Restoration Thinning Program Review
Cedar River Municipal Watershed

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1.0 Background

The Restoration Thinning (RT) Program in the Cedar River Municipal Watershed (CRMW) was one of three forest restoration programs (the others being Ecological Thinning and Planting) defined and funded through the *Cedar River Watershed Habitat Conservation Plan* (HCP) that was signed and initiated in April of 2000. The primary goal of the RT program, which is analogous to pre-commercial thinning, was to actively thin dense young second-growth forest stands (generally less than 30 years old) to facilitate ecological development towards old-growth forest habitat conditions.

The performance goals for the RT program as stated in the HCP are:

"*Funding for restoration thinning in upland areas will total $2,620,000. This includes $1,614,000 over the first 8 years and $1,006,000 over the next 7 years. The funding level is based on estimated approximate average cost of $250 per acre for restoration thinning. Based on that assumed cost per acre, the City expects that about 10,480 acres would be treated by restoration thinning, all of which would be treated in the first 15 years of the HCP term*." (HCP: 4.2-35)

The RT program was defined more specifically in the *Cedar River Municipal Watershed Upland Forest Habitat Restoration Strategic Plan* (2008), and treatment priorities were redefined in 2006 using the *Landscape Synthesis Framework* (2009). RT treatment areas were identified based on their current age, height, and stand condition, and prioritized based on their proximity to highly valued or rare habitat (e.g., old-growth forest, riparian, and wetland areas).

RT projects began in the CRMW in 2000, though pre-commercial thinning had been taking place since 1995. The planning and implementation of projects occurred on an annual cycle until the program's completion at the end of 2013, when the financial performance goals were achieved two years earlier than was anticipated in the HCP.

This report summarizes the program, from ecological objectives, the evolution of treatments, the amount of forestland affected, the compliance and effectiveness monitoring, and project costs.

2.0 Program Goals and Objectives

The overarching goal of RT is to accelerate development of complex forest habitat in the near-term and late-successional and old-growth forest conditions in the long-term. Objectives of RT include:

- Reduce competition among trees.
- Stimulate tree growth.
- Increase light penetration under the top tree canopy.
- Increase tree and understory plant species diversity.

- Accelerate forest development beyond the competitive exclusion stage towards a more biologically diverse stage.
- Extend the forest development stand initiation stage such that diverse species become established and diverse stand structures develop.
- Provide multiple development pathways for variable forest stand structures.
- Reduce long-term fire hazard.
- Increase resilience to catastrophic windthrow, insect, or disease outbreak.
- Increase habitat connectivity and structural variability of riparian areas.

