Figure 25. Gauging station weir in late spring 2006. There is some disagreement amongst fisheries professionals on whether or not this poses a barrier for ELRT during runoff conditions.

3. Improvement of Riparian Vegetation and Water Retention

Channel conditions along the lower mainstem of Pine Creek have been labeled in various documents as poorly functioning, downcut, eroded, degraded, and a host of other descriptions indicating undesirable conditions of the stream and riparian area. While the lower stream segment of Pine Creek (from Camp 10 downstream to Eagle Lake) has not been considered favorable rearing or spawning habitat for Eagle Lake trout, it certainly offers habitat to a wide variety of other fish and wildlife species. Restoring ecological function to the stream and associated riparian areas has been, and continues to be, a goal of the CRMP members and all involved in management of the watershed. Due to poor water retention in the valleys below the Fruit Growers station at Camp 10, suggestions were listed by the USFS in 1949 to create dams to hold water on site longer. A proposal was first formulated in 1936 by Niel Meadowcroft of the FS to create a series of dams and stockponds throughout the system, including adjacent watersheds. Due to World War II, projects were put on hold and when re-evaluated in 1949 by Lord, only a few were recommended for implementation. Meadowcroft's notes of 1953 indicated a need for a land strategy that looked at all uses in order to avoid conflicts amongst landowners, grazing interests, and water development.

Figure 26. Top, area near Bradford Crossing circa 1936. Bottom, 2005.

Seeing the rapid disappearance of water from the lower stretch of Pine Creek, it is easy to see the thought process that spawns the "solution" of damming streams or swales to hold water on site longer. Benefits of the stored water include increased wetland areas, potential to increase water infiltration, and likely an increase in vegetation with increased water availability. Downsides may include heating of the water body dammed up which may in turn increase stream temperatures, as well as changes to habitat for other aquatic species since not much is known of the life history of many mollusc or invertebrate species, or some amphibians. Balancing these objectives sometimes results in walking a fine line between fish passage and habitat restoration.

After years of consideration, one such structure was built at an area known as Bradford crossing, downstream of Harvey Valley confluence with Pine Creek and upstream of Champs Flat. This location may have been one of the sites from Meadowcroft's 1936 reconnaissaince report of water retention structures. The design for the present structure came from CRMP participant Natural Resources Conservation Service, formerly the Soil Conservation Service. Instead of one high structure to retain water, NRCS engineers, after coordination with CRMP due to fish passage concerns, designed a three step structure, with each step being one foot higher than the downstream dam. This design was adopted and the structure was built in 1995. It was calculated that the structure would back up water nearly 5/8ths of a mile, into the Harvey Valley allotment (CRMP 1993). Concerns were raised about impeded fish passage and/or increased water temperatures, with the caveat that the structures would be removed if either situation occurred. Cost of the structure was $27,000, of which $8,000 was EPA source funds (CRMP 1995). Willows have pioneered the site and are increasing in vigor and number. ELRT have passed over the series of structures, and in conjunction with a fence to eliminate livestock use upstream of the structure, vegetation is rebuilding on streambanks and in the flat valley. Willows are beginning to appear on and upstream of the structures, along Pine Creek just above the junction with Harvey Valley Creek.

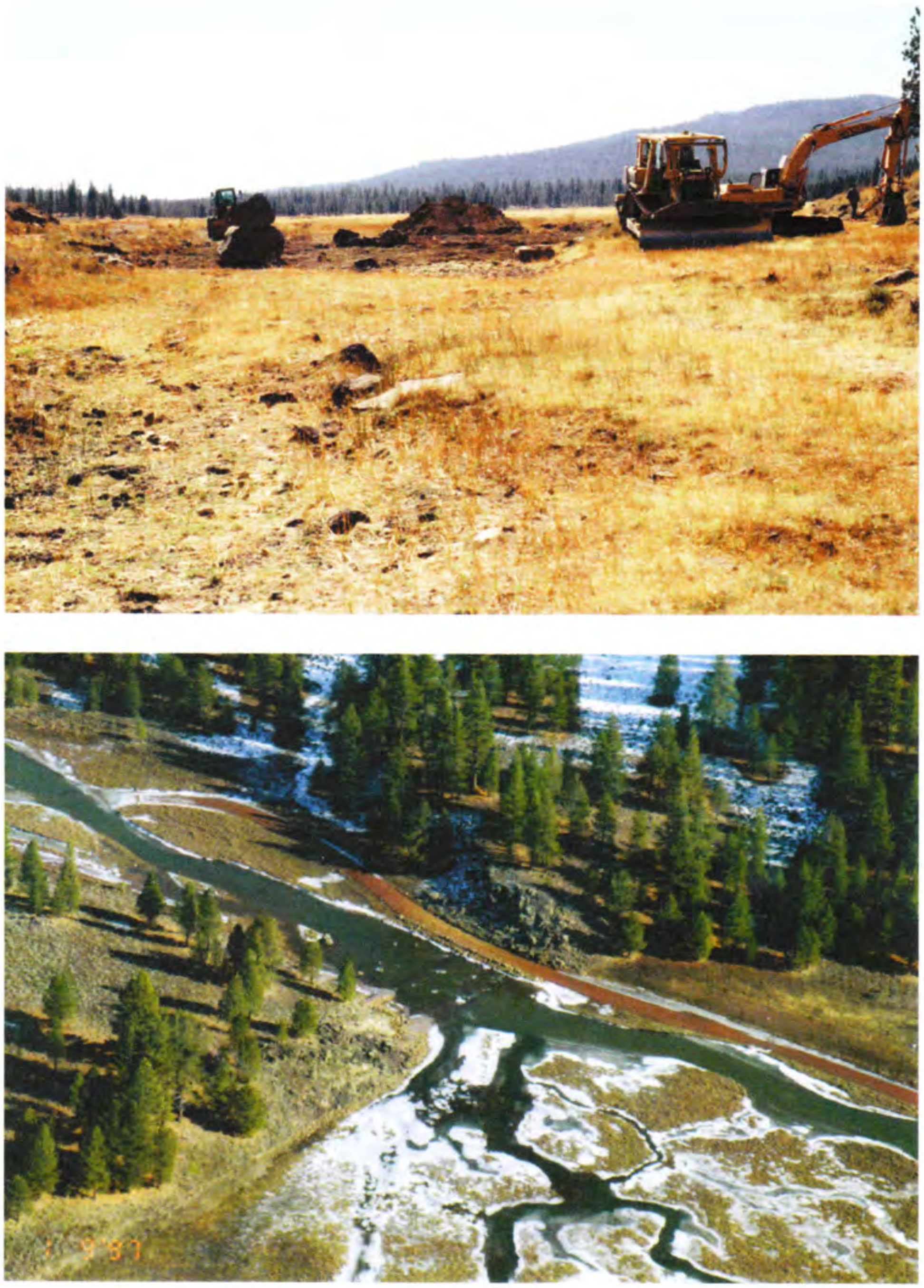


Figure 27. Above, Bradford three-step rock structure constructed in 1995. Bottom, aerial view showing stream backed up into the valley.

Another structure that was referred to after the fact in CRMP notes is the dam to create wetlands upstream of Camp 10 in Pine Creek valley that was constructed in the mid 1980's. This structure backs up water across a wide flat, and a series of islands were constructed with moats encircling them to create nesting islands for waterfowl. The structure was completed prior to the collaborative effort of the CRMP group. It is not on the mainstem of Pine Creek, but on a side channel to the southeast in the braided and meandering portion of the valