Watershed Restoration Stewardship

What is the Restoration Stewardship Project?

The Restoration Stewardship Project was developed by the Education Leadership Program at the University of Oregon. It was created in response to a growing need for a monitoring program to evaluate restoration sites within the Upper Willamette Valley. In 2004-2005 the project involved developing and implementing a monitoring program to serve the needs of several local landowners and two public parks. In addition, the project will provide valuable information to future riparian restoration participants on how to best nurture their trees to a free-to-grow status. Now, in its second year a six-member team will be leading this endeavor. They will be gathering and analyzing second year data as well as preparing new sites for integration into the monitoring program. The team includes project manager Chris Massingill and five undergraduate students: Bess Ballantine, Adam Fleenor, Hilary Lewis, Emily Mulford & Sky Skach.

Kate and Jerica at Moss' Place (2004)

Implementation versus Effectiveness Monitoring:

There are two kinds of monitoring: implementation and effectiveness. This project is focused solely on implementation monitoring. Implementation monitoring asks how successful restoration methods are at keeping plants alive and healthy. To determine this, planted stock is monitored for survival, growth, and vigor. Using comparisions of these characteristics allow feedback to be given to the restoration process as part of an adaptive management plan. Adaptive management allows restoration techniques to change according to the needs of a site over time. In addition, comparisons improve estimations of time to free-to-grow status. Once a tree or shrub is free-to-grow, they require only minimal maintenance and implementation monitoring is no longer needed. Alternatively, effectiveness monitoring asks how successful restoration methods

have been at meeting overall project goals. There are many protocols for this type of monitoring, but they are beyond the scope of this project.

Current Goals of the Restoration Stewardship Project (2005-2006):

- Assist watershed councils with collection of monitoring data in order to improve success in restoration projects
- Create and deliver presentations to local watershed councils on riparian restoration monitoring and the scope of our project
- Coordinate student efforts for field days
- Provide field experience and skills practice for undergraduates
- Provide a graduate student with opportunities for project management and teaching
- Develop a website and poster which provide information on our project

Long Term Goals for WRS

- Continued collection of data for restoration projects
- Streamline monitoring process
- Add additional project sites
- Nurture all trees and shrubs to free-to-grow stage

Rudy and Jess at Moss' Place (2005)

Bess and Hilary (2006)