3.0 Landscape Perspective

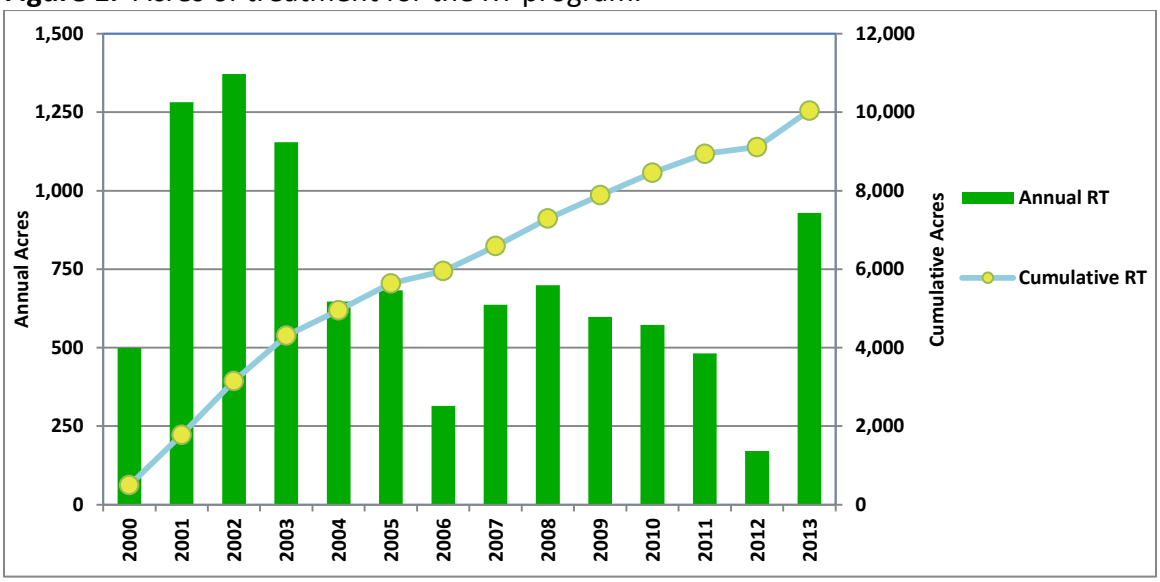
Each RT unit can be characterized by its unique features and how it relates to other features on the landscape. Relatively high elevation units, for example, contain many unique features such as talus slopes, rock outcroppings, and shrub openings, as well as stands of old-growth forests adjacent to and within the landscape planning area. Three key landscape criteria shaped the thinking behind individual thinning prescriptions including decisions to place areas in reserve status:

- Individual unit objectives and unique features (e.g., what special characteristics does a particular unit have when compared to other units and how should the unit objectives be tailored to protect, enhance, and promote those features?).
- The location and characteristics of old-growth forests and special habitats relative to the thinning units (e.g., what locations and characteristics of nearby old growth and special habitats are unique that we should consider them in the prescriptions?).
- The proximity and location to previously thinned stands (e.g., what should be done differently now considering the prescriptions and ecological response of nearby previously thinned stands?).

4.0 RT Program Treatments and Treatment Areas

The RT program was active in the CRMW from 2000 to 2013. The total area of forestland treated for that period was 10,041 acres (Figure 1). This accounts for 96% of the treatment performance goal of 10,480 acres. Generally, annual treatment rates were initially relatively high due to relatively low wildlife-related seasonal restrictions and low treatment complexity. As the treatment complexity increased towards the middle of the program period, the annual treatment rate declined. Seattle Public Utilities (SPU) staff turnover also may have had an influence on the annual treatment rate, as new program managers came up to speed on the daily issues of individual projects. The annual treatment level averaged 717 acres per year.

Figure 1. Acres of treatment for the RT program.



Seasonal restriction issues for the RT program include weather, fire precautions, nesting wildlife, and contract labor. Early and late season snow can limit access to treatment areas, especially at higher elevations where the typical snow-free period is from July to November. Fire precaution levels, as set by the Washington State Department of Natural Resources, can limit the use of chainsaws in the forest, usually in the driest months of August and September. The HCP restricts potentially disturbing activities (e.g., loud) in proximity to the potential nesting sites (e.g., old-growth forest) of sensitive wildlife species (e.g., northern spotted owl, marbled murrelets, northern goshawk). The nesting season generally ended on September 1st (September 22nd in 2013 because of new data). And all of the contractors used during the course of the program typically hired Hispanic workers who can be subject to immigration issues. During the U.S. federal government shutdown in 2013, for instance, it was impossible for one of the contractors to obtain new work visas for potential employees, thus delaying his company's availability.

The complexity of RT treatments varied over time (Table 1). For the first four years of RT the treatment prescriptions included only provisions for residual tree spacing, an upper limit on the diameter of trees cut, and limiting the species of trees to be cut to the most abundant. The average size of RT units was also relatively large. This resulted in the relative uniform spacing of trees across large portions of the landscape. In an effort to increase the variability in tree densities, skips and gaps were included in prescriptions, spacing between trees was more variable between units, and the average unit size decreased (Figure 2). Skips are areas where no trees are cut, and gaps are areas where all or most of the trees are cut. Concerns about the slash resulting from RT potentially increasing the fire hazard on the landscape resulted in treating some slash to lessen the hazard (e.g., lop and pile, mastication, yard and chip). Girdling was attempted in a few units with larger tree sizes to mitigate the pulse of slash from

thinning, in hopes that the girdled trees would remain standing for some time and potentially provide some habitat benefit.

