CRPP) approved by the Washington State Department of Archeology and Historic Preservation (WDAHP).

Thinning commenced at the beginning of June, 2015, in two training areas adjacent to and north of the 30 Road. To get the harvester operator accustomed to the prescribed residual tree spacing, blue rings were painted around "leave" trees by SPU staff. Roughly two acres were painted in each of the 100 and 50 TPA areas. Additional leave trees were painted red by the contractor south or the 30 Road to continue the training process. Once completing the thinning of the training areas, the operator had difficulty getting the prescribed tree density, initially cutting too many trees and then too few. On the landscape scale, however, the resulting variable density of residual trees is an ecological benefit and one of the objectives of the project.

The general tendency of the operator was to be conservative in his thinning choices, always choosing to cut the smaller tree and erring towards leaving trees standing. Indeed, in 88 compliance plots distributed throughout the 55 acres of the "light" thin area of the project, the average tree density was 117 TPA, ranging from 10 to 190 TPA (Figure 1). Similarly in the "heavy" thin areas, where four compliance plots in 4 acres indicated an average tree density of 63 TPA.

Figure 1. Residual tree density in the "light" thin areas.



Since the project area had been planted with Douglas fir seedlings following a windthrow event in 1983, and then pre-commercially thinned in 1995 favoring Douglas fir, the residual trees in this project are overwhelmingly Douglas fir. The few western hemlock trees that share the overstory canopy were maintained during this project, but did not fall into the compliance plots. Additionally, western hemlock and western redcedar have been seeding in on their own and currently contribute to the understory canopy. During this project, they were also maintained where possible but were not accounted for during compliance.

The 0.25-acre gaps were installed as planned with the exception of one of the gaps in the skipped area south of the 30 Road was moved into the thinning matrix where two forwarding corridors converged. The resulting hole in the overstory canopy was enlarged rather than entering the skip. In a few cases, the initial gap size was smaller than intended and the harvester had to return to enlarge it. As the operator gained experience with the gaps and

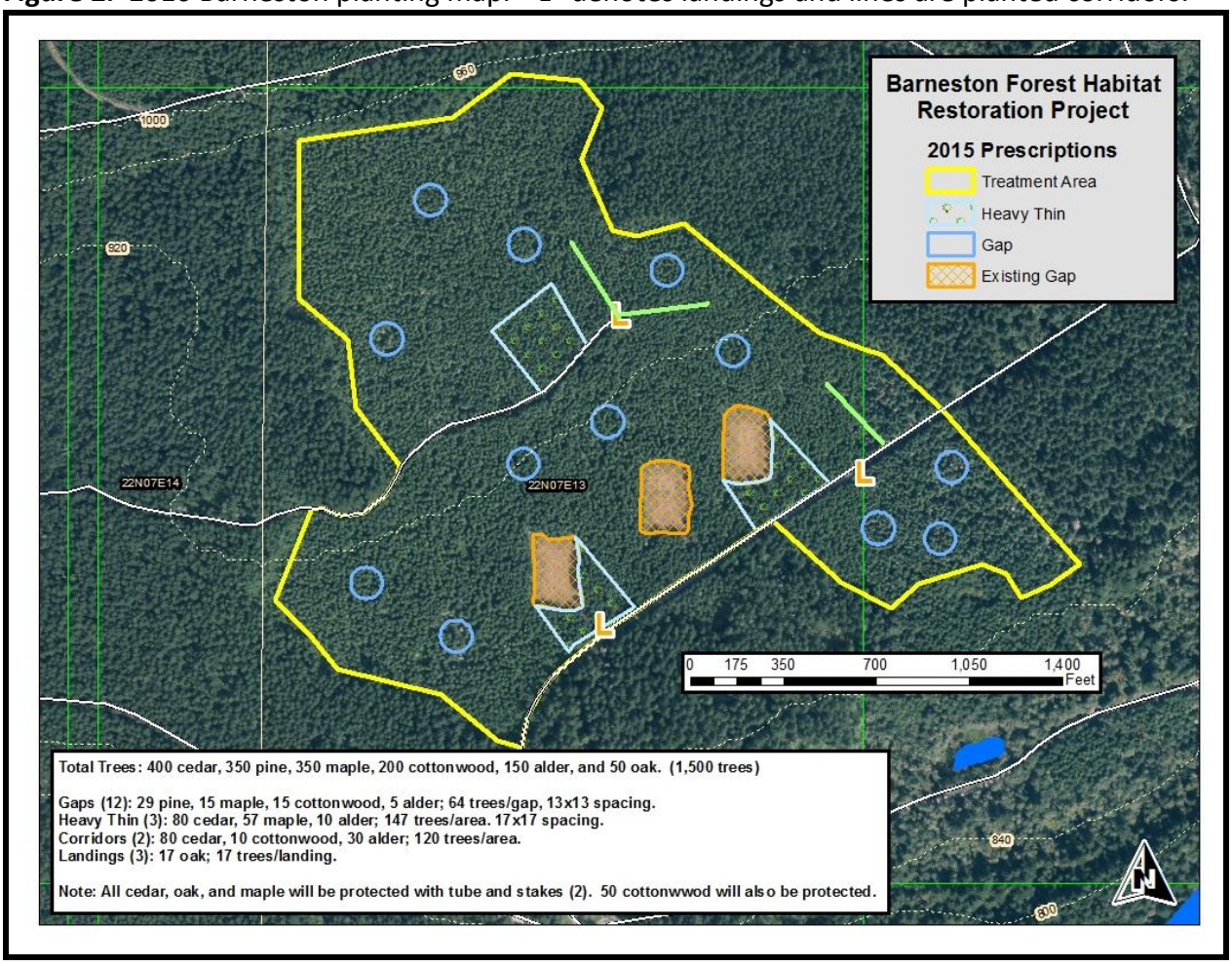
following conversations with SPU staff about variable density, he started leaving the odd dominant tree within the gap.

