

Webster Creek Conifer Underplanting

2001- 2017



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Background

Webster Creek originates in the northwestern corner of the Cedar River Municipal Watershed (CRMW) at about 2,500 feet above sea level (asl). It flows in a southerly direction, terminating in Walsh Lake at about 760 feet asl (Figure 1). Walsh Lake is a 68-acre lake with a diverse aquatic and riparian plant community surrounded native second-growth forest. Over 120 native aquatic and riparian plant species were identified in the lake and its adjacent wetlands during a 2005 survey (Herrera 2005).

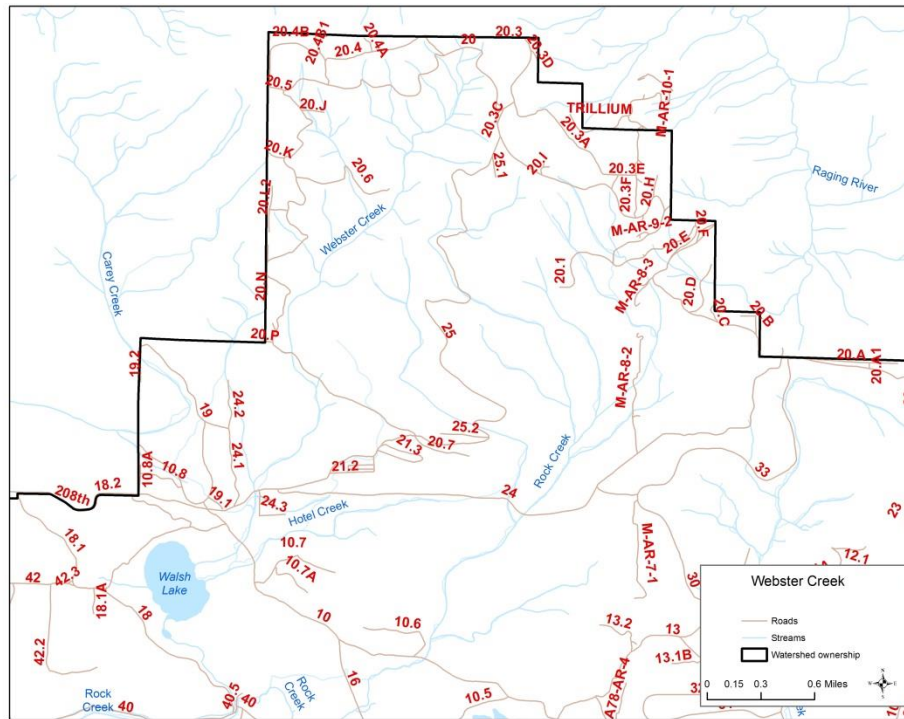


Figure 1. Webster Creek and Walsh Lake in the northwest corner of the municipal watershed

Webster Creek is a unique stream in the CRMW in that in the late 1990s and early 2000s it supported a population of spawning kokanee salmon (*Oncorhynchus nerka*), although none have been seen since 2005 (Barnett et al. 2008). Walsh Lake, Webster Creek, and their riparian areas support over 50 fish and wildlife species, many of which are listed in Seattle's Cedar River Watershed Habitat Conservation Plan.

The riparian forest surrounding Webster Creek near Walsh Lake was clearcut logged between 1910 and 1920. It is currently dominated by deciduous trees, mainly alder (*Alnus rubra*) and cottonwood (*Populus balsamifera*), with some bigleaf maple (*Acer macrophyllum*). Many of the alder are over 80 years old and starting to senesce. There are a few scattered Sitka spruce (*Picea sitchensis*) and western redcedar (*Thuja plicata*), but very few near the creek (Figure 2). There is an often dense shrub understory, primarily salmonberry, with some vine maple (*Acer circinatum*) and red elderberry (*Sambucus racemosa*). There were several patches of non-native invasive species that have been removed and replanted with native species (see Nickelson 2017 for a complete description of these projects).

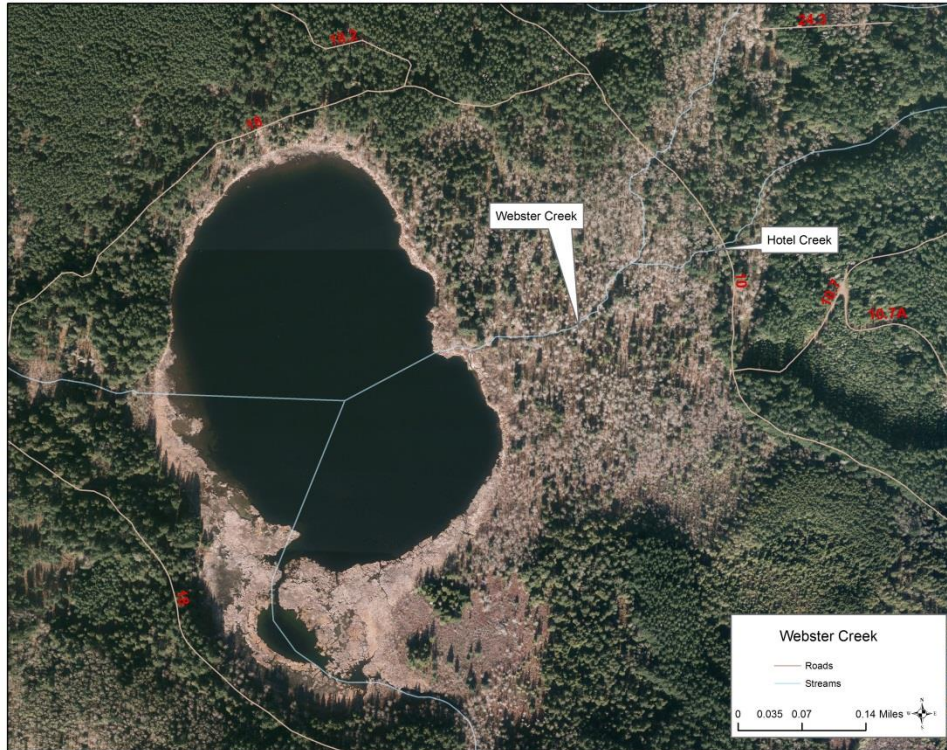


Figure 2. Riparian area near Webster Creek and Walsh Lake.

As of January 2018, seven conifer underplanting projects have been implemented in the Webster Creek riparian area. The 2001 project was the first underplanting project under the HCP and was conducted as an experiment to evaluate different underplanting treatments (understory clearing, tilling, and the use of browse control). It was located on the right bank of Webster Creek from about 300 to 1,100 feet downstream of the 10 Road (see Chapin 2010 for a complete description of this project and monitoring results). The remaining projects are described below.

2010 Webster Creek Western Redcedar Planting Trial

From 2001 to 2010, underplanting of western redcedar (*Thuja plicata*) in riparian areas of the Cedar River Municipal Watershed had been relatively unsuccessful due to browsing by deer and elk. Although survival of cedar was often relatively good, growth was poor due to the continued browsing of leaf area. Use of mesh or solid/translucent browse control tubes was not found to increase growth or survival of cedar seedlings. Where cedar seedlings did escape browse, surviving seedlings generally grew well, even in partial shade. The 2010 project was intended to evaluate different methods of planting cedar, with the objective of finding a successful strategy for underplanting cedar in riparian areas.