ENVIRONMENTAL STUDIES

SERVICE LEARNING PROGRAM

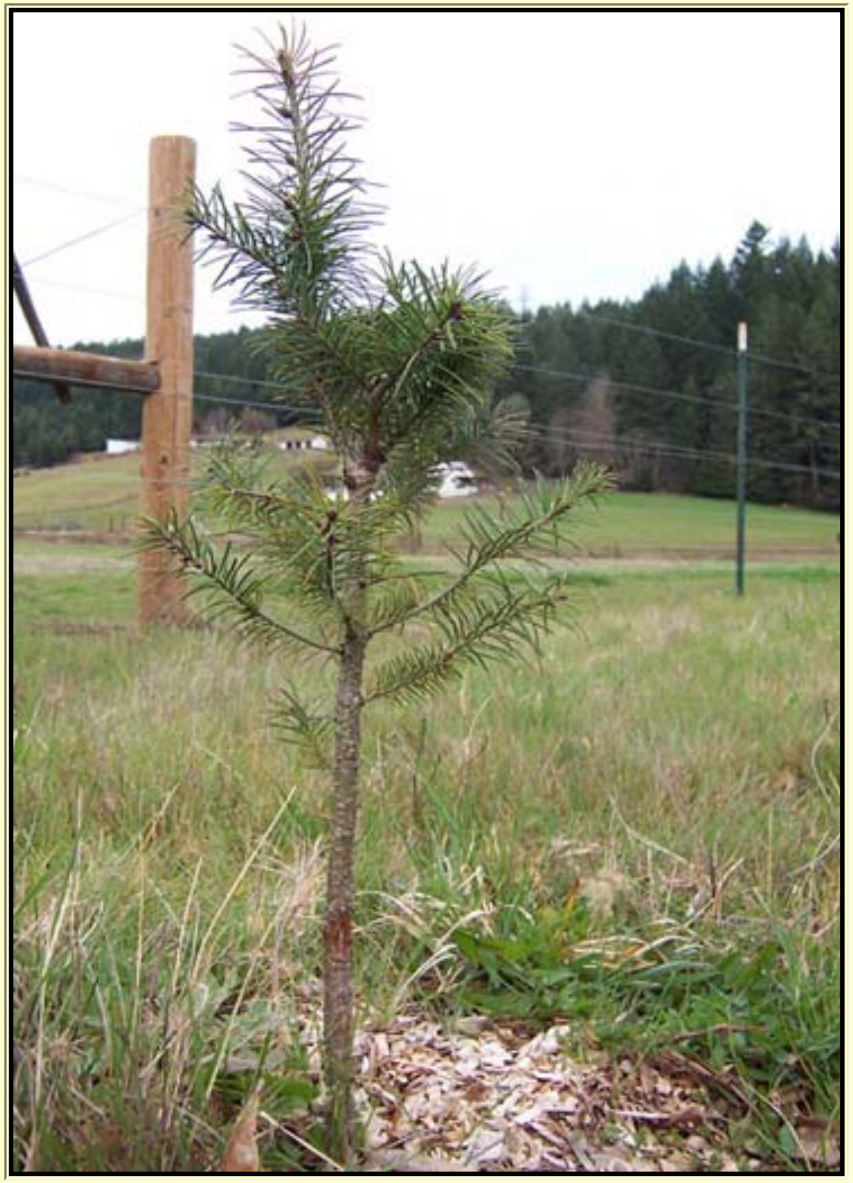
Watershed Restoration Stewardship

Monitoring Methods

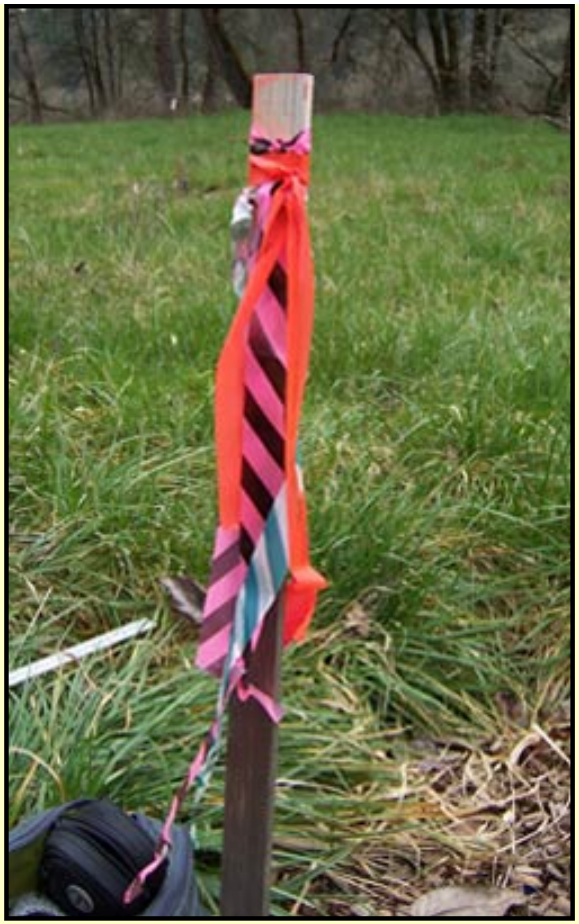
Our team records information for many different variables on each tree we monitor. This information helps us to determine how successful the implementation of these restoration sites has been. For instance, if many of the plants are shown to have low vigor, our data can point to the source of the problem.

Along side the picture of the Douglas fir sapling, you will see examples of the characteristics that we measure in the field. Click on each characteristic to get a more in-depth description.

Kate and Rudy collecting data on a western redcedar.



- Species
- Height
- Overstory Competition
- Grass Competition
- Damage



This is one of the plot stakes at the Buford Site that marks the northwest corner of each plot.

