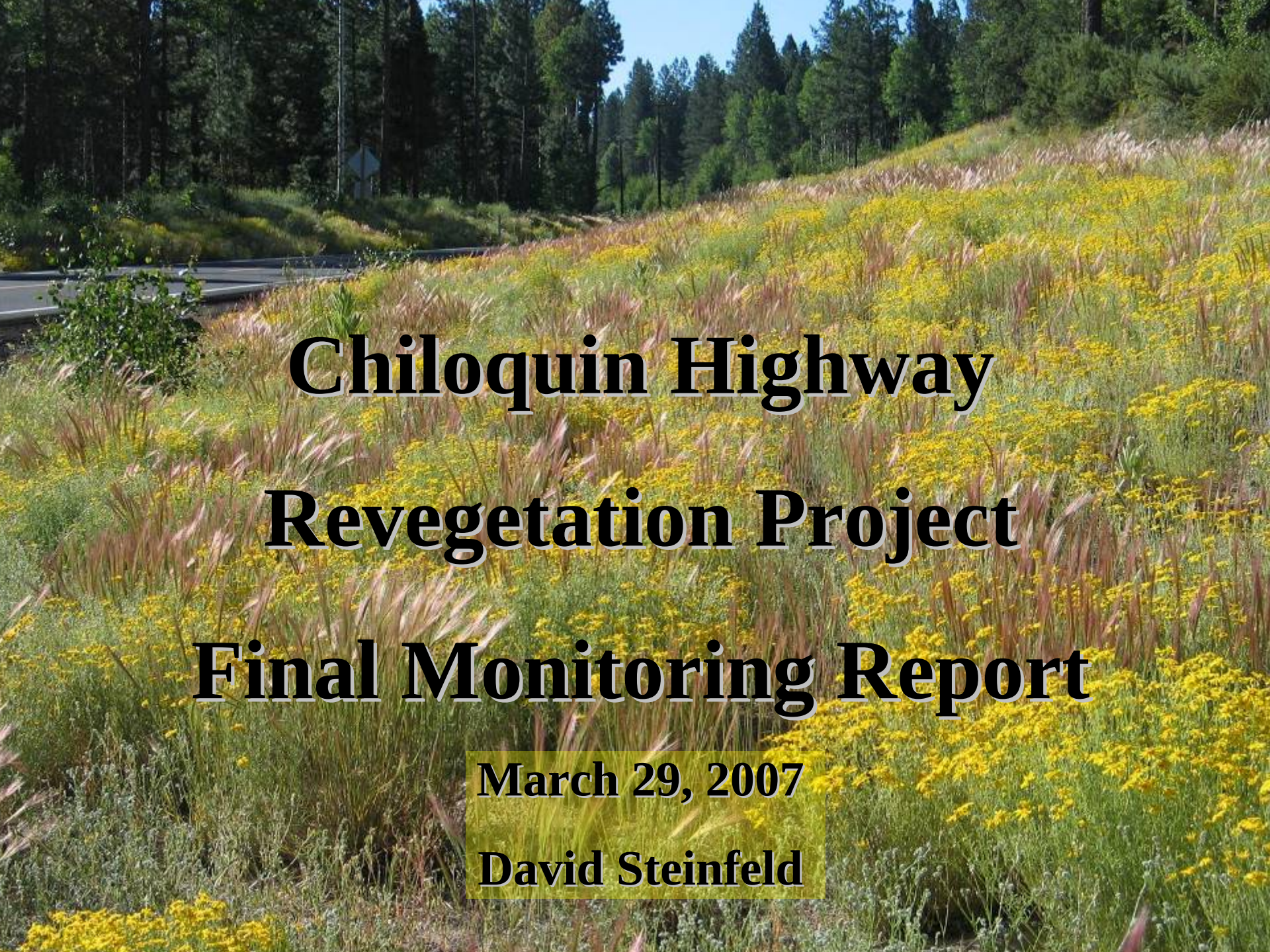


Chiloquin Highway Revegetation Project

Final Monitoring Report

March 29, 2007

David Steinfeld

Summary of Monitoring Findings

Monitoring took place in the summer 2006 and spring 2007.

Aside from one section of abandoned road that was affected by the cone moth, plantings of ponderosa pine, quaking aspen, bitter cherry, serviceberry and Klamath plum were established and growing well. There was no topsoil conserved and reapplied for either the abandoned roads, but this was compensated for by applying mulch. The application of mulch to the road surface also eliminated any soil exposure.

The grass and forb seeding performed well but bare soil exposure was high. Over 85% of the vegetation found in our plots were from the species we seeded.

The draw was replanted to ponderosa pine, quaking aspen, and willow. The pine and aspen are performing well, but the willow is not. The abandoned road adjacent to the draw was ripped and planted to ponderosa pine. Because the site was planted a year later with smaller stock, these seedlings are not as tall as other pine in the project.

INTRODCTION

The following is a a final monitoring report for the revegetation of the Chiloquin Highway project (PFH 158-1) under Reimbursable Agreement No. 01-A-17-0049 between the Federal Highway Administration and the U.S.D.A Forest Service. The initial agreement was established in June 2001 to develop a revegetation plan for the project area. Once I submitted the revegetation plan, an amendment was made to the agreement in November 2002 for the Forest Service to implement the vegetation plan and monitor the results. Two subsequent amendments were made to extend the agreement.

In accordance with the agreements, the following was accomplished: a revegetation plan was submitted in October 2002; revegetation treatments were implemented during October 2003, March 2004, March 2005, and March 2006; and monitoring took place after implementation during the summer/fall months of 2004, 2005, and 2006.

ABOUT THIS REPORT

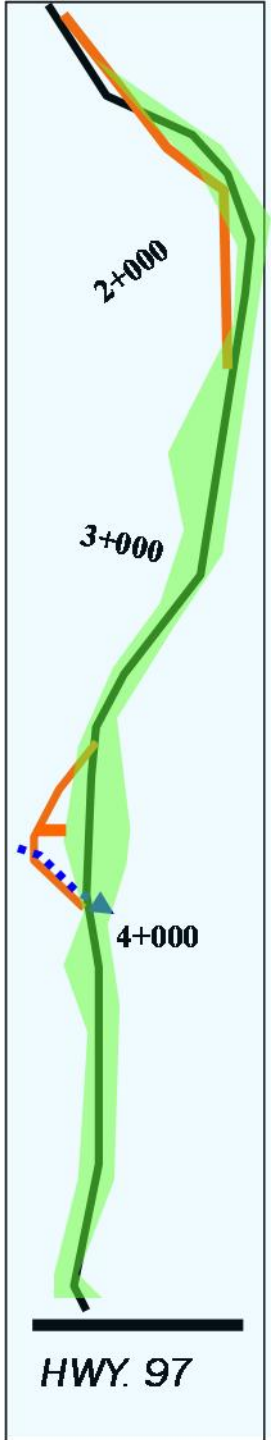
This is the first of many monitoring reports that the R6 Revegetation Team will be presenting to the FHWA. As far as we are aware, there is no standard format for presentation. I have attempted to present a summary of monitoring data interspersed with photographs and short dialogues of the types of revegetation treatments applied in different parts of the project. Using PowerPoint is not a typical way of presenting a report but considering that displaying just data, can leave readers scratching their heads wondering what it really looks like. A picture is "worth a thousand words" and accompanied with monitoring data can give a fuller view of what is actually happening. I would enjoy any feed back you might have on this method of presentation. You can also print this report out by setting the print setup to place two pictures per page.