Table 1. Summary of the RT program in the CRMW.

Management	Year	Acres Treated	Treatment Summary						
			# Subunits	Thinning Spacing (ft)	Maximum Diameter Limits	Skips	Gaps	Slash Treatment	Girdling
Pre-HCP	1995	590	28	12	Y	N	N	N	N
	1996	671	7	13	Y	N	N	N	N
	1997	455	2	6-13	Y	N	N	N	N
	1998	166	2	13	Y	N	N	N	N
	1999	0							
CRW-HCP	2000	499	8	13	Y	N	N	N	N
	2001	1,282	9	15	Y	N	N	N	N
	2002	1,372	8	15	Y	N	N	N	N
	2003	1,154	14	12-15	Y	N	N	N	N
	2004*	1,017	16	13-16	Y	N	N	Y	N
	2005	683	17	12-18	Y	N	Y	Y	Y
	2006**	362	13	11-17	Y	Y	Y	Y	N
	2007	637	25	12-18	Y	Y	Y	Y	N
	2008	699	43	8-18	Y	Y	Y	Y	Y
	2009	598	19	10-18	Y	Y	Y	Y	Y
	2010	573	27	12-18	Y	Y	Y	Y	N
	2011	482	20	13-18	Y	Y	N	Y	Y
	2012	171	8	13-18	Y	Y	N	N	N
	2013	929	33	13-45	Y	Y	Y	Y	N
Total	**Non-HCP**	**2,554**							
	HCP	**10,041**							
Grand Total		**12,595**							

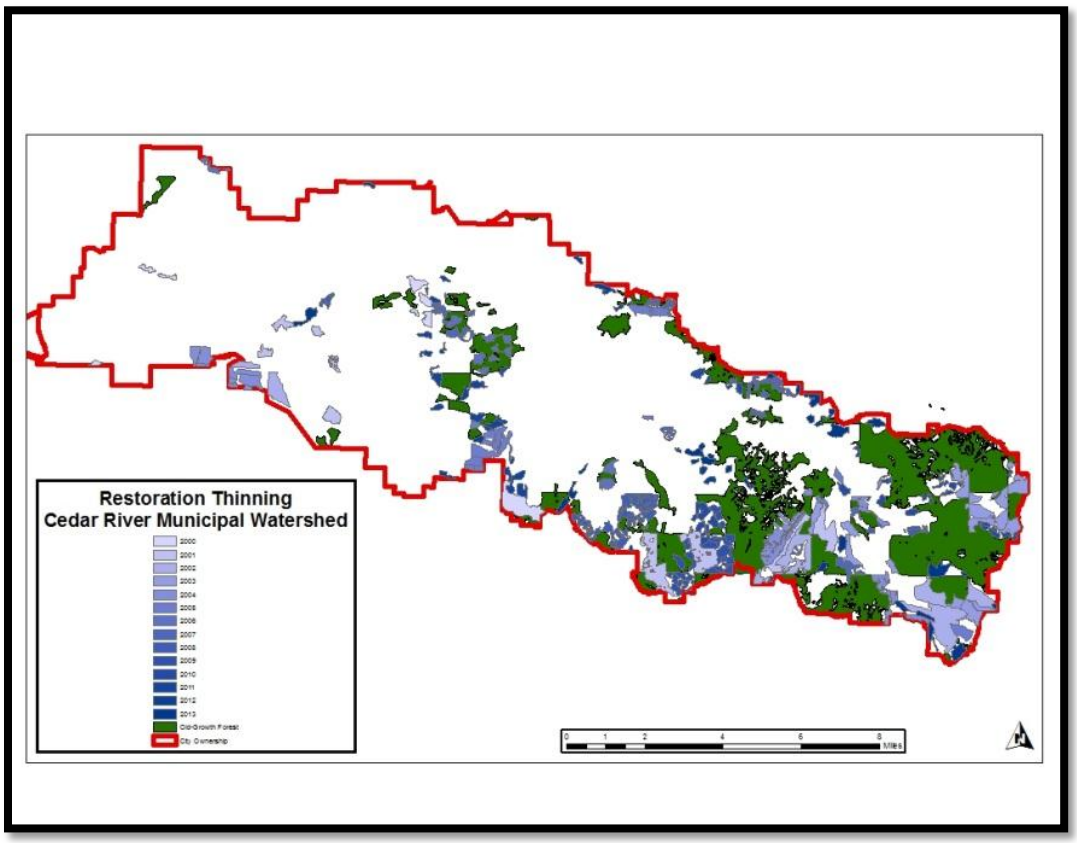
*Includes 370 acres (Selleck and Foothills) funded by BPA (non-HCP).
**Includes 47 acres (Trillium) funded by BPA (non-HCP).