ENVIRONMENTAL STUDIES
SERVICE LEARNING PROGRAM

Watershed Restoration Stewardship

Summary Report - Taylor's Place

Project Info

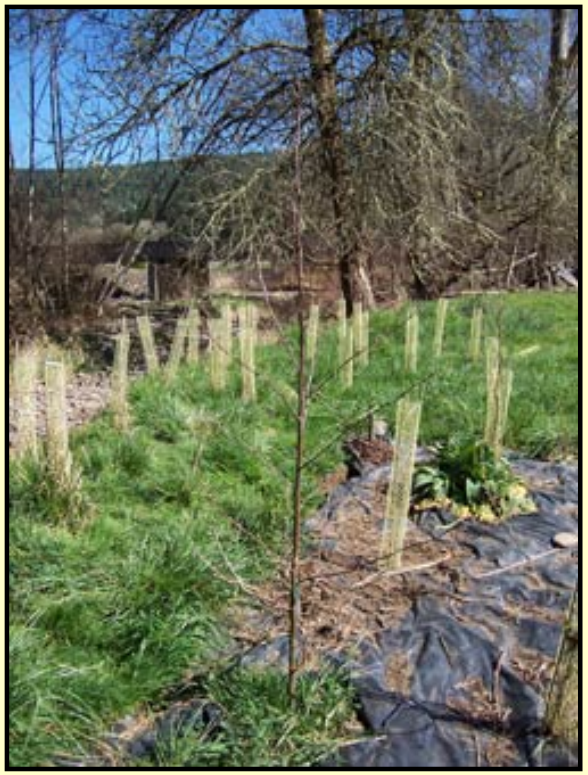
The Taylor site, owned by Greg and Jada Taylor and managed by Dave Bontrager, is located on Lost Creek in the Middle Fork Willamette Watershed. The site was surveyed by Rudy Dietz, Jerica Miller, Jess Parker, and Kathryn Skelton on the 20th of January 2005.

Summary

This riparian planting measures 28' by 136' running parallel to Lost Creek. There are 155 planted stock on the site, consisting of Red Alder (Alnus rubra), Red-Osier Dogwood or Creek Dogwood (Comus sericea), Oregon Ash (Fraximus latifolia), Pacific Ninebark (Physocarpus capitatus), Cottonwood (Populus balsamifera), Sitka Willow (Salix sitchensis), and Snowberry (Symphoricarpos albus). Because of the size of this site, we decided to collect data on all planted stock instead of setting up plots.

Much of the site was prepared with matting, and when the site was planted, the blackberry was cut back. Some of the planted stock are protected by vexar tubes and mulching. A sprinkler system waters the site when needed.

Among the types of damage observed, flood wash and browsing stand out as significant sources.

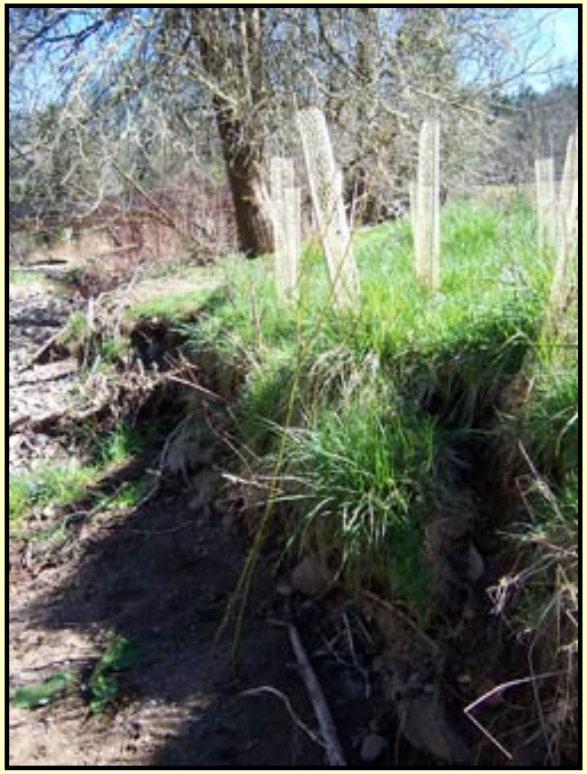


Black matting is visible on the right, and vexar tubing is visible as well.

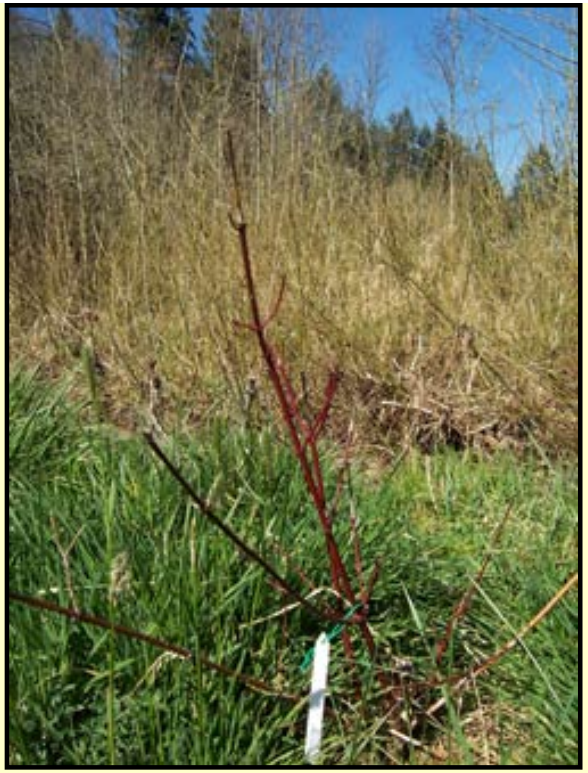
Because the stock were planted on the edge of an eroding bank, many have fallen with the eroding soil and are now in the streambed, and some sit perpendicular to the bank. Browsing is also a major issue because only some of the stock are protected by tubing. The planted stock in the west end of the plot are shaded (>50% on average) by Aldus rubra , and planted stock in the east end are shaded (<25% on average) by Fraxinus latifolia <50%. The average height of the trees is 46.2", and the average height class for shrubs is 2-4ft.

Pivot Table

TAYLOR'S - BASELINE DATA 2005									
		Species							
Plot #	Data	ALRU	COSE	FRLA	PHCA	POBA	SALI	SYAL	Grand Total
1	Count of Species	20	13	10	31	11	42	6	133
	Count of Live Plant	20	13	10	31	11	40	6	131
	Average of Height (in)	50.3		49.6		35.8			46.2
	Average of Height Class		1.85		1.71		1.58	1.92	1.68
	Average of Live Crown Ratio	0.9		0.7		0.9			0.8
	Average of Ovsty Comp	1.9	2.1	1.4	1.7	1.7	1.6	2.8	1.8
	Average of Brush Comp	0.7	0.6	0.5	0.5	0.5	0.8	1.0	0.7
	Average of Grass Comp	2.2	1.7	2.6	2.0	1.4	2.2	2.2	2.1
	Average of Damage Code	1.1	2.6	1.0	1.0	1.4	1.2	0.8	1.3
Total Count of Species		20	13	10	31	11	42	6	133
Total Count of Live Plant		20	13	10	31	11	40	6	131
Total Average of Height (in)		50.3		49.6		35.8			46.2
Total Average of Height Class			1.85		1.71		1.58	1.92	1.68
Total Average of Live Crown Ratio		0.9		0.7		0.9			0.8
Total Average of Ovsty Comp		1.9	2.1	1.4	1.7	1.7	1.6	2.8	1.8
Total Average of Brush Comp		0.7	0.6	0.5	0.5	0.5	0.8	1.0	0.7
Total Average of Grass Comp		2.2	1.7	2.6	2.0	1.4	2.2	2.2	2.1
Total Average of Damage Code		1.1	2.6	1.0	1.0	1.4	1.2	0.8	1.3



Because of this eroding bank, many willows and other planted stock have fallen into the stream.



A Happy, healthy dogwood

Watershed Restoration Stewardship

Landowner Interviews

In winter term, the team had the opportunity to interview some of the private landowners about their projects. Below, are some of the stories of these landowners, project histories, and valuable advice for people thinking of beginning their own projects in the future.

The Bontrager Story

Dave Bontrager owns a piece of land near Dexter, Oregon through which a small, unnamed tributary of Lost Creek in the upper Lost Creek Watershed flows. Planting began on this site about 10 years ago. This site has approximately 10 acres that could be restored, but at this point, only 4-5 acres have been planted. Bontrager estimates that 1200 stock have been planted thus far, and a small percent are trees. Most are shrubs.

Being a biologist and bird enthusiast, Bontrager provided his own technical assistance. He received funding from OWEB (Oregon Watershed Enhancement Board), and the grant included provisions for 40-50 hours per year of work. However, he estimates that he has logged far more hours. In an acceptance speech for the 2004 Fish and Wildlife Steward Award for Non-industrial Forest Lands in Northwest Oregon, Bontrager thanked a couple of groups. ODFW (Oregon Department of Fish and Wildlife) and their scientists--biologists and hydrologist--were instrumental in his project planning. Amy Chinitz, coordinator for the Middle Fork Willamette Watershed Council, was a great support, providing assistance with grant proposals and volunteer recruitment. In addition, AmeriCorps volunteers helped with some of the labor.


Huhtanen-Schöllers are restoration-minded landowners on the Long Tom River.