Three variables involved in planting cedar were tested. One was the use of browse control materials, specifically testing a larger protection system. We also tested how site clearing and seedling size affect browse frequency and seedling survival and growth. Although uncleared planting locations are generally shadier, they may allow seedlings to better “hide” from herbivores to escape browse damage. However, lower light levels are expected to result in

slower growth, relative to unbrowsed seedlings in cleared areas. On the other hand, the less shading from both understory and overstory vegetation, the faster seedlings are likely to grow and the sooner they will escape major browse damage. Another factor that may attract the attention of elk and deer and result in increased browsing frequency is the marking of seedlings with either flagging or browse protection, so no flagging was used to mark seedlings in the experiment. Seedling size may affect browsing in two ways. First, larger seedlings may escape browsing sooner by growing taller than the height usually browsed, which is likely at least six feet. Secondly, as seedling leaf tissue ages, leaf nitrogen concentrations decrease, resulting in lower nutritional value and lower attractiveness to elk and deer.

Project Design and Implementation

The project was implemented in the riparian area along Webster Creek downstream of the 10 Road (Figure 3). Planting areas were generally to the west of the Webster Creek Conifer Underplanting Experiment set up in 2001, with one set of additional planting areas to the east of Webster Creek near Hotel Creek. The project consisted of planting circles approximately 30 feet in diameter, ranging from about 180 to 450 feet away from the stream. Some of the planting circles were cleared of understory and some left uncleared. One cleared and one uncleared planting circle were paired in the same area. The center of each planting area was recorded with a GPS. Areas were located where overstory tree canopy closure was generally less than 50 percent to reduce the effects of overstory shading.

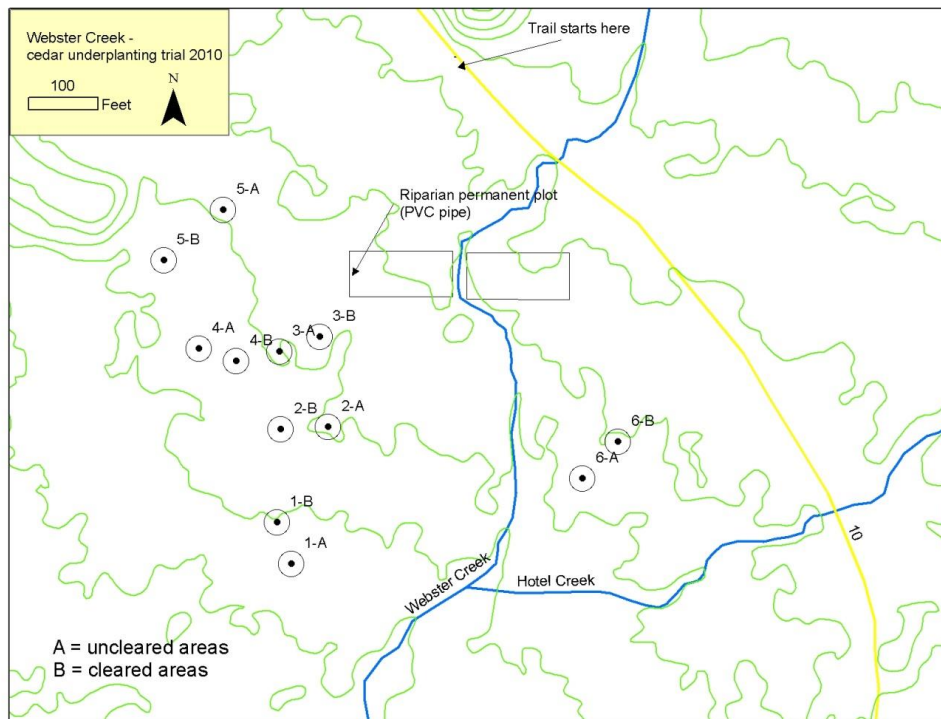


Figure 3. Location of 2010 western redcedar planting trial at Webster Creek. Each circle represents an approximately 30-foot diameter area. Each number represents a paired circle, A=uncleared, B=cleared.

In both cleared and uncleared planting circles, seedlings of two sizes were planted (Figure 4). Seedlings were not as different in size as desired, but we were not able to find seedlings from the same source meeting our initial criteria of 18 inch versus 48 inch seedlings. In the cleared planting circles, both protected and unprotected cedar seedlings were planted. In the uncleared areas, only unprotected seedlings were planted. In the cleared areas, a group of smaller seedlings were protected by browse control structures consisting of stucco wire “cages” 4.0 feet high and about 1 foot diameter supported by wooden stakes (Figure 5). The larger seedlings were left unprotected. The structures were modeled after those found to be successful in British Columbia conifer plantings (Booth and Henigman 1996).

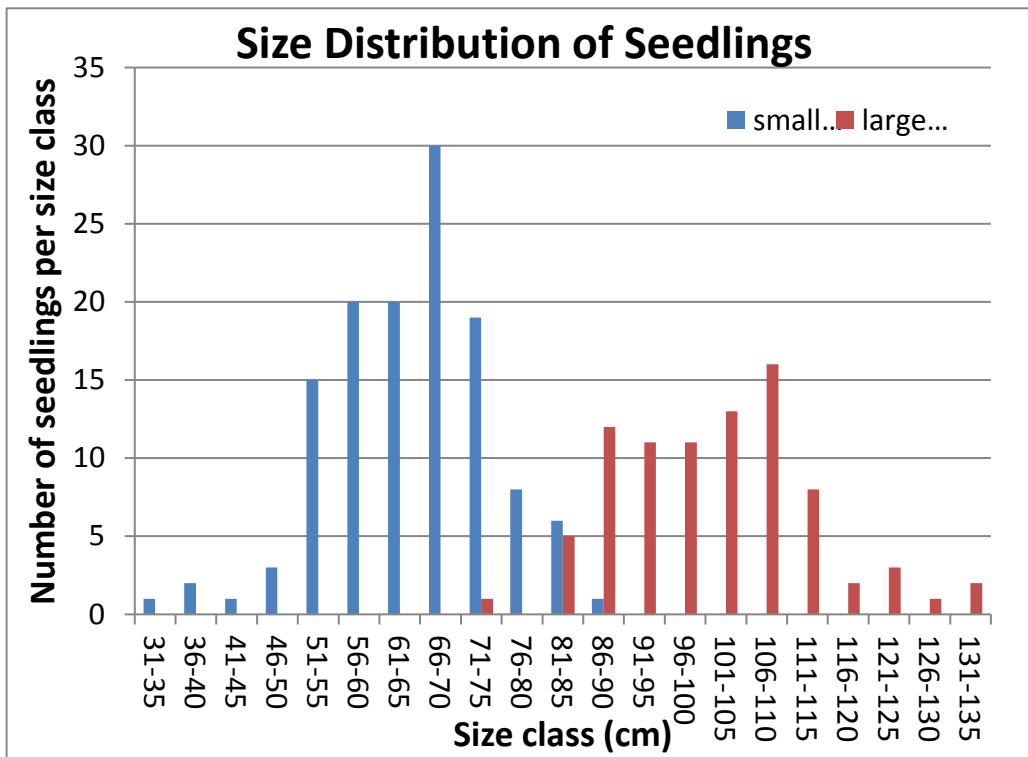


Figure 4. Size distribution of seedlings planted at Webster Creek 2010.



Figure 5. Photograph of browse protection cage constructed in 2010 western redcedar planting trial. A “smaller” seedling is planted in cage with “larger” seedling planted to right of cage.

Seedling material consisted of “small” seedlings 1+2 year averaging 25.8 inches high (standard deviation of 3.8 inches) and “large” seedlings 1+3 year averaging 40.2 inches high (standard deviation of 4.6 inches). Larger seedlings tended to be substantially greater in stem diameter than smaller seedlings, although no caliper measurements were made. Both seedling sizes were in two gallon pots and grown at a local nursery. Although we were told the seedlings were not fertilized, there was evidence of fertilizer in some of the pots.

In each of the cleared planting circles, a total of 21 seedlings were planted at approximately 6 foot centers. In the uncleared areas, a total of 14 seedlings were planted over a similar area (Table 1). Maps were drawn of seedling locations to relocate seedlings for future monitoring. Contract crews conducted the clearing on Nov. 3 and 9 and planting on Nov. 9 and 10. Total costs to install this project were \$10,000, including staff and contractor time, plant materials, and materials for browse protection.

Table 1. Treatments, number of treatment areas, and number of seedlings in western redcedar underplanting evaluation project.

Treatment	Number of planting areas	Number of seedlings			Total
		No browse protection-small seedlings	With browse protection-small seedlings	No browse protection - large seedlings	
Understory clearing	6	42	42	42	126
No clearing	6	42	0	42	84
Total	12	84	42	84	210

Monitoring Results and Discussion

Initial planting data were taken on Nov 10, 2010, with subsequent monitoring data collected on Feb 13, 2012 and March 19, 2013. Data collected included alive/dead, height, and an estimate of browse in four categories: no browse, <20%, 20-80%, or >80% of branches browsed. In January of 2012 there was a major ice storm. Twelve of the browse protection cages were damaged from this storm. An additional four cages had been ripped out, apparently by elk. Fourteen of these cages were repaired. The other two cages were beyond repair and the seedlings dead. In 2013, two cages had been damaged by elk and two damaged by falling debris. Three of these cages were repaired, one was beyond repair. Four additional cages required minor repair.

From 2010 to 2012, overall mortality was low, with only 9 out of 210 seedlings dead (>95% survival rate). By 2013 25 total seedlings were dead or missing (88% overall survival). Seedlings in uncleared areas had lower survival than those in cleared areas in both 2012 and 2013, likely due to competition for resources with the surrounding shrubs (Figures 6 and 7). Large seedlings in cleared areas had greater mortality from 2012-2013 than from 2010-2012. But there were only two dead and one missing in 2013, a 93% survival of large unprotected seedlings in cleared areas from 2010-2013. No small seedlings in cleared areas, either protected or unprotected, had died by 2013.

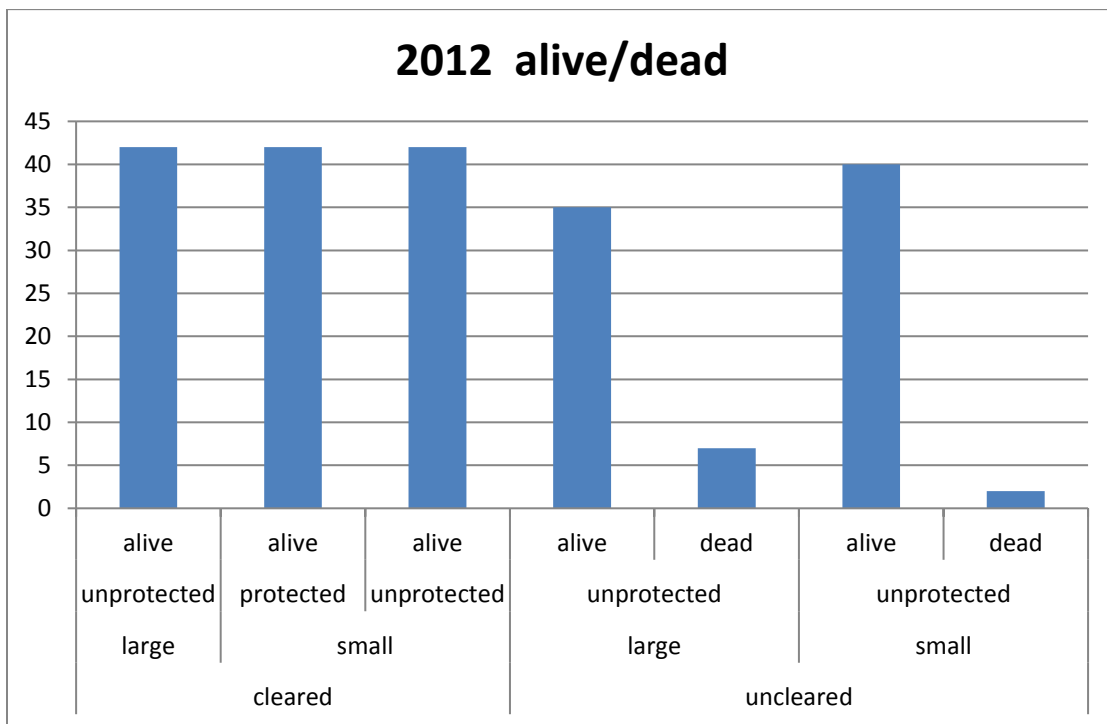


Figure 6. Survival of seedlings in 2012 by treatment type (in 2010 there were 42 seedlings in each treatment).