All of the acres thinned in 2006 also received slash treatment, while in other years slash treatment occurred on only a subset of the RT acres. Treatment prescriptions were simplified to some extent during the last three years of the program, to streamline both the planning and implementation process. The low annual treatment rate in 2012 was a direct result of early and late season snow limitations, with many acres deferred until 2013. The 45-ft thinning spacing in 2013 refers to the distance between target trees in an "individual tree release" prescription.

Across the CRMW landscape, the location of RT units was an artifact of previous forest management. Clearcut timber harvesting typically started at the lower elevations of the western part of the CRMW and moved eastward over time into the upper elevations. When clearcut harvesting was terminated in the CRMW in the mid-1990s, the most recent cut-over areas were adjacent to the remaining old-growth forest. The young forest that regrew in those recent clearcuts made up the majority of the target stands for this program (Figure 3).

Figure 2. Aerial photos showing uniform (left) and variable (right) tree distributions with skips and gaps after thinning.

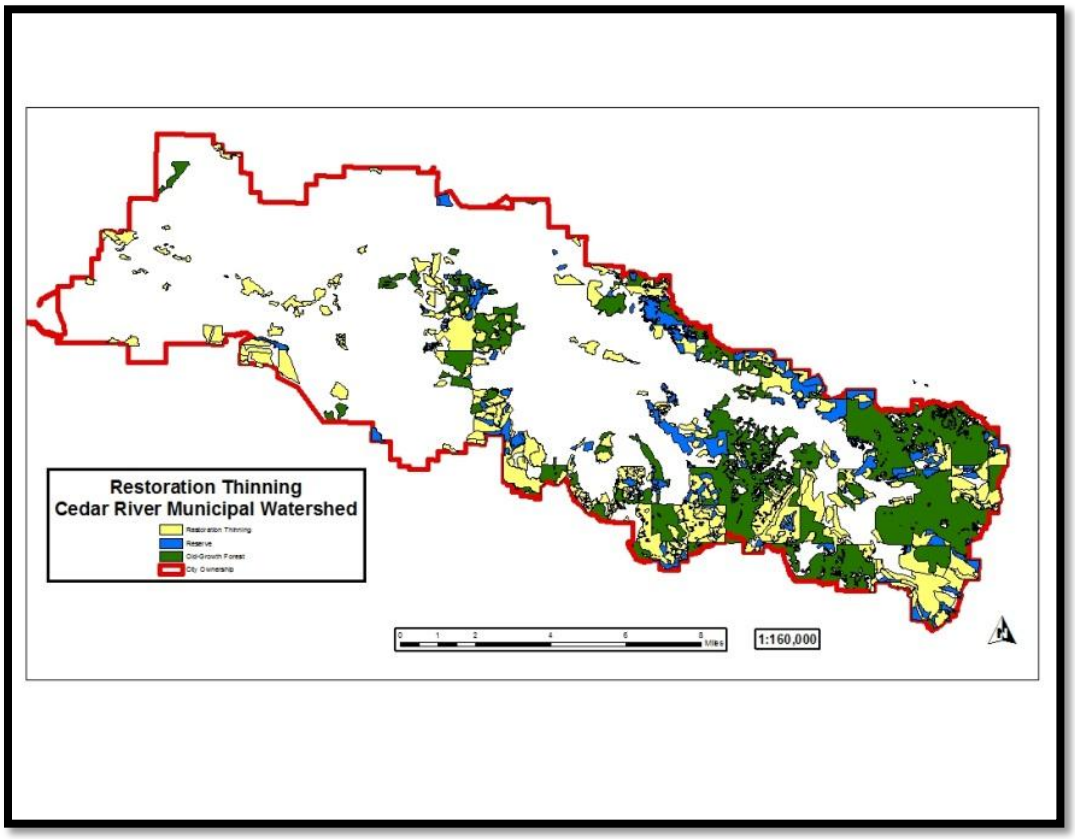
Figure 3. RT treatment areas in the CRMW.