At the project's conception, Bontrager had two types of goals: in-stream and terrestrial. The stream was incised and disconnected from the surrounding terrain. It no longer had a relationship with the floodplain. In an attempt to reestablish this connection, Bontrager installed log structures in the streambed. This benefited the stream in many ways. The logs diverted some water to form additional channels, raised water levels, and increased spawning habitat for trout and other salmonids. The log structures increased stream complexity by trapping sediment and allowing the water to leave the stream channel during peak flow events. This provides the landscape with much needed nutrients and further alleviates the need for irrigation. Although he hasn't seen it happen recently (due to lack of precipitation), it worked perfectly during the last high flow event.

For his terrestrial goals, Bontrager wanted to rid the area of homogeneous, non-native plant cover and replace it with native successional growth. As a bird enthusiast, he was interested in reestablishing bird habitat and biological integrity. In addition, planting near the stream will improve water quality by adding organic material (leaves and insects) to the water and providing shade for aquatic habitat.

As in all well thought projects, Bontrager's goals and motivation were connected. When he bought this beautiful piece of land and discovered it was overgrown with retched, non-native plant cover, as a biologist, he felt compelled to repair the damage and restore bird and other natural habitat. Bontrger worked for US Fish and Wildlife as a restoration expert for many years in southern California, and it felt instinctive to continue the work up here in Oregon.

Blackberry bushes have proved to be a sizable challenge, as they have a way of dominating a landscape and choking out all other life. In an attempt to control their growth, Bontrager cut the blackberries back with a metal-bladed weed trimmer to a 6-inch stub (in order to locate the base later). In areas where native species were present, Bontrager embarked on the lengthy process of following the chains of blackberries back to the base by hand. After the blackberry chains were cut back, there are a couple of options. He could either lay matting to suffocate the blackberry or go in with a tool (shovel, etc) and dig up the roots as much as possible. After planting, it is important to stay atop the blackberries. If the terrain is level and the planted stock sufficiently spaced, he mows the site. Otherwise, it is necessary to clear the blackberry and other invasive species by hand or with a metal-bladed weed trimmer. They are resilient, but Bontrager doesn't use herbicides and emphasizes the importance of mulching, especially in times of drought.

Bontrager had some advice for future restoration-minded landowner that he wanted to share. The most important being, "don't undertake this process, unless you mean it." A single project, regardless of size, can take relentless maintenance for 3-5 years. He also emphasized the importance of working with an expert and not taking on a larger project than you can manage. The second most important piece of advice was, "don't turn your back on the blackberries."

Clearing blackberry takes hours of hard, physical labor, and it is disappointing to see that all wasted.

In the future, Bontrager would like to try his hand at oak savanna and wetland restoration, and he may have his chance. He hopes to restore the remaining 5-6 acres but will follow a different plan. That portion of his property is wetland (not riparian), the planting will be more scattered. Although he feels like he bit off more than he could chew, Bontrager is always happy to help things grow. It is very satisfying as a biologist and "someone who is emotionally connected to the aesthetic part of restoration" to see birds make nest in the trees planted during these projects.

The Huhtanen-Schöller Story

Karen Schöller and Richard Huhtanen own 82 acres within the Long Tom Watershed. A half of a mile of the old, windy river runs through their property, where the secondary channel system remains intact. When Schöller and Huhtanen first bought their property, almost three years ago, they had two specific goals in mind: to have a place where Karen could train and ride her horses and to continue their efforts as thoughtful stewards to the land. When making these decisions, they asked, "How do we protect the river?" Despite previous owners farming and cattle grazing, the area along the river experienced very little impact. Red-legged frogs, wood ducks, various woodpeckers, and western pond turtles are found along the property.

With a year and a half of planning, Schöller and Huhtanen set aside 35-40 acres for restoration efforts and habitat renewal. The first task involved the removal of a ten-foot wall of Himalayan blackberry that took over valuable habitat and blocked access to the river and various ponds. PacWest Excavating's Bobcat Jeff, brought a bobcat with a large mowing blade to tear up most of the blackberries. Richard followed the mowing with spot herbicide treatments. After the blackberry had been cleared, in January of 2005, 1200 trees were planted. Among the trees and shrubs planted are Oregon ash, big leaf maple, twinberry, cascara, snowberry, red alder, Indian plum, Douglas spiraea, nootka rose, white oak, Pacific ninebark, Oregon grape and ponderosa pine. The goal of the planting is to shade out blackberry habitat and create more space for the various critters that live in the area.