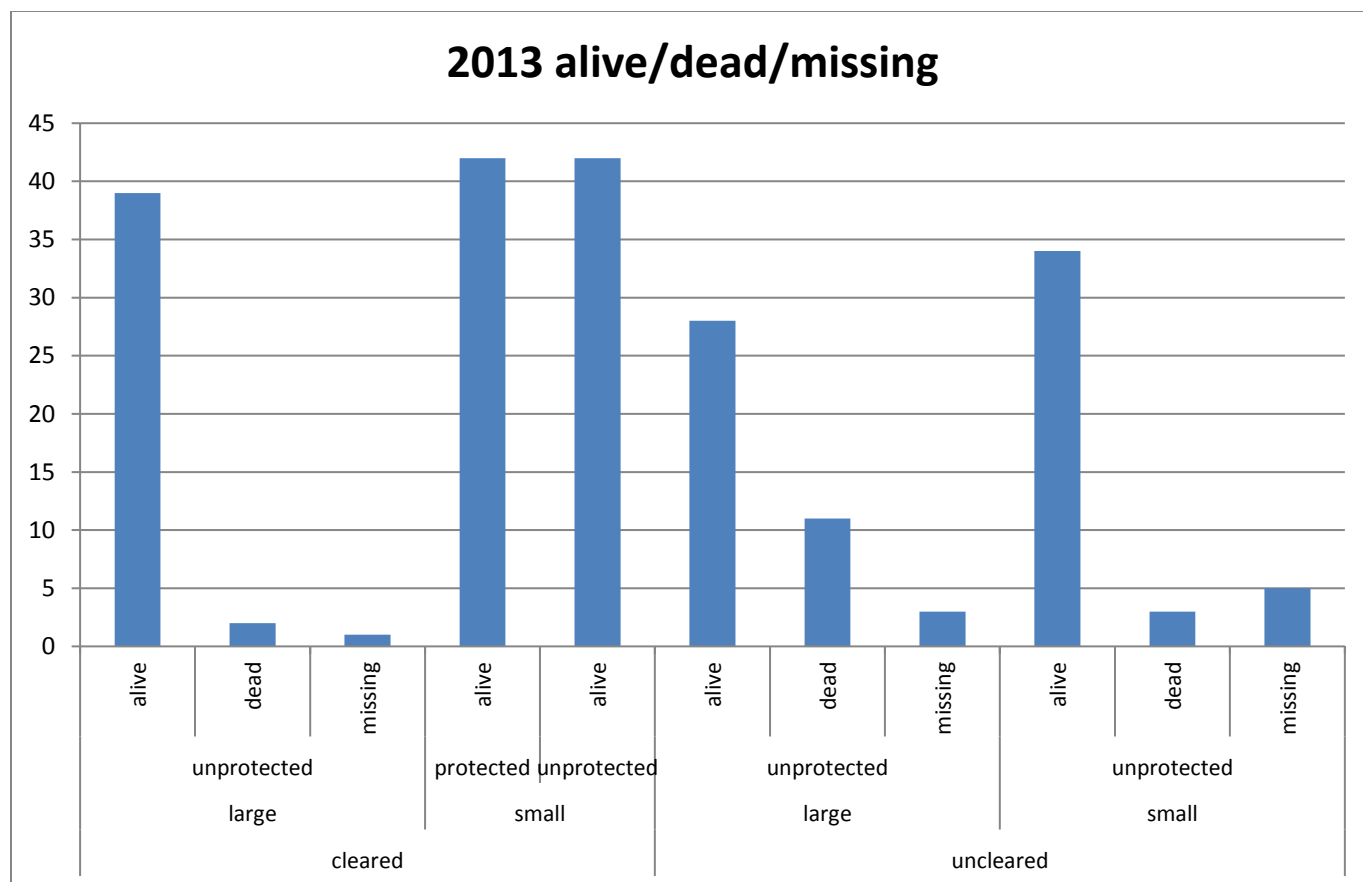


Figure 7. Survival of seedlings in 2013 by treatment type (in 2010 there were 42 seedlings in each treatment).

Large seedlings were about 100 cm and small about 60 cm at the start of the experiment in November 2010 (Figure 8). Large seedlings in both cleared and uncleared areas lost about 20 cm and averaged 80 cm by spring 2012 (due to browse or tops broken by storm damage). They stayed about the same through spring 2013. Small unprotected seedlings in uncleared areas had little change in height by spring 2012 and lost about 5 cm by spring 2013. Small, unprotected seedlings in cleared areas decreased slightly in height by spring 2012 and stayed about the same through 2013. Small protected seedlings increased in height about 10 cm by spring 2012 and another 20 cm by spring 2013, about a 50% increase over two growing seasons (Figure 9).

Protected, small seedlings suffered almost no browse by 2012, with about 25% having light browse by 2013 (mostly branch tips outside of cages). Large unprotected seedlings in cleared areas suffered the most browse by 2012, but were exceeded by small unprotected seedlings in cleared areas by 2013. All unprotected seedlings in uncleared areas suffered less severe browse than those in cleared areas, with large unprotected seedlings in uncleared areas having the least amount of severe browse after three years (Figure 10).

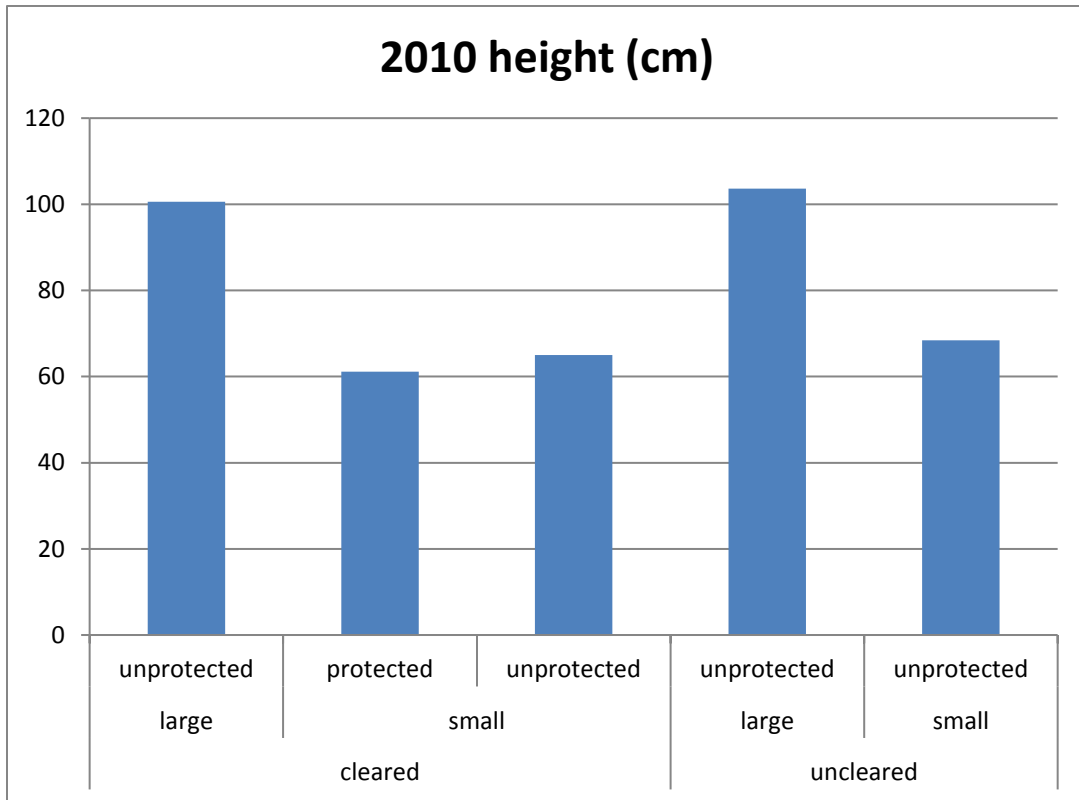


Figure 8. Height of seedlings at the start of the 2010 trial

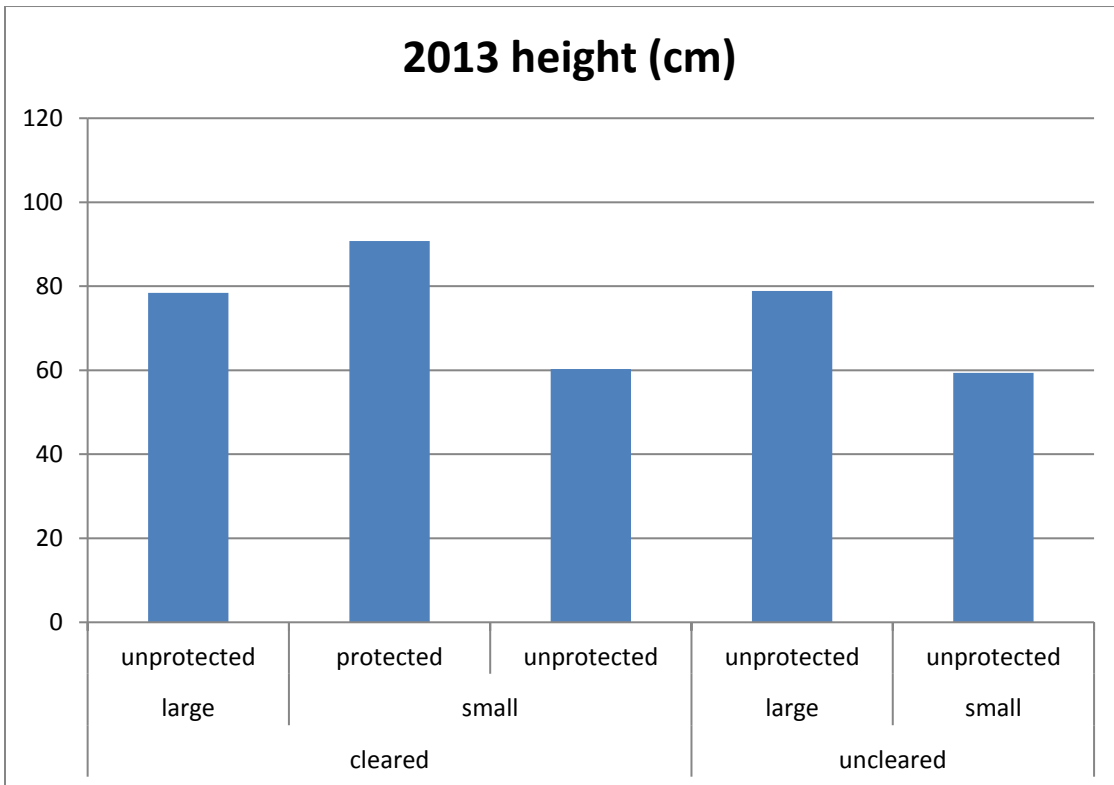
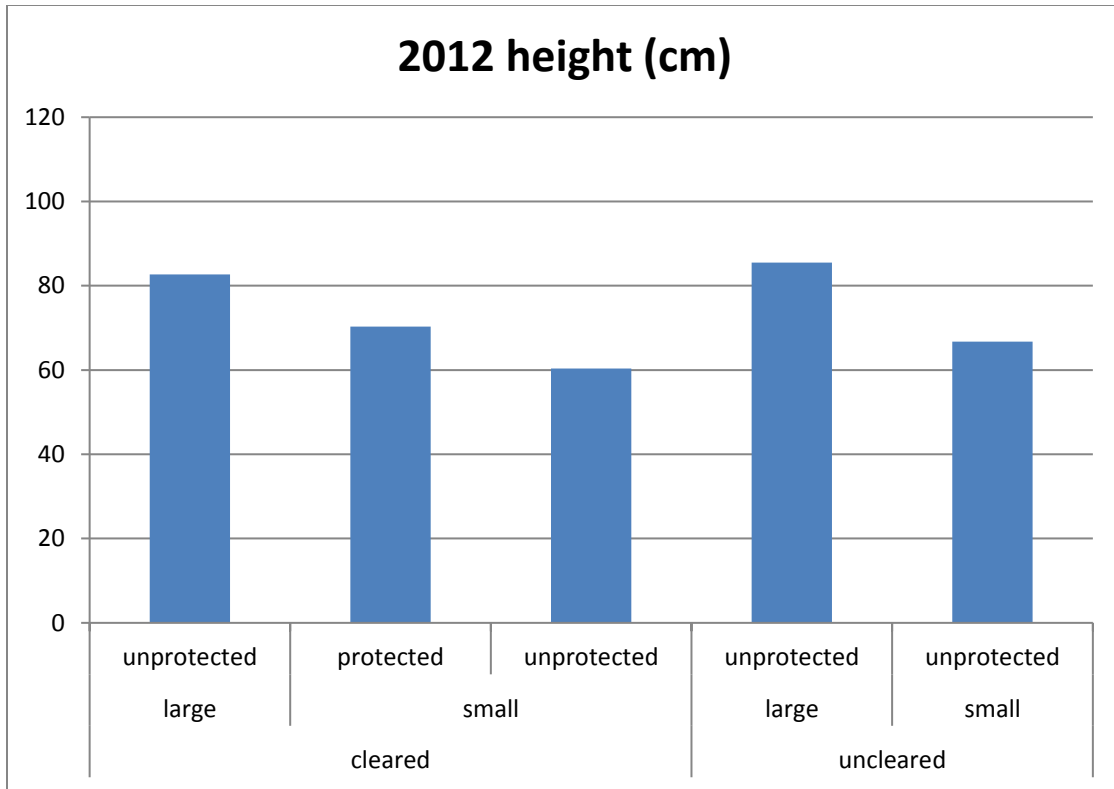


Figure 9. Average seedling height by treatment in 2012 and 2013.