Not all of the eligible young forest in the CRMW was thinned under the RT program. Almost 4,300 acres was set aside as untreated RT reserves (Figure 4). Some of the areas were determined to have relatively low ecological benefit from thinning (e.g., there is already a patchy tree distribution), have trees too large for RT (resulting in excess slash loading), or have logistical concerns (e.g., too steep, no road access). Maintaining some

areas of dense trees, both in skips and reserves, also increases the variability in tree density across the landscape. Many of these reserves were so designated in the last two years of the program, as they were deferred during earlier planning processes.

Figure 4. RT treatment and reserve areas in the CRMW.



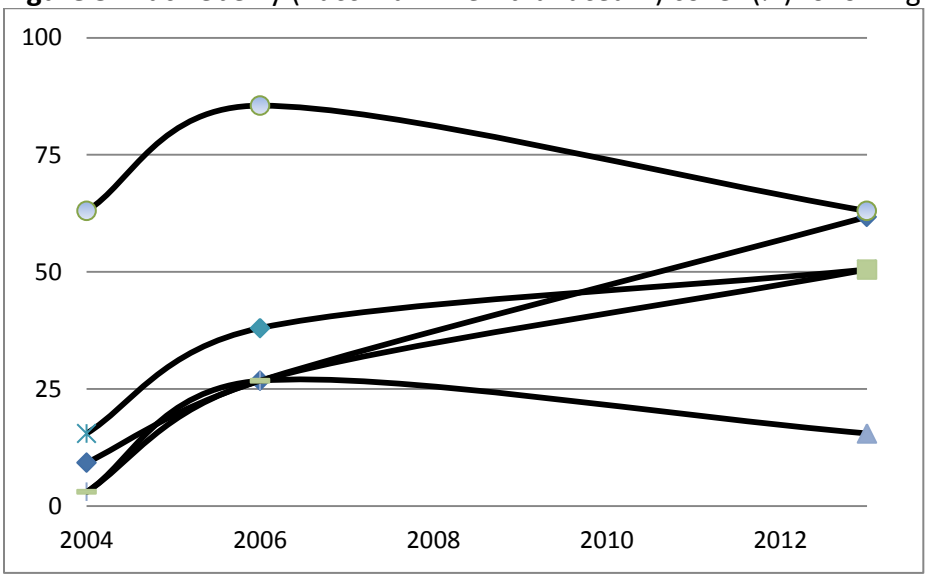
5.0 RT Program Compliance and Effectiveness Monitoring

In the later years of the program, measuring compliance of treatment implementation with treatment prescription was done with compliance plots taken at a density of roughly one every two acres. At least some plots were taken while the work was being conducted to timely evaluate contractor performance and be able to modify any issues. The compliance data also acts as baseline forest inventory information for the RT units going forward. Digital compliance data is available from 2007 to 2013, with hard-copy data available from previous years.

Effectiveness monitoring, or measuring if our assumptions of the ecological effects of RT are accurate, was conducted using data developed from permanently marked plots established in 2004 and remeasured in 2006 and 2013. Figure 5 illustrates how understory huckleberry shrubs have responded to RT, initially increasing in cover but then moderating. Effectiveness can also be evaluated in the future as a function of the

permanent sample plots (PSPs) established to measure long-term forest landscape dynamics by the HCP.

Figure 5. Huckleberry (*Vaccinium membranaceum*) cover (%) following RT in 2004.

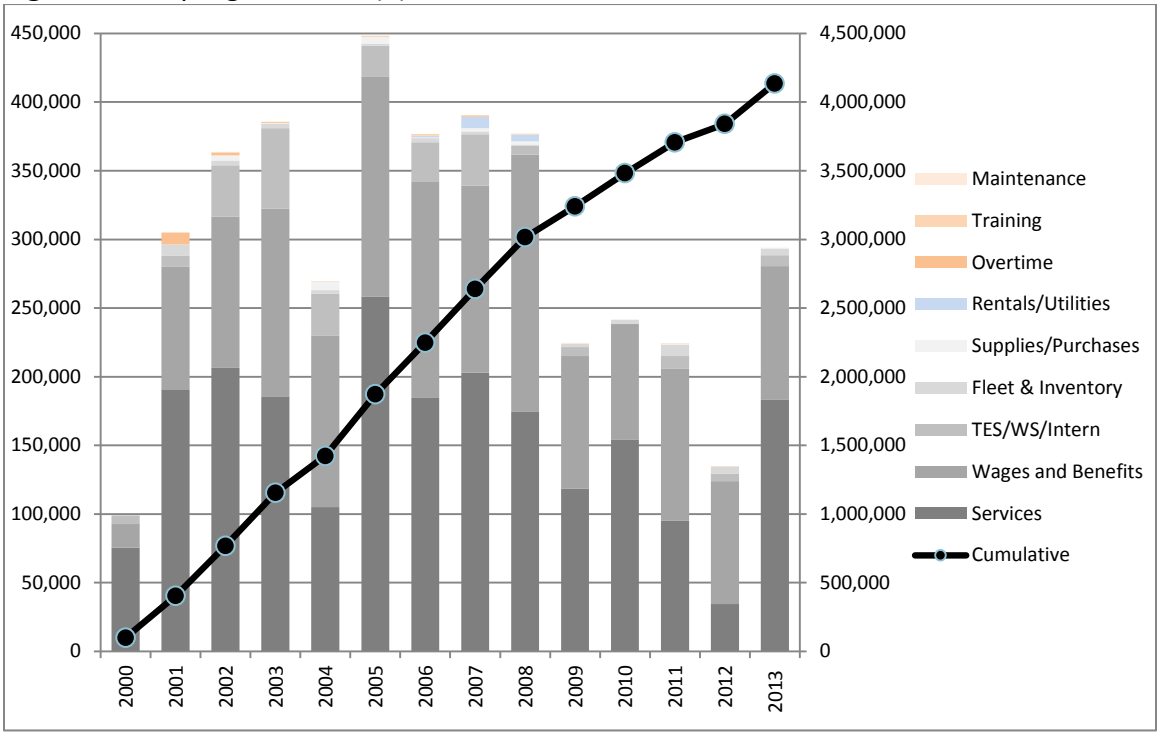


Two blocks of a restoration thinning trial were also installed in 2005 and 2007, to more rigorously investigate the effects of different densities and patterns of RT on tree growth and understory development. These blocks will be remeasured as part of the HCP terrestrial monitoring program. Findings from this work may be applied to similar restoration efforts on other lands and/or any future work that may be conducted in the municipal watersheds.

6.0 RT Program Costs

The original financial performance goal ("cost commitment") for the RT program was $2,620,000, which is $3,417,990 in 2013 dollars. This amount was intended to cover field labor (e.g., treatment, compliance), with additional costs of planning and layout (not "cost commitment" expenditures). Figure 6 shows the actual costs by year, with an overall expenditure of $4,134,991, which is 121% of the original financial performance goal. Field labor accounts for $2,559,024, or 62% of this total. SPU and the services that oversee the HCP (NOAA and USFWS) agreed that the financial performance goal was attained for the program. The acreage performance goal of roughly 10,000 was also attained.

Figure 6. RT program costs ($).



Trends in Figure 6 generally follow the amount of acres treated, except in 2005 when concerns over the fire hazard of RT slash warranted additional expenditures on slash treatment. Also, the planning costs incurred in 2012 were also for the layout of most of the units thinned in 2013.

It is difficult to evaluate the cost per acre since the amount mentioned in the performance goal does not include planning and layout costs. The total average cost per acre treated was $401, which is significantly more than the amount mentioned in the performance goal. Figuring only the contractor costs, however, equates to only $214 per acre, which is significantly less than the performance goal.

7.0 Lessons Learned

Included in many of the more recent annual RT project reports is a section on the unexpected issues that arose during that RT year, and how we can learn from them. This section is similar except on a programmatic temporal scale.

- The RT program started out quickly, treating lots of acres with relatively simple prescriptions. After a few years of working under the HCP, the Ecosystem Section began to focus on developing a more strategic process for implementing the work. Options were analyzed, actions were justified, and unknowns were questioned. This process resulted in elaborate strategic and project plans which inevitably slowed the rate of thinning. It also resulted in diversified prescriptions for ecological reasons that increased the variability of tree density on the landscape. Finally, toward the end of the program, planning and

implementation was again streamlined to reflect the success of the strategic planning process while incorporating varied treatments.

- The process of contracting thinning companies was expedited by creating a five-year roster of qualified vendors through the City of Seattle's Purchasing and Contracting Department. This allowed for selected vendors to be awarded work from bids without developing and signing new contracts every year. This was initially done in 2003 and reinitiated again in 2009.
- Seasonal restrictions (weather, fire precautions, nesting wildlife, and contract labor) seemed to play a bigger role as the RT program developed. Weather and fire precautions naturally vary annually, and cause a high level of uncertainty in every thinning season. One of the primary variables in the wildlife restriction is the distance of RT to old-growth forest habitat. At the beginning of the program it seems that large areas with easy access were prioritized for thinning, leaving higher elevation units, which tend to be adjacent to old growth, for later years. Labor issues were largely unpredictable.

8.0 Acknowledgements

This work could not have been done without the effort of numerous people. Jim Erckmann was the primary architect of the HCP and the Ecosystems Manager in the Watershed Services Division of SPU until his retirement in 2010. George McFadden (2000 – 2001) and Amy LaBarge (2002 – present) led the forest ecology group in the Ecosystems Section. Stan Pasin (2000 - 2004, 2007), Wendy Sammarco, (2005 - 2008), Andy Chittick (2009 – 2010), and Bill Richards (2011 – 2013) led the day-to-day activities of the RT program. Rolf Gersonde, Melissa Borsting, Lee Boeckstiegel, Sally Nickelson, Dwayne Paige, David Chapin, Todd Bohle, and Dave Beedle, provided valuable input during the planning processes. Chris Raynham, Jayme Clarke, Matt Weintraub, Jesse Saunders, Andrew Larson, Abigail Weinberg, Steve Lockhart, and Mike Wilkerson were instrumental in field layout and compliance monitoring. Finally, Ramirez Reforestation, Wild West Reforestation, and Coronel Reforestation did most of the difficult thinning work.