GENERAL REVEGETATION UNITS

For simplicity, the Chiloquin revegetation project can be grouped into three sections:

- Cut and fill slopes (shown in shaded green)
- Abandoned roads (red lines)
- Wetland (dotted blue line)

The objectives and mitigating measures used in each section were different and require separate discussions.



Cut and Fill Slope Revegetation

Background. The cut and fill slopes were constructed during the summer 2004 with no topsoil or other soil mitigating measures. In October 21, 2003, under a contract with the R6 Revegetation Team, cut and fill slopes were seeded either by hydroseeding equipment or by hay blowing equipment.

The seed mix, fertilizer, and mulches varied slightly by area, but generally the rates for hydroseeding work were:

- Biosol fertilizer: 1,750 lbs/ac
- 13-13-13 all purpose fertilizer: 200 lbs/ac
- Ecofiber hydromulch: 1,000 lbs/ac
- Atlas Soil Loc tackifier: 100 gals/ac

Cut and Fill Slope Cont.

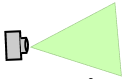
Approximately an acre of fill slopes from Highway 97 to station 3+500 was hydroseeded, then covered with straw obtained from Stone Nursery and composed of prairie junegrass (Koeleria macrantha) and squirreltail (Elymus elymoides). Both straw sources were obtained from seed production beds at Stone Nursery and blown through a hay blower. The seed of the squirreltail was not harvested at the nursery; instead it was cut and bailed with seeds and stems. Hayblowing operations distributed this seed.

Seed for this and other hydroseeding areas was produced over a two year period in seedbeds at Stone Nursery starting from native seeds collected near the project site. The general seedmix was:

- Squirreltail (Elymus elymoides): 21 lbs/ac (60 seeds/ft^2)
- Western needlegrass (Stipa occidentalis): 4 lbs/ac (20 seeds/ft^2)
- Wooley sunflower (Eriophyllum lanatum): 6 lbs/ac (201 seeds/ft^2)

Photo-documentation.

The following series of photographs cover most of the cut and fill areas that were seeded. The majority of pictures were taken during the early summer when plants were in full bloom and at their maximum growth for the year

Locations of the pictures are shown on the side of the image in a very generalized map. The camera direction and general range of view is shown with this symbol  . I have tried to capture the entire revegetation project with a series of photographs.

Most of the plants that are seen in the photographs were the species that were sown. The yellow flower plant is woolly sunflower and the grass is squirreltail.