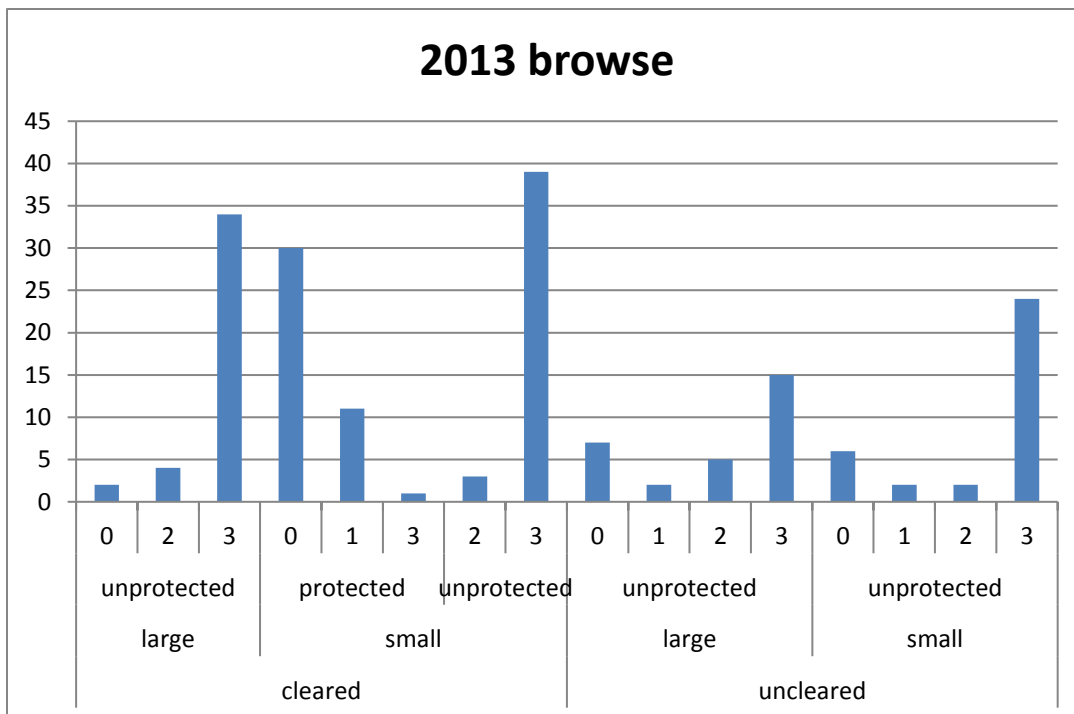
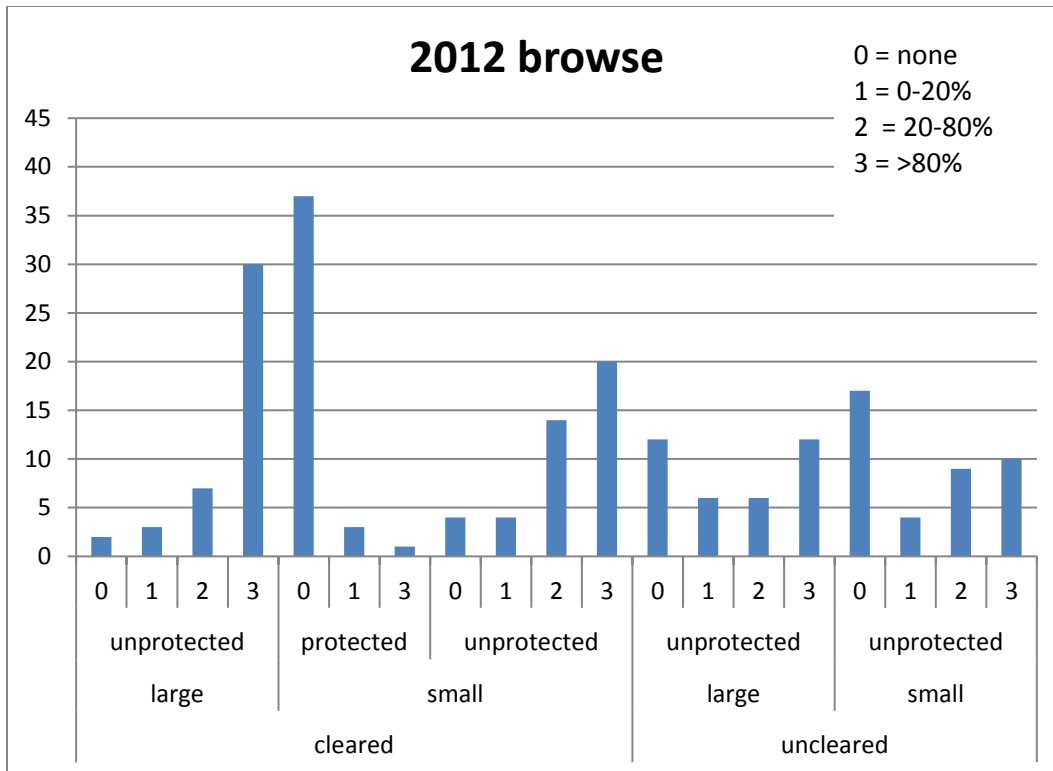


Figure 10. Amount of browse by treatment in 2012 and 2013.

2012 Webster Creek Conifer Underplanting

The 2012 conifer underplanting project also consisted of circular areas cleared of understory and was located from about 750 to 1,500 feet downstream of the 10 Road. This third underplanting project was implemented at Webster Creek in order to further augment existing conifers on the Webster Creek floodplain, particularly closer to the stream and further downstream than the two previous projects. Limited survival and growth of seedlings from the 2001 experiment also contributed to the rationale for implementing a third Webster Creek project.

Project Design and Implementation

The 2012 project consisted of 10 planting circles cleared of understory and measuring approximately 30 feet in diameter. The planting areas were located where overstory canopy closure was generally less than 50 percent to reduce the effects of overstory shading. Six of the planting areas were on the left bank, adjacent to the trail that follows the creek from the 10 Road to Walsh Lake (Figure 11). The other four areas were on the right bank of Webster Creek within about 50 feet of the stream channel. The cleared understory debris was tossed to the outside of the circles, leaving an open patch with no shrubs but in some cases a few herbaceous plants remaining. The plots were located in fairly open sites with low canopy cover (< 50%) from the surrounding red alder dominated forest.

In each cleared circle, 10 western redcedar and 10 Sitka spruce seedlings were planted (Table 2). All were 1-gallon potted stock from a local nursery. Seven of the cedar were enclosed in browse protection cages (Figure 12), and the other three cedar were each planted with a spruce seedling (both seedlings in the same hole without browse protection (Figure 13)). The remaining seven spruce were planted without protection. The planting of cedar and spruce together has been reported as a way to decrease browse damage by deer and elk, and was previously tried with some success in conifer underplanting along the upper Cedar River in 2008 and 2009. This was intended to be another opportunity to evaluate its utility for increasing cedar survival and growth.

Browse protection structures for the cedar were modified from the 2010 design. They were made with 4 foot high plastic fencing (Tenax poultry fence with $\frac{3}{4}$ inch hexagonal mesh) made into cylinders averaging about 16 inches in diameter. The cylinders were held together by zip ties and each was supported by two 5 foot metal t-posts. In the 2010 underplanting project, 16 gage wire fencing supported by 4 foot wooden stakes were used. However, these were found to be easily damaged by elk and falling debris. The original design (Booth and Hennigman 1996) was changed for this project to hopefully provide sturdier structures that will be more resistant to damage.

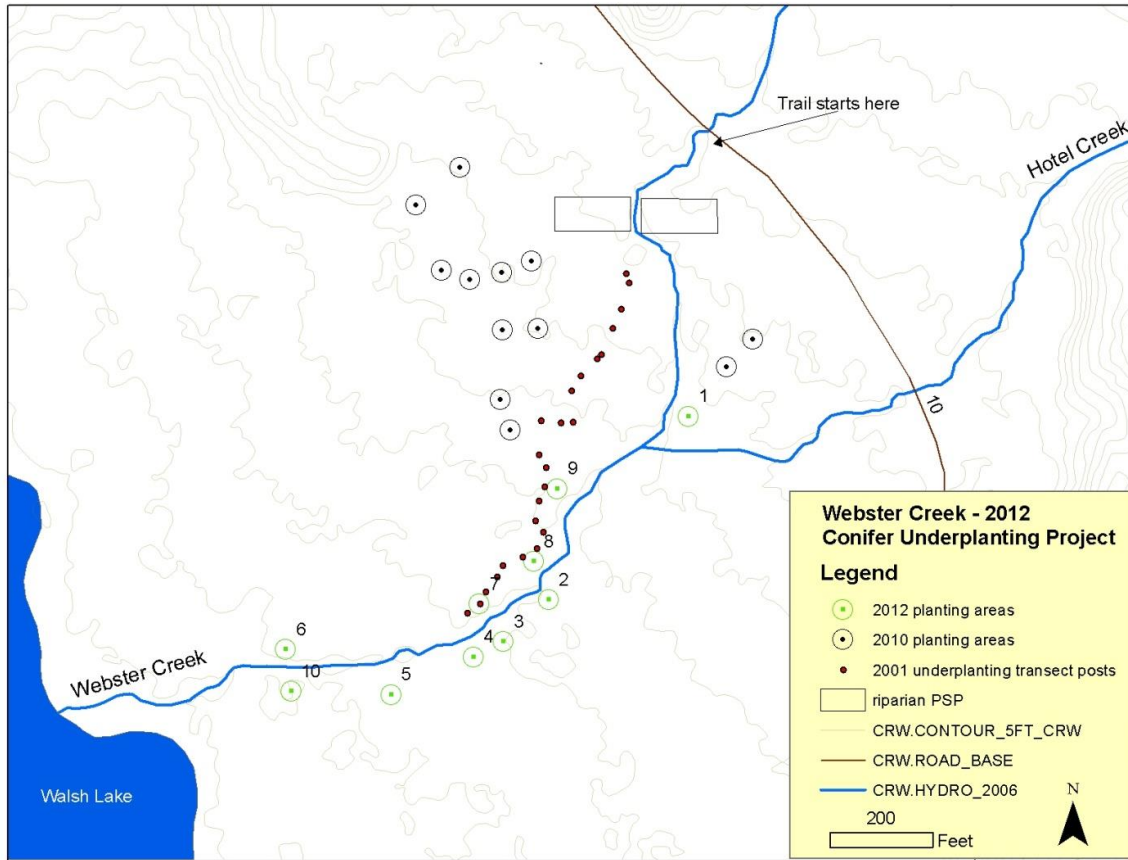


Figure 11. Location of 2001, 2010, and 2012 conifer underplanting areas at Webster Creek. Each open circle represents an approximately 30 foot diameter area.

Table 2. Number of seedlings planted in Webster Creek 2012 underplanting project.

Species	Number of planting areas	Number of seedlings per planting area			Total
		With browse protection-	No browse protection	Planted together – no browse protection	
Western redcedar	10	7	0	3	100
Sitka spruce	10	0	7	3	100
Total					200



Figure 12. Photograph of browse protection cage constructed in 2012 Webster Creek conifer underplanting project.

Contractor crews conducted the clearing on November 14 and the planting on November 15, 2012. Total costs for this project were \$6,100, including staff and contractor time, plant materials, and materials for browse protection.

Initial seedling height was not measured until March, 2013. At this time six seedlings were missing (4 cedar, 2 spruce), and 13 had been browsed (10 cedar, 3 spruce). Three seedlings had <20%, three 20-80%, and seven >80% of the branches browsed. The three browsed spruce were all in the >80% category.

Average height for the cedar was 70 cm (range 44-98 cm), and the spruce was 60 cm (range 49-80 cm). Average cedar height was the same between treatments (caged = 70 or paired with

spruce = 72). Spruce paired with cedar were slightly taller (average 65 cm) than those with no treatment (58 cm).

Most seedlings were in the “small” category as defined by the 2010 project. This category of cedars had the highest survival after three years in the cleared sites (Figure 7), and the protected small cedar in cleared areas had the lowest amount of severe browse (Figure 10). We tried to maximize survival by protecting most of the cedar. Pairing the remaining cedar with spruce will provide information on survival using this technique in low-elevation, cleared riparian sites.



Figure 13. Photograph of western redcedar and Sitka spruce seedling planted together.

2014 Webster Creek Conifer Underplanting

A fourth underplanting project was conducted along Webster Creek in 2014. This project had three main goals. First was to help stabilize the lower reach of Webster Creek near Walsh Lake and promote a more natural outlet movement pattern over time. Currently the stream in this area is migrating and moving in a way that historically was not seen. A potential reason is there are few live trees stabilizing the streambank. Re-introducing trees near the stream could promote more stability over time.

Second was to provide future large woody debris recruitment. Currently there are a few large decadent red alder are growing near the stream, but few if any conifer trees. There is also little long lasting large woody debris present in the stream itself. Based on the presence of large old stumps, conifers historically existed in this area.

Finally we wanted to increase plant species diversity and future forest complexity. Planting a mix of conifer trees and black cottonwood in the riparian corridor will improve species diversity and future ecological functions, including wildlife habitat. All of the 2014 planting supplemented that planted in 2010 and 2012.

Project Design and Implementation

The 2014 planting prescriptions included the same site preparation as in 2010 and 2012: clearing existing understory vegetation in approximately thirty-foot diameter circles. Staff marked twenty site centers based on soil characteristics (highly hydric soils were avoided) and areas with <50% overstory canopy cover (Figure 14). In addition two transects were established on either side of the creek, within ten feet of the streambank. Seedlings were spaced about ten feet apart along the transects, with a two-foot diameter area cleared around each seedling. These seedlings were flagged for future monitoring and maintenance.

Fourteen seedlings were planted in each cleared gap: two Douglas fir, four western red cedar, six Sitka spruce (all in 1-gallon pots), and two black cottonwood stakes (Table 3). Four of the Sitka spruce were planted in the same planting holes as the four western red cedar, to deter ungulate browse. The contractors were instructed to use the best available sites for a seedling based on sunlight conditions within each gap. The seedlings were planted approximately ten feet apart within the gaps.

Site prep and planting occurred on December 16-17, 2014. Total cost of this project was \$7,300, including contracted labor and plant material, but excluding staff labor.

While they were on site, the contractors also brushed around all seedlings planted in 2012, and repaired any protective cages that were damaged.

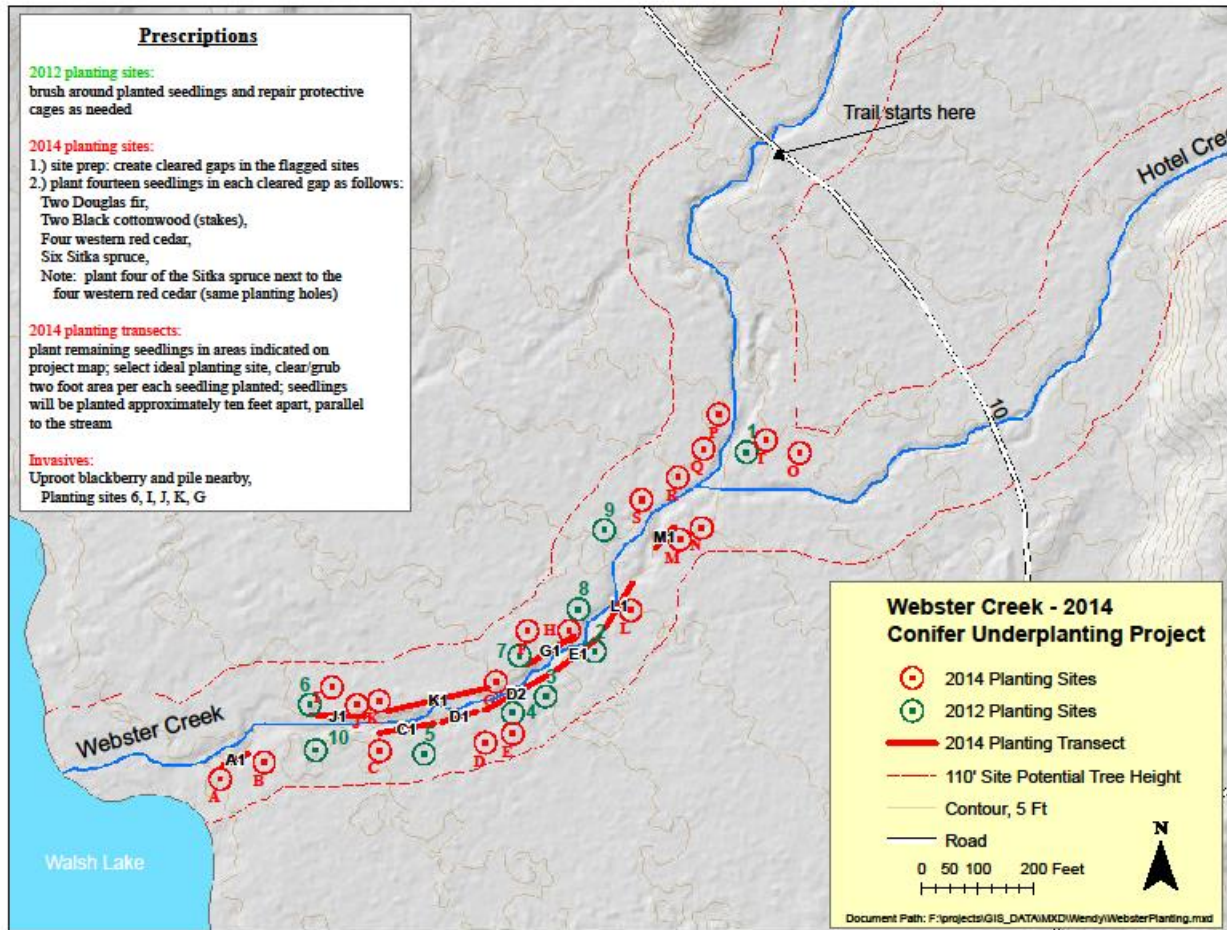


Figure 14. Location of streamside planting along Webster Creek in 2012 and 2014.

Table 3. Number of seedlings planted in 20 planting circles along Webster Creek, 2014 underplanting project.

Species	# planting circles	Number of seedlings per planting circle		Total number in planting circles	No browse protection, along transect	Total number planted
		No browse protection	Planted together			
Western redcedar	20	0	4	80	37	117
Douglas-fir	20	2	4	40	35	75
Sitka spruce	20	2	4	120	0	120
Black Cottonwood	20	2	0	40	60	100
Total Number Planted						412

2015 and 2016 Webster Creek Conifer Underplanting

In 2015, an additional 10 planting circles were installed near Webster and Hotel Creeks, on either side of the 10 Road (Figure 15). Objectives and methods were the same as in 2014, with existing understory vegetation cleared in approximately thirty-foot diameter circles. Within each circle, 3 Douglas-fir, 5 western red cedar and 7 Sitka spruce were planted, all 1-gallon potted stock. Five of the spruce were planted next to the cedar to deter ungulate browse. The other 2 spruce were planted singly. All trees were planted approximately 10 feet apart. Planting contractors also cleared around seedlings planted in 2012 and 2014, and replaced any cedars that had died. Total 2015 cost, including plant purchase and contractor time, was \$6,092.

In 2016, 95 western redcedar were planted along both banks of Hotel Creek, from the 10 Road west to the Hotel/Webster Creek confluence. Existing vegetation was cleared in a two-foot radius around each of the planted cedar. The seedlings were placed approximately every 10 feet, with standard commercial vexar tubes installed as browse protectors. Total 2016 cost was approximately \$1,500.

2017 Webster Creek Conifer Underplanting

The final conifer underplanting along Webster Creek was installed in the spring of 2017 (Figure 15). Thirty 30-foot diameter planting circles were cleared, scattered along both sides of Webster Creek north of the 10 Road. Within each circle, 3 western redcedar, 3 Douglas-fir (both 1-gallon potted stock), and 3 black cottonwood stakes were planted, for a total of 270 trees planted. Standard commercial vexar tubes were installed around each cedar as browse protections, and the cottonwood stakes were flagged for ease in locating. Location of the planting circles are shown in Figure 16. Total cost for the 2017 installation, including plant purchase and contractor time, was approximately \$8,950.

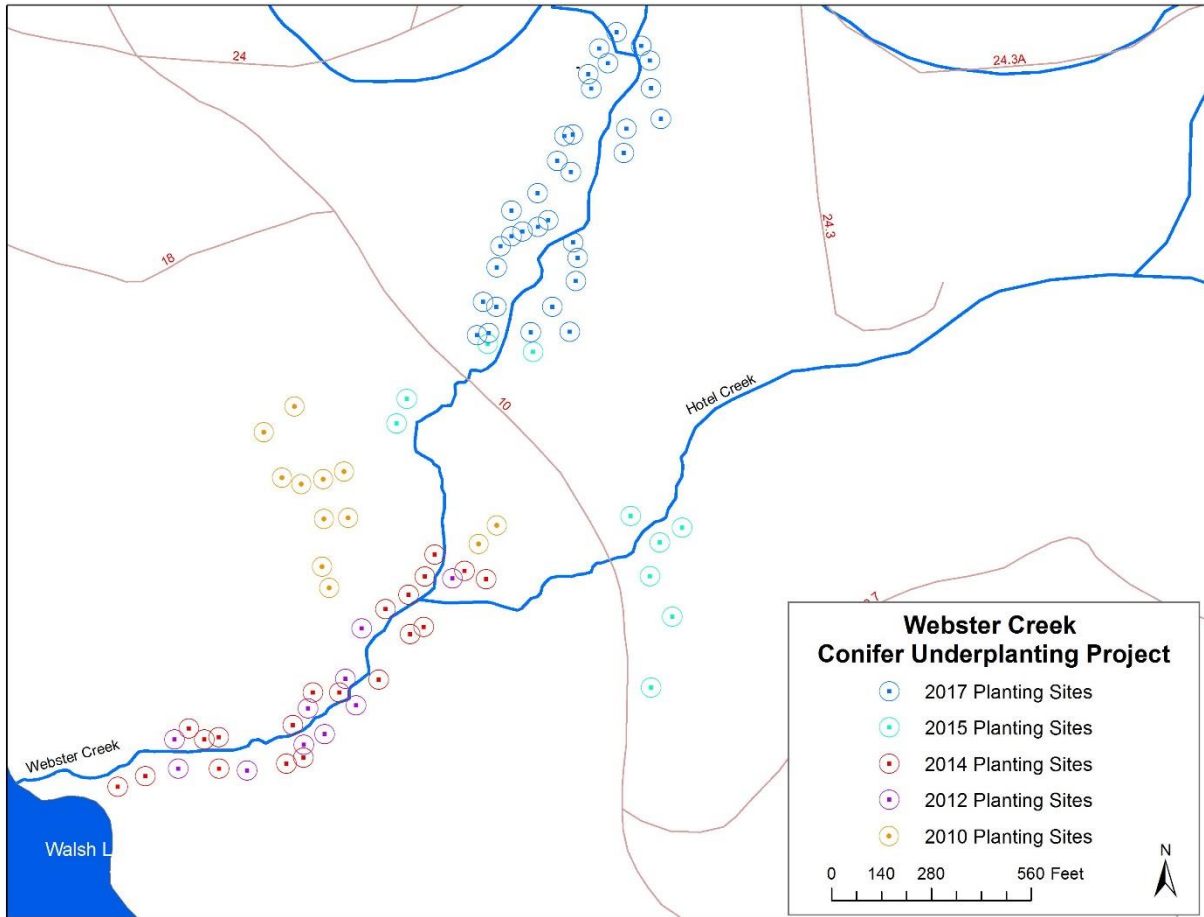


Figure 15. Location of planting circles installed 2010-2017.

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