The majority of the funding came from the Long Tom Watershed Project and 2-5 acres qualified for support from the Conservation Reserve Program (CRP) Project. Cindy Thieman, projects and monitoring coordinator for the Long Tom Watershed Council, is the project manager and has provided an endless amount of support in helping Schöller and Huhtanen create a plan that nurtures their dreams and goals for the property. Thieman has not only helped design the project, but has also been a bridge to access various landowner management classes that saved time and money. Thieman has given contact information of various consultants and experts, and been available for moral support as well.

Richard will take on the maintenance of this large endeavor. With plenty of summer watering, Huhtanen will have his hands full. Luckily, he will have a water truck and road accessibility to most of the plantings. Besides tree and shrub maintenance, reed canary grass will also require constant looking after. The project is young and there are high hopes for its success.

For those interested in doing projects of their own, Karen Schöller is a wealth of valuable advice. First of all, she says, "take three long breaths." Constantly ask yourself what your goals are, what kind of time and energy will this take and more importantly, what is your fantasy about your project? Begin the process with the Watershed Councils. They are non-regulatory; they know everything and are connected to everyone. Watershed Councils will ask questions for you and help you educate yourself about your property and its potential. When someone comes to your property, an expert from Fish and Wildlife or a botanist for example, phrase your questions to them in a personal manner so that you get a personal response: "If this was *yours* , what would *you* do with it?" Keep having your fantasy, but remember to be flexible about your plans, your goals, and the issues-- because all of these will change. There may not be any right answers and everyone you talk to will have different solutions.

When asking Schöller how she feels about her project, she says, "I am awestruck." Planting trees felt so good and she is relieved to have that phase of the project completed. The support from the Long Tom Watershed Council (LTWC) and CRP has exceeded her expectations with the quality of trees they provided and the support they have given. The LTWC alone provided time, advice, material, trees, flagging and stakes. The only expense Karen and Richard have had to carry has been the cost of herbicides for the blackberry and their valuable time. In one year, they have seen the duck population double!

In the future, Karen envisions taking half of their property out of a buyer/seller relationship and protecting it permanently under some sort of land trust. There is more space to be explored by biologists for woods, plants, and animals: areas that are still left relatively unexplored by Huhtanen and Schöller. For now, there is the first project to complete. After that, who knows? One thing remains certain; our knowledge of how to be good stewards is an evolving process, and one to which Karen Schöller and Richard Huhtanen have dedicated themselves.

The Taylor Story

As a fisheries biologist for the Army Corp of Engineers, Greg Taylor easily recognized the need for riparian vegetation along the back edge of his property, along Lost Creek a tributary to the Middle Fork Willamette. The area, virtually devoid of all riparian vegetation also had blackberry encroaching. Wanting to restore habitat for birds and fish, Greg soon enlisted the help of Dave Bontrager, a friend and Wildlife Biologist, who had designed several other restoration projects in the watershed. Bontrager came up with a plan to replant the site, which is approximately 150 feet by 30 feet, with a variety of native species including: Indian plum, snowberry, willow, ash,

cottonwood, and dogwood. With Bontrager's assistance Greg was able to draw up a grant proposal, which he then submitted to the Oregon Watershed Enhancement Board (OWEB) for approval. OWEB provided Greg with the small grant he had been seeking and planting of the site was completed in 2004.

Preparation of the site was minimal. Blackberry was removed, the site was mowed, and black plastic sheeting was laid down to help control weed growth. Together, Greg and Bontrager planted all the purchased stock. Maintenance of the site has varied throughout the year. In the summer watering has been the top priority and Greg uses a sprinkler to help achieve the task. Greg also does occasional grubbing and mulching to help maintain the site. Greg stated that he has made the maintenance of the site work for him, putting in an average of a couple of hours a week during the summer, while during the winter months the site is maintenance free.

Now a year into the project Greg states that he is happy with the results, "The growth of the plants has made me pretty happy and we've had good survival." Greg also added that the project has proved not to be too burdensome and that the time and energy commitments have been consistent with those laid out by Bontrager during the projects inception. Greg confessed that he wishes the project could be five years from now, so could enjoy the full benefits of the project today. However, he recognizes that the restoration is moving along well and that time is needed to bring the results he is looking forward to: a restored riparian community that provides needed habitat for surrounding wildlife.

During the project Greg received support in his efforts from Bontrager and the Middle Fork Willamette Watershed Council, both of whom he has worked closely with in the past and throughout the project.

When asked what he would tell a person just getting started on a restoration project Greg replied, "That it takes work, but to stick with it." Greg also advised that working with OWEB throughout a project could be a bit of a challenge, especially if the project undergoes any changes before or during the actual planting. In his experience OWEB has become more stringent on what is reported in the grant proposal matching exactly what is done on the site and was disappointed with his own back and forth experience with OWEB. However, he acknowledges that since OWEB is offering financial support for projects, meeting their demands may be well be worth the time and effort.

For future restoration projects on or around his property Greg indicated that he could imagine looking into a project to restore the upland vegetation near his home. Furthermore, he stated that he would like to see what could be done about a local county culvert that is preventing fish passage along Lost Creek, which remains the last un-damned tributary on the Middle Fork Willamette. In addition, Greg suggested that a study to discover the upper reaches of reed canary grass in the area could be useful for concentrating efforts toward its removal.

Watershed Restoration Stewardship

Some common species found on our sites. . .

Big Leaf Maple, *Acer macrophyllum*

Tree. Leaves opposite, 5-lobed maple leaves, dark green above, paler below. Flowers are greenish-yellow, 3 mm across; numerous on short stalks in a hanging cylindrical cluster; appear with or before leaves. Bark reddish on young tree, branches opposite and making a strong V-shape.

Big Leaf Maple (*Acer macrophyllum*)

Black Cottonwood, *Populus balsamifera* ssp . *trichocarpa*

Tree. Leaves alternate, thick, oval, but heart-shaped at base, pointed at tip. Buds are red, pointed and sticky. Flowers are in catkins, male and female flowers on separate plants.

Creek Dogwood, *Cornus serica*

Shrub. Leaves opposite, oval, 5-10 cm long, mostly sharp-pointed with 5-7 prominent parallel veins that converge at leaf tips. Flowers are white to greenish, small, 4 petals and stamens, numerous in dense flat-topped terminal clusters.

Douglas spiraea, *Spiraea douglasii*

Shrub. Leaves alternate, oblong to oval, 4-10 cm long, toothed above the middle, dark green above, paler and often grey-woolly beneath. Flowers are pink to deep rose, about 5 mm across); numerous, in long, narrow, compact terminal cluster several times longer than wide. Young growth is reddish-brown and woolly.

Nootka Rose, *Rosa nutkana*

Shrub. Leaves alternate, compound with an odd number (5-7) of toothed leaflets; leaflets elliptic, 1-7 cm long, with more or less rounded tips. This plant is spindly, with a pair of large prickles at the base of each leaf, other prickles usually absent except on some new growth. Very fine prickles on young plants. Flowers are pink, large, 4-8 cm across, typically borne singly at the branch tips.

Black Cottonwood *(Populus trichocarpa)*

Creek Dogwood (*Cornus sericea)*

Douglas Spiraea *(Spiraea douglasii)*

Oregon Ash, *Fraxinus latifolia*

Tree. Leaves opposite, pinnately compound with usually 5-7 leaflets; leaflets to 13 cm long, oval olive-green above, paler and woolly beneath. Flowers small, inconspicuous, yellowish (male) and greenish (female) flowers on separate trees; appear before leaves, in bunched clusters on the twigs. Bark is grayish brown.

Oregon Grape (tall), *Berberis* or *Mahonia aquifolium*

Shrub. Leaves clustered, long, alternate, with 9-19 leathery leaflets, somewhat shiny on both surfaces; leaflets oblong to egg-shaped, with several prominent spiny teeth (resembling English holly). Flowers are bright yellow, flower parts in 6s; many-flowered erect clusters to 20 cm long. This is an evergreen, erect, stiff-branched shrub with yellowish wood and bark.

Oregon White Oak, *Quercus garryana*

Tree. Leaves alternate, deeply round-lobed oak leaves to 12 cm long, shiny dark green above, greenish-yellow and brown-hairy below. Flowers, male and female, are tiny and inconspicuous. Both male and female flowers on same tree; male flowers in hanging catkins, female flowers single or in small clusters; flowers as the leaves appear.

Nootka Rose *(Rosa nootka)*

Oregon Ash *(Fraxinus latifolia)*

Oregon Grape *(Mahonia aquifolium)*

Osoberry, *Oemlaria cerasiformis*

Shrub. Leaves alternate, thin, round to oval, regularly toothed on top half of leaf. Flowers are white, 5 petals, 15-20 stamens, in short drooping to erect, leafy clusters of 3-20.

Pacific Ninebark, *Physocarpus capitatus*

--Shrub. Leaves alternate, 3-6 cm long, 3-5 lobed, the lobes toothed, deeply veined, shiny dark green above, lighter and with abundant star-shaped hairs below. Flowers are white, small (4mm), 5 petals, 30 pink stamens, and there are several to many flowers clustered in terminal (at the end of the plant), rounded clusters.

Ponderosa Pine, *Pinus ponderosa*

--Tree. Leaves are long needles (10-20 cm long) in bundles of 3. The bark is cinnamon-coloured and scaly. It smells of vanilla in the hot sun.

Oregon White Oak (*Quercus garryana)*

Osoberry *(Oemleria cerasiformis*)

Red Alder, *Alnus rubra*

--Tree. Leaves alternate, broadly elliptic and sharp-pointed at base and tip, 5-15 cm long, dull green and smooth above, rust-colored and hairy below. The margins are wavy, slightly rolled under with coarse, blunt teeth. Flowers are in hanging, cylindrical spikes (catkins) that appear before the leaves; male catkins 5-12 cm long, female catkins to 2 cm long.

Twinberry, *Lonicera involucrate*

--Shrub. Leaves opposite, short-stalked, somewhat elliptical to broadly lance-shaped, pointed, often hairy beneath. Flowers yellow, tubular with 5 lobes, 1-2 cm long; in pairs in leaf axils, cupped by large, green to purplish bracts. Young twigs are 4-angled in cross-section, greenish, erect and straggly. In the honeysuckle family.

Western Red Cedar, *Thuja plicata*

--Tree. Leaves are scale-like, opposite pairs in 4 rows, the leaves in one pair folded, the leaves in the other not, closely pressed to stem in overlapping shingled arrangement that looks alike a flattened braid; glossy yellowish green. Cones are minute, numerous, reddish; seed cones with 8-12 scales, egg-shaped, about 1 cm long, in loose clusters, green when immature, becoming brown, woody and turned upward; seeds winged. Bark is grey to reddish-brown. In young trees that you will see it is mostly reddish-brown.

Ninebark *(Physocarpus capitatus)*

Ponderosa Pine *(Pinus ponderosa)*

Red Alder *(Alnus rubra*)

Twinberry *(Lonicera involucrate)*

Western Red Cedar *(Thuja plicata)*

Species - The species is recorded by entering the first two letters of the genus followed by the first two letters of the species. For example, *Thuja plicata* becomes THPL on the data sheets. Recording the species allows us to determine if certain problems are species specific. For instance, disease may affect one species and not others.

Height or Height Class- The height of each tree species is recorded in inches. A height class is recorded for shrubs: .5 is given for shrubs less than one foot in height, 1 is given for shrubs between the height of 1 and 2 feet, 2 is given for shrubs between the height of 2 and 4 feet, and so on. Height measurements will be taken in subsequent years and used to help estimate the time it will take various species to reach a free-to-grow status.

Overstory Competition -The degree of overstory competition and its source are recorded in order to identify the ways in which access to sunlight is affecting the survival, growth, and vigor of the planted stock. A scale of 0-3 is used to indicate the degree of overstory competition. Zero indicates there is no overstory competion, one signifies less than 25%, two signifies between 26-50%, and three indicates that overstory competition is greater than 50%. The species name that is the source of competition is also recorded.

Grass Competition Level - An excess amount of grass and forbs can out-compete trees and shrubs for water and nutrients. A scale of 0-3 is used to indicate the degree of grass competition within a 2' radius. Zero indicates there is no grass/forb competition, 1 indicates grass/forbs are within 18" of the planted stock, 2 indicates grass/forb competition within 7-12", and a 3 indicates that grass/forbs are wihtin 6" of the stem.

Source - The source of grass providing the competition is also noted, such as "pasture grass" or "forbe". In addition, a special note is made of reed canary grass or other aggressive invasives.

Damage Type - The degree, type, and source (if known) of damage is recorded to determine how these impacts are affecting the survival, growth, and vigor of planted stock. A scale of 0-3 is used to indicate the degree of the damage. Planted stock receives a 0 if no damage is detectable, 1 if the damage is impacting less than 25% of the tree or shrub, 2 if damage is assessed between 26-50%, and 3 if damage is greater than 50%. Note is also made of the type of damage. For instance, "TB" signifies tipped branches and "GI" stands for girdling. Each source of damage also has its own code. For example, "RU" which stands for rubbing, would get a source code of "WL" for wildlife. By specifying direct sources of damage, suggestions on how to improve project maintenance can be made.