4.0 PLANTING IMPLEMENTATION

Planting took over two days in February, 2016. A total 1,500 trees of six species were planted in the project area (Table 2 and Figure 2):

- Gaps (12 at 0.25 acres each): Each gap was planted with 64 trees including 29 western white pine, 15 bigleaf maple, 15 black cottonwood, and five red alder. The maple and cottonwood were protected from browse with plastic mesh tubes affixed with two bamboo stakes.

Figure 2. 2016 Barneston planting map. "L" denotes landings and lines are planted corridors.



- Heavy Thin Areas (3 at 1.5 acres each): Each heavy thin area was planted with 147 trees including 80 western redcedar, 57 bigleaf maple, and 10 red alder. The cedar and most of the maple were protected.

- Corridors (2 at 1000' in length): Each corridor was planted with 120 trees including 80 western redcedar, 10 black cottonwood, and 30 red alder. The cedar and cottonwood were protected.
- Landings (3 at 0.05 acres each): Each landing was planted with 17 Oregon (aka Garry) oaks, which were all protected from browse.

In gaps where there weren't enough planting sites to hold the allocated seedlings, planting extended into the yarding corridors adjacent to the gap. When running out of protection tubes, cedars were prioritized for coverage leaving a few dozen maples unprotected in the two southern heavy thin areas. Maples are thought not to attract browse as much as antler rubbing damage, which may or may not be deterred by mesh tubes.

5.0 COMPLIANCE MONITORING

Compliance monitoring continued throughout the implementation of both thinning and planting phases of the project. Tree density (Figure 1) and damage plots were taken every few days during the thinning to inform the operator of recent success in applying the prescriptions. Harvest damage to the residual trees decreased over the course of the project as the operator's skill increased and the running sap slowed, improving bark resistance to scuff damage. Damage to the salal understory along the log forwarding corridors was seen as a benefit to improving access for tree planting. And potential soil compaction and erosion in the corridors was minimized by the flat topography, rocky soil, minimizing corridor width, and running machines on vine maple and other harvesting debris where possible.

SPU staff were on-site for the entire planting phase of the project, directing seedling distribution, evaluating tree spacing, and assess the quality of individual tree plantings.

6.0 PROJECT COSTS

The bid price by NWREG for thinning this project was $4.25/ton of logs or pulp removed from the site. They removed 1,688.11 tons of wood (951.41 tons of logs and 736.70 tons of pulp) resulting in a payment to SPU of $7,174.47. This exceeded the original timber cruise estimate of 1,400 tons.

Planting costs included $1,457.20 for the plants, $1,765.06 for the protection, and $4,176.00 for two days of labor from the Meduzia Reforestation crew. Planting costs exceeded thinning revenue by $223.79.

7.0 EFFECTIVENESS MONITORING

Going forward, effectiveness monitoring will include photo-points, a minimum number of small measurement plots (tree attributes only), and seedling survival surveys. Tree growth and understory response will be tracked in the two thinning treatments and skip treatments. Sample point locations will be determined and installed after project implementation and sampled at 5, 10, and 20 years post-treatment. As-needed maintenance and monitoring of the

planted seedlings will occur every 2-3 years until they are above competing understory vegetation and ungulate browse.

8.0 LESSONS LEARNED

- Over the course of several thinning projects it has become apparent that thinning operators tend to error on the conservative side when cutting, resulting in slightly higher residual tree density than the prescribed treatment. This should be accounted for during the development of the prescriptions.
- The flat topography and relatively small trees of this project afforded NWREG the opportunity to train their young staff in an ideal setting. They had purchased a new Komatsu 931.1 harvester and a used Valmet forwarder just prior to this project.
- Early summer sap flow resulted in “loose bark” which then contributed to the susceptibility of residual trees to be damaged during the thinning process. Thinning during autumn might result in less residual tree damage.
- NWREG started another thinning project in the CRMW prior to completing the work at Barneston. They worked at Barneston periodically through the end of 2015, when staffing and equipment scheduling allowed. Yarding was finally completed by January 1, 2016, and hauling the logs to the mill was completed on January 13, 2016. This scheduling allowed flexibility for the contractor, even though the original plan called for the completion of the thinning portion of the project in July, 2015. The extended timeline had no impact on the reaching the objectives of the project, since planting occurred on schedule at the end of February.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Periodic Updates:

March 2016: Repaired many damaged plantings including reinstalling mesh tubs and replanting seedlings pulled from the ground. Appears to be malicious activity from elk and deer. Most of the damage was along corridors and in two gaps.

April 2016: Applied Plantskydd repellent to selected seedlings and their protective mesh tubes to discourage ungulate damage. Seedlings sprayed include those along the corridors and in the low density thin areas, including those repaired during the previous visit.

May 2016: No additional trauma to seedlings or their protection.