Photo taken late summer

Photo taken mid summer


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Photo taken late spring

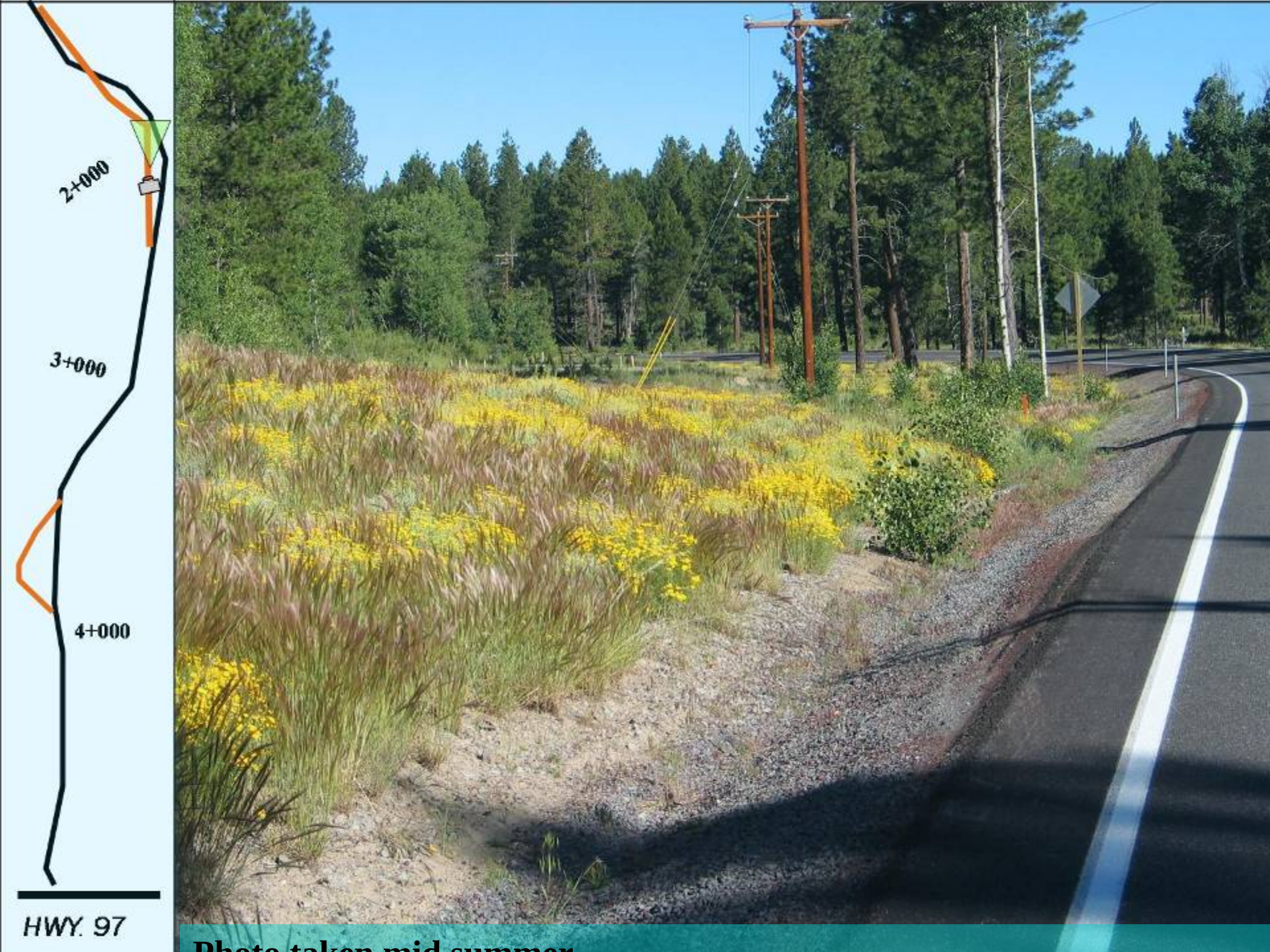

Photo taken mid-summer

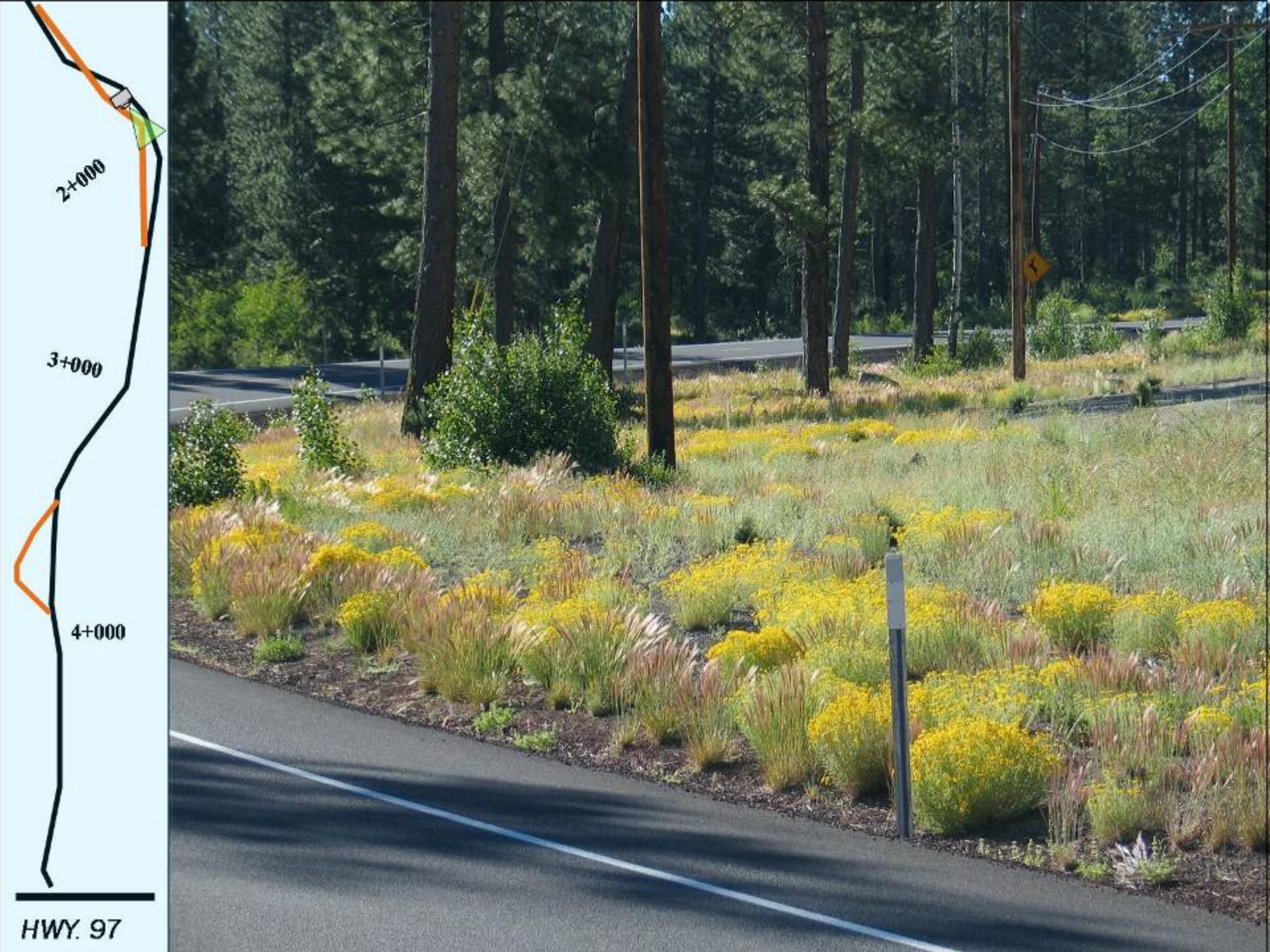
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Photo taken late spring


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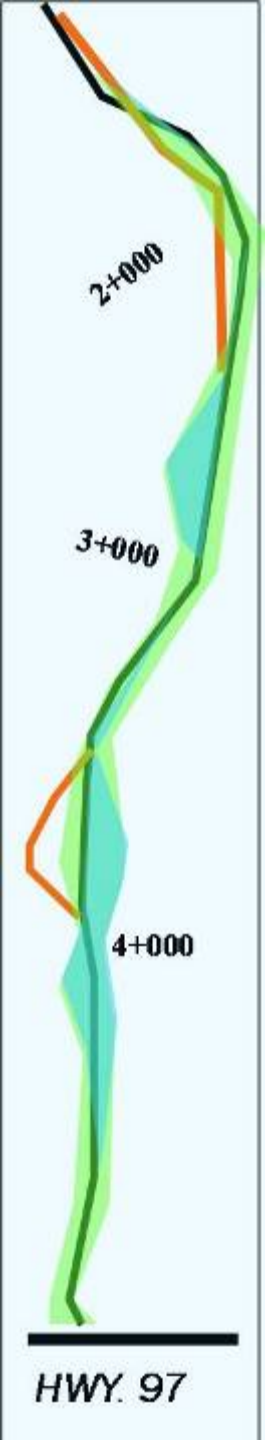
squirreltail
woolly sunflower
Photo taken mid summer



Cut and Fill Slope Cont.

Monitoring for Ground Cover. Monitoring for ground cover was conducted on July 9, 2006 by David Steinfeld and Greg Carey (consulting botanist). Ground cover was assessed using a monitoring protocol, being developed by the R6 Revegetation Team and Kerns Statistical Services, Inc., that bases quadrate analysis on digital photographs. This preliminary protocol uses a baseline, laid out along the highway, from which transects were located perpendicular to the road every 30 feet.

The blue shaded sections of the map show the areas that were monitored for ground cover. As can be observed, not all seeded areas were good candidates for sampling because of the narrowness of the cut and fill slopes. We considered the entire area one sampling unit and did not stratify the area.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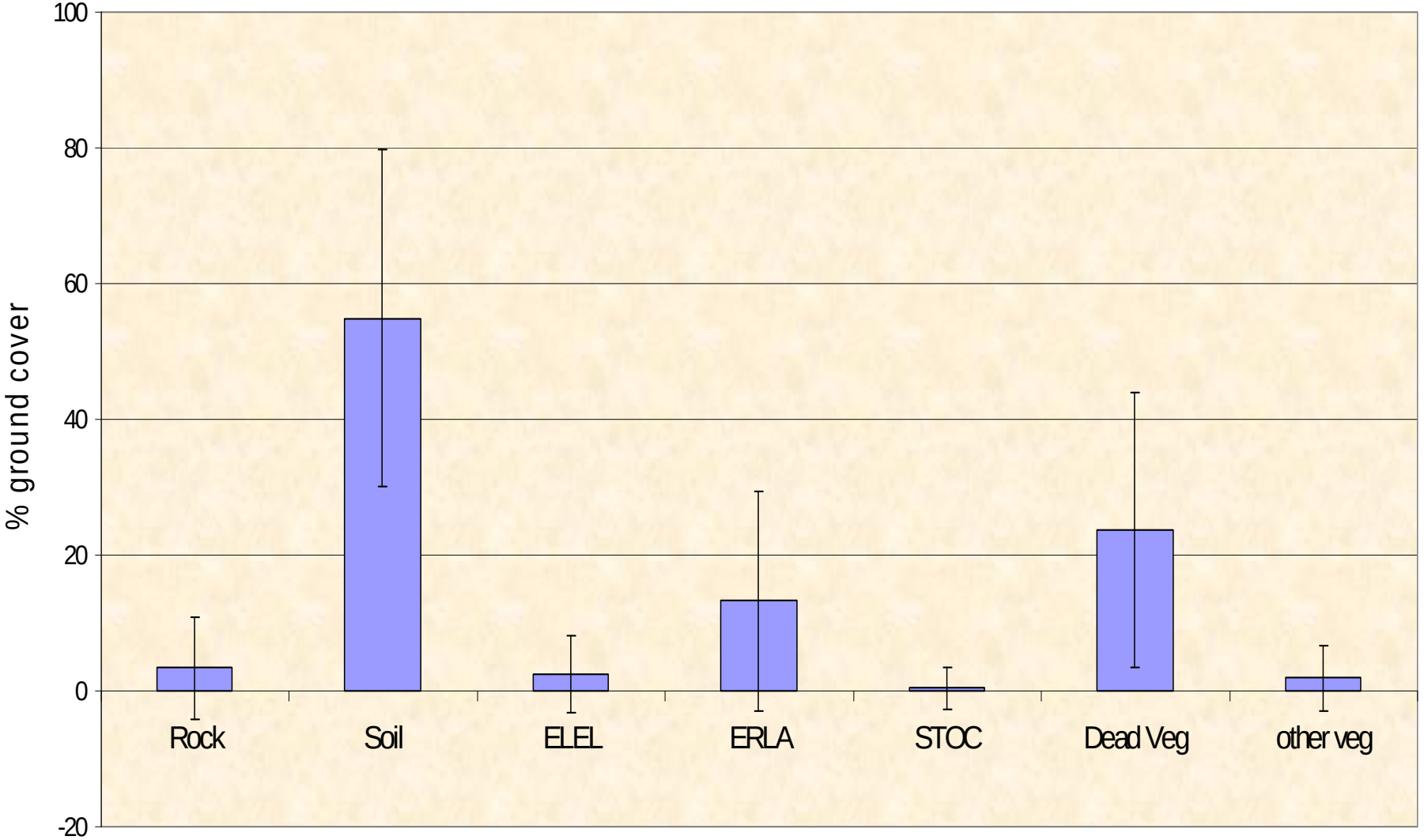
Cut and Fill Slope Cont.

Four photographs, or quadrates (an example of one is shown in the pervious picture) were taken along each transect at predetermined distances. Prior to taking the photograph, the vegetative crown cover was removed to expose just the soil surface, giving a "true ground cover". In the development of the ground cover protocol, we debated where to cut the vegetation or not, and we concluded that if we did not, we would get wildly varying cover percentages depending on the season of the year (in the winter, most of the vegetation dies back).

28 transects were sampled, resulting in 112 quadrates (or ground photos). The previous picture shows the 3rd quadrate for the 20th transect. For each quadrate, a 20 point grid was superimposed over the photograph and for each point. the ground cover type was determined. The ground cover can include bare soil, rock, dead vegetation, species (if they can be discerned).

The following is the summary of the dataset for ground cover of seeded areas:

Cut and Fill Slope Revegetation



ELEL = squirreltail, ERLA = woolly sunflower, STOC = western needlegrass

Brackets indicate standard deviations

A quick look at this monitoring data should raise some eyebrows - what the eye sees in the previous photographs might not seem to reflect what the data in the bar chart is showing. There doesn't appear to be over 50% bare soil when looking at the photographs from a landscape view, but the flowers and vegetation hide, even distract from, what is really going on at the surface of the soil.

So is 50% bare soil a big deal? Since we did not establish a criteria for "success" during the planning stages, this is somewhat of a debatable question. If the criteria for success is that the roadside is visually appealing when in the full flowering stage, I think we would all agree that this project was successful. If we established a success criteria that the majority of the species now on the site be native, this project would also be considered successful (85% of the ground cover of live vegetation is from the native species that we sowed). If we were to judge this monitoring data against EPA Standards for cover however, we would have a range of answers from "successful" to "unsuccessful" because of the ambiguity of the standards (a discussion of the applicability of EPA Standards is presented in supporting document titled "The Need for Developing Clear Standards Tailored to Revegetation Projects).

The importance of establishing "success" standards during planning cannot be overemphasized. An objectives-based monitoring strategy is discuss in length in the Roadside Revegetation Manual (out later this year).

Abandoned Roads

Background. The realignment of the Chiloquin Highway left 5 abandoned roads. The objectives were to revegetate these sites to blend into the surrounding forest environments. The surrounding forests are composed of clumps of ponderosa pine trees, quaking aspen, bitterbrush, Klamath plum, manzanita, and bitter cherry. There was no topsoil applied to these roads and the substrate left after the pavement was removed consisted of a sandy pumice subsoil, high in rock fragments and pavement remnants in some areas.

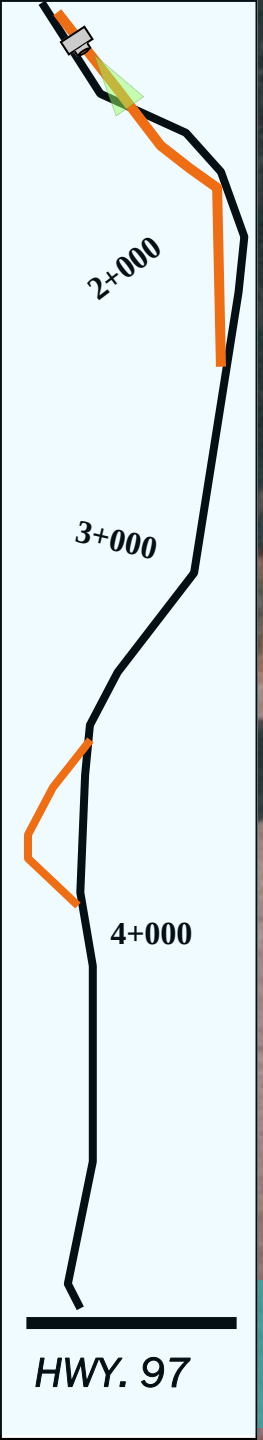
Lacking topsoil, I looked for other means of improving the soil within the budget and timeframe I was given under the agreement. One option was to apply composted organic matter, but because of the high material and transportation costs, this was not an option. I decided instead to obtain a free source of sawdust from the Medite Corp in Medford that I could use as a mulch over the surface of the soil. Transporting the material from Medford to the site was the only associated expense.

Abandoned Roads cont.

I selected this course of action because I felt the greatest limiting factor to plant establishment was soil moisture and that with a mulch cover, weeds and other competing vegetation would minimal, resulting in greater soil moisture for shrub and tree establishment. I had also worked at J. Herbert Stone Nursery with the Medite sawdust and was familiar with it's effects on plants (which was negligible).

During the later part of October 2003, we applied 2,000 yards of Medite sawdust to 3 of 5 abandoned road sites; the other two were not available for work at that time. The material was spread at a 4 inch depth with the bucket of a tractor. After application, the site was fertilized with Biosol (a slow release organic fertilizer) at 2,000 pounds per acre, then ripped with a subsoiler to 18 inches to break up compaction (some areas were too high in rock fragments to rip).

The application of sawdust created 100% soil cover, thereby exceeding the standards for bare soil exposure (however they be calculated).



Truckloads of Medite were placed on the abandoned road surfaces, then spread with a tractor to achieve an approximate 4” mulch depth.

Once sawdust was applied, the site was fertilized and subsoiled to 18 to 24” to break up compaction. This tractor is pulling a 5 tined subsoiler

Abandoned Roads cont.

We grew a variety of species for this project in large containers. The reason for large containers was the concern that small containers would "pop" out of the ground through freeze-thaw action (this subsequently has been observed on the site where a few small containers were planted). Large containers were also necessary in order to achieve quick establishment of vegetation. The species that were grown were from seed collected from local seed sources.

In early March 2004, we planted seedlings on abandoned road sites.

Quaking aspen in 18" containers

Tree shelters were placed around quaking aspen, bitter cherry, and service berry after planting to increase growth and reduce animal damage. The plant extends above the shelter several feet before it is removed. This photograph was taken two years after planting. The aspen grew out of the tree shelter and was 3.5 feet tall. At this point the shelter is removed.

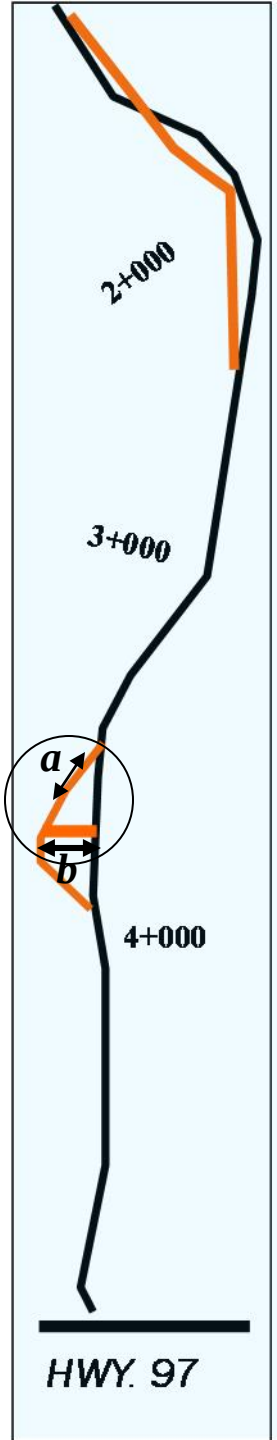
Abandoned Road Section 1

This section (shown in the circle) was planted with the following species and stocktypes:

Ponderosa pine	14" pots	243
Bitterbrush	18" tubes	187
Serviceberry	18" tubes	38
Quaking aspen	18" tubes	155
Choke cherry	12" tubes	119

The first year establishment of all planted species, except bitterbrush, was high (over 85% survival rates). Approximately a third of the bitterbrush died the first year and was mainly observed in the smaller containers (2” diameter).

First year monitoring showed that the ponderosa pine was infested by the cone worm insect (Diaryctria sp). This insect lays eggs on the buds of the terminal leader of the tree and hatching larvae mine through the new leader growth, destroying the entire years growth. This happened two years in a row. In the western portion of the road (a), this damage, weakened the seedlings to the point that most ponderosa pine in this area did not survive by the end of the third year.

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Very low seedling establishment due to cone worm

Abandoned Road Section 1 cont.

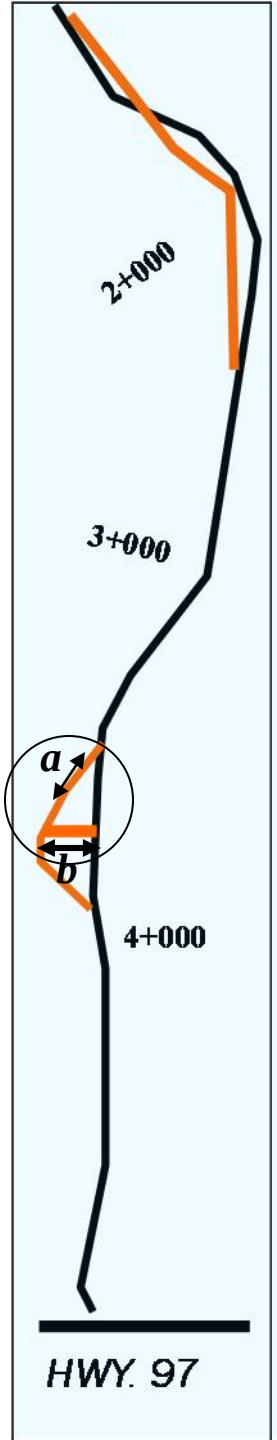
The area that was severely affected by the cone moth was replanted in March 2006 with lodgepole pine seedlings because this species is not affected by the cone worm insect. Because we had no time to grow larger container seedlings, the size of the seedlings that were planted last spring were of bareroot stocktype and small. They performed poorly and an evaluation of them this spring indicates that survival rates will be very low this year. While this area is not stocked with trees at this time, it should fill in with seedling over the coming decade from the seed of the adjacent pine trees.

Bud and leader destroyed by cone worm

Abandoned Road Section 1 cont.

The remaining areas, outside of area “a” have well-established stocking and are growing well, as shown in the following pictures.

Area “b” was not planted in March 2004 because of a large slash pile that still remained in the area at that time and the lack of seedlings available (this area was not originally in the revegetation plan). A unique stocktype was developed for this section which involved repotting small containers of ponderosa pine in the late summer into long tubes that would be ready the following spring. This large stocktype would normally take a year to produce but we were pushing to get it ready in 6 months. We used 30” tree shelters instead of PVC or one gallon containers to plant the containers in. We held the media in the treeshelters together with zip ties. By the spring the root system had grown over two feet to the bottom of the container and were ready to plant. Because all we had to do was cut the zip tie, we could keep the media intact with the root system and plant without loosing the media from around the roots. This resulted in very fast growing ponderosa pine. After the trees were planted, we placed the tree shelters around each seedling to protect and increase seedling growth. Tree growth for these seedlings is very high.



Abandoned Road Section 2 cont.

Sections 2, 3 and 4 were planted with the following species and stocktypes. Survival of ponderosa pine was above 90% for planting areas 2 and 3, and around 85% for area 4. All areas are well-stocked and free to grow.

				Planting Areas		
		Survival	**Growth**	**2**	**3**	**4**
Ponderosa pine	14" pots	High	Good	80	96	75
Bitterbrush	18" tubes	Low	Fair	103	120	96
Serviceberry	18" tubes	High	Fair	-	4	-
Quaking aspen	18" tubes	Mod - High	Good	25	56	35
Choke cherry	12" tubes	High	Good	-	-	27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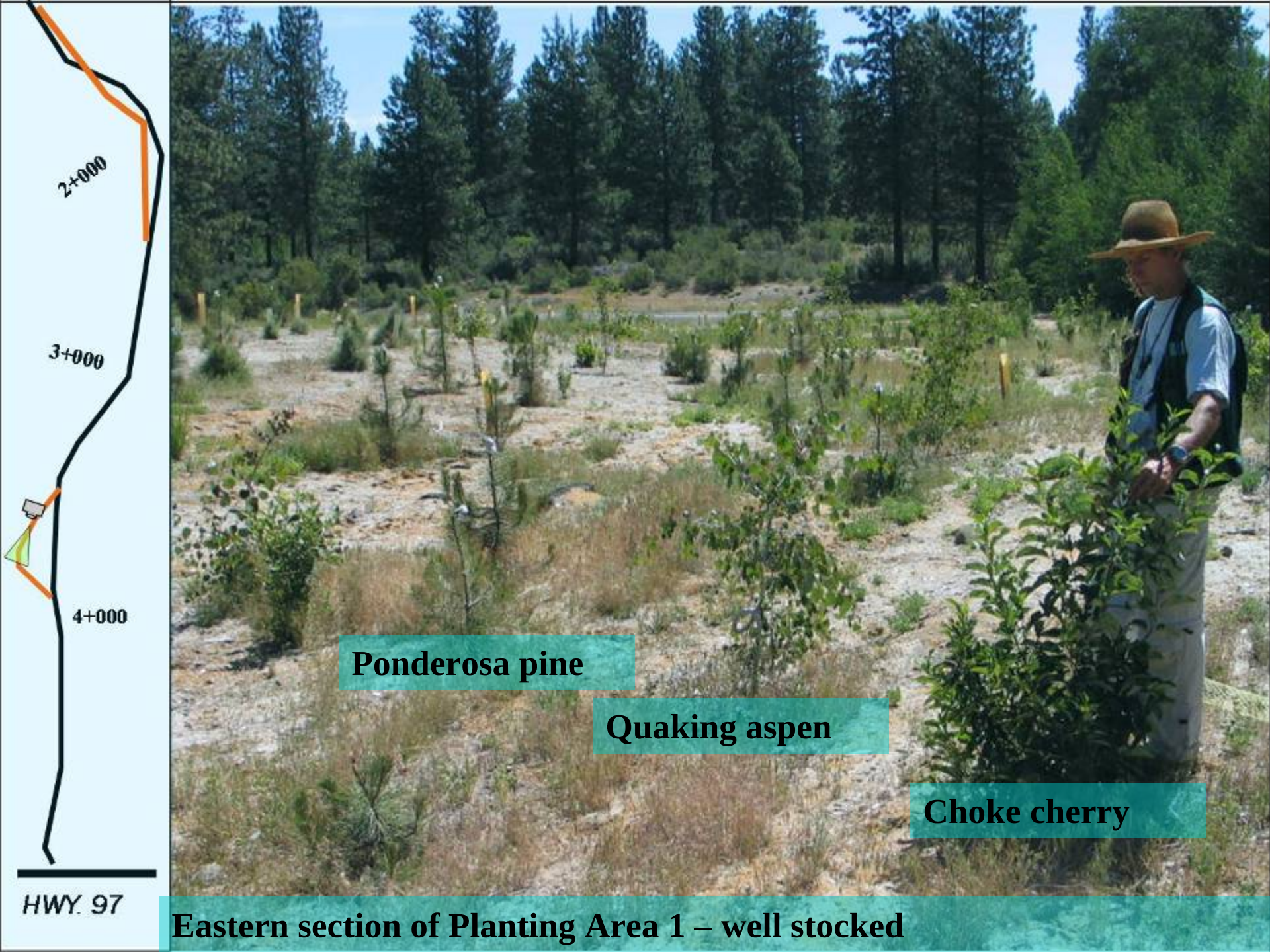
The black cloth over the top of the ponderosa pine are bud caps we placed to protect the seedling from the cone moth

Growth Rates.

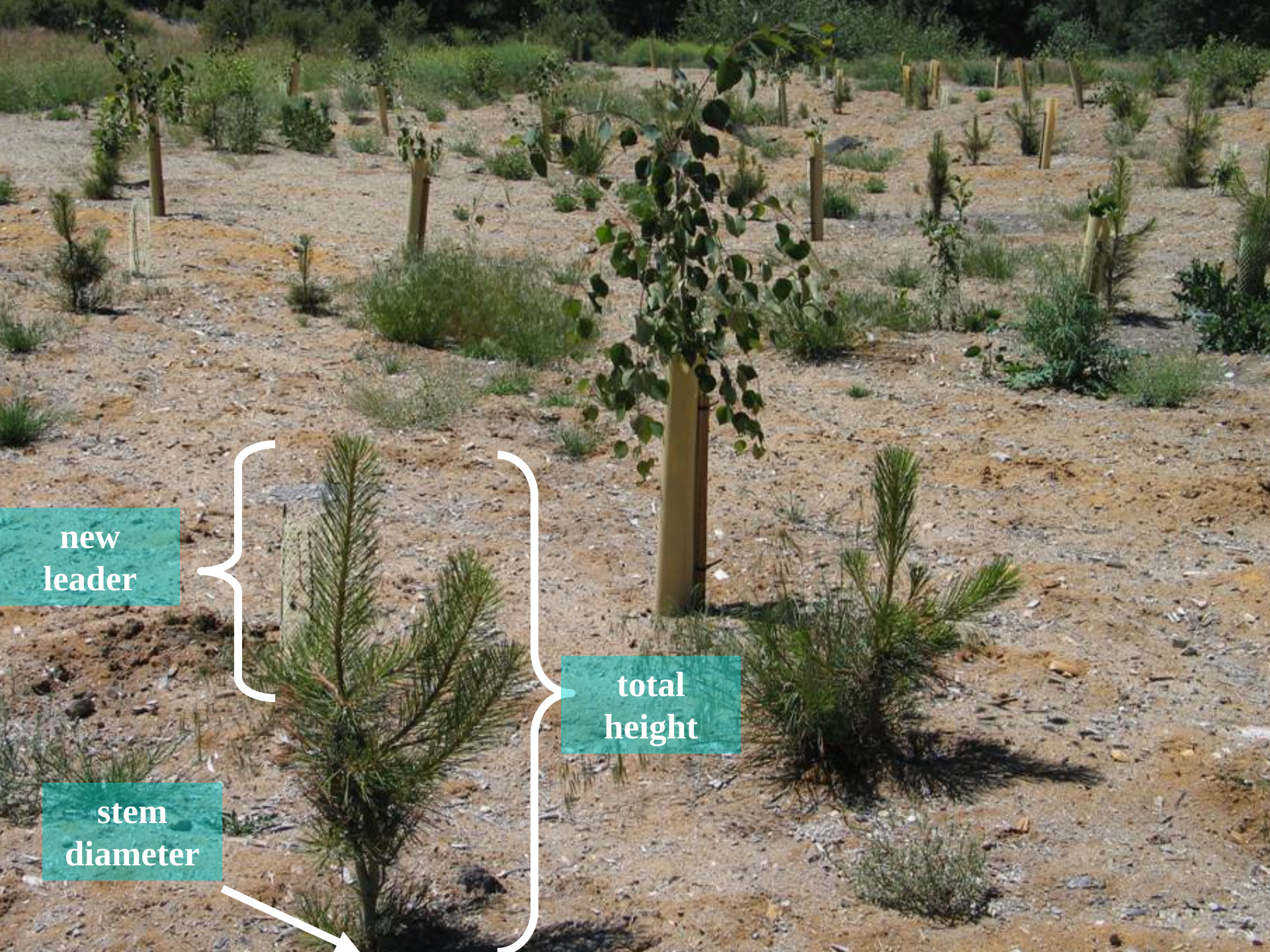
Plant growth for most species is very good. Monitoring data collected in March 2007 show the following (based on the measurements of 70 plants):

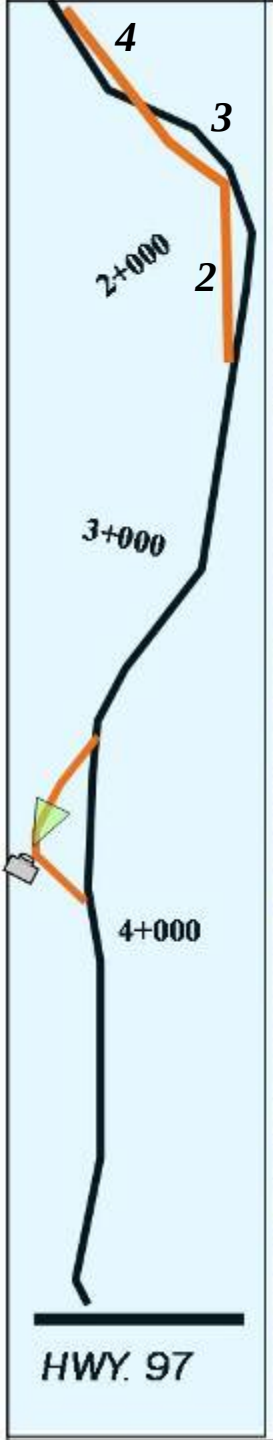
Species	Container	Growth	Comments
Ponderosa pine	14" pots	Good	On trees without insect damage average height = 34 inches, last years leader growth = 10 inches, and stem diameter = 1.3 in
Bitterbrush	18" tubes	Fair	Average height is 2 feet and diameter cover is 20 inches. There are many natural seedlings that were found in the plots.
Quaking aspen	18" tubes	Good	Good appearance and growth - 57 inch average height and 1 in average stem diameter
Choke cherry	12" tubes	Good	Healthy - 28 inches average height and 0.7 inches

Aspen will average almost 6 feet after three years and ponderosa pine 3 feet in three years which is considered exceptional growth for this area.



Eastern section of Planting Area 1 – well stocked


new leader
total height
stem diameter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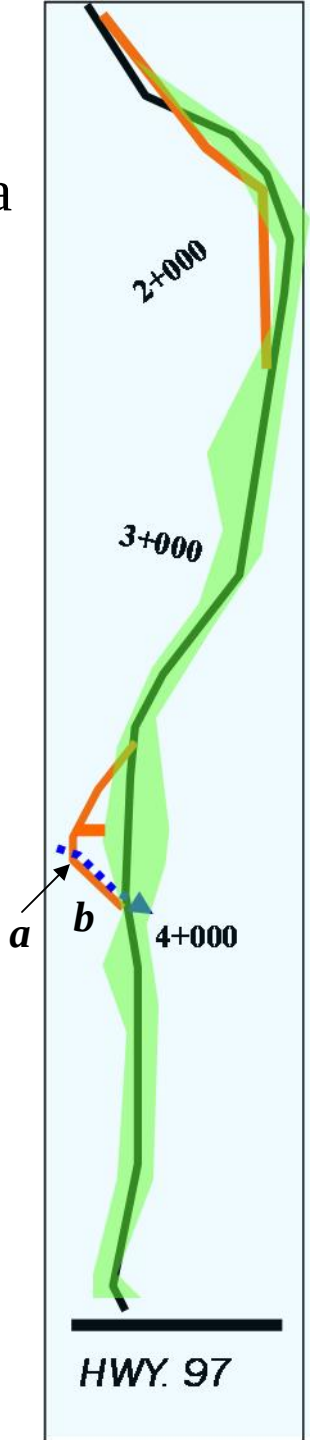
Draw/Wetland

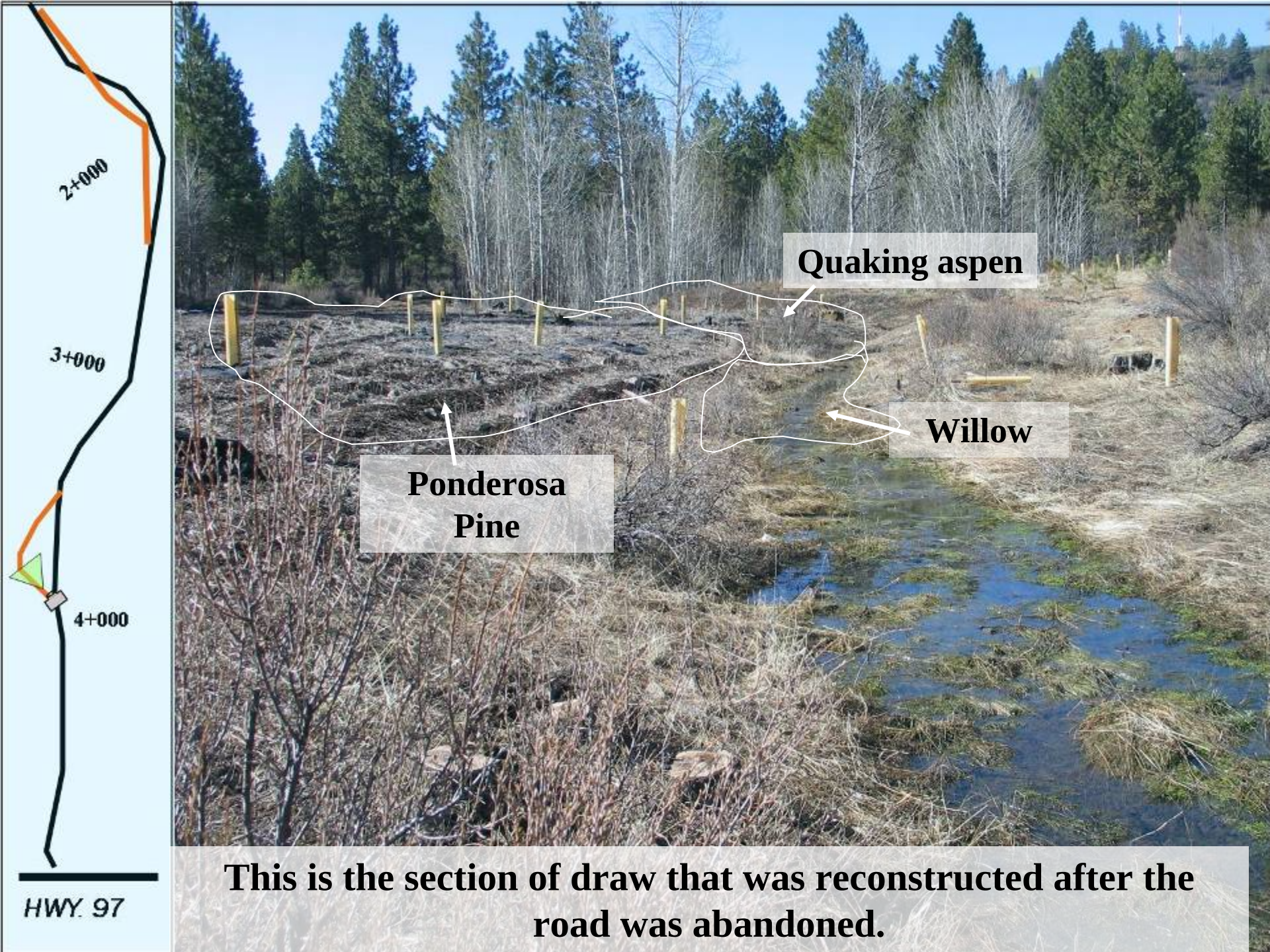
Background. When the portion of the old highway that crossed a seasonal drainage was removed, the road was abandoned and the area was re-landscaped to connect the upper with the lower draw. The remainder of the draw in the project area was left disturbed (which is shown in the following picture taken in spring during snow melt). Once the snows melt there is little presence of water in this draw the rest of the year.

Notice in the following picture the composition of the vegetation. The dominant component is ponderosa pine, followed by bitterbrush understory (both very dry species). There are no sedges, rushes, willows, or other key wetland species. In our plantings, we mimicked this composition.

The 150 foot section of disturbance (a) was planted with willows, ponderosa pine, and quaking aspen. The abandoned road approximately 50 feet to the east of the draw (b) was ripped and planted to ponderosa pine, while the upper portion of the draw was planted in quaking aspen.



Undisturbed Draw/“Wetland”



This is the section of draw that was reconstructed after the road was abandoned.

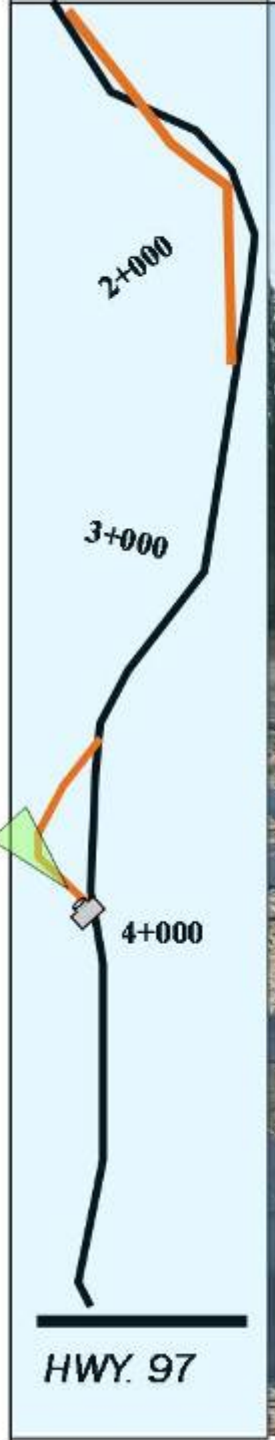
Draw/Wetland cont.

We were not able to rip the abandoned portion of road (b) until the follow year because it had not been obliterated until late 2004 so planting of the abandoned road did not take place until 2005. Because stock was not available, we took the same strategy as was described in Section 1b above. Smaller ponderosa pine containers were grown for six months in a tree shelter (as container). The seedlings are well-established and growing very well (averaging 20 to 24” tall in two years).

Draw/Wetland cont.

While the ponderosa pine and quaking aspen are growing well after several years and appear to be established, the willows did not survive well, with only a few plants that became established (I have replanted willow stakes this year). The fact that willows are not present in this area might indicate that establishment is difficult. Soil survey prior to road construction indicated bedrock within 24” of the surface in the draw. I was not on site when they re-contoured the draw, but if shallow soils were present in this area, this would explain why willows did not perform very well. The fact is that this area is very dry most of the year and explains why wetland species are not obviously present. While it might be wet from March through a portion of April, it is very dry the rest of the year.

The abandoned road to the east of the draw was ripped and planted to ponderosa pine and other species, then covered with WoodStraw as a mulch. The abandoned road borders the undisturbed portion of the draw. Over time, the ponderosa pine will grow into trees that will widen the riparian area.



Summary and Followup

The revegetation of the Chiloquin Road was a six year project that resulted in the successful revegetation of road cuts and fills, abandoned roads, and reconstructed draw. In the process, many different techniques were tried which included mulching abandoned roads with sawdust, growing a unique container for small seedlings, using tree shelters.

What remains to be accomplished is to remove the tree shelters and animal netting from around some of the seedlings. This will be accomplished within the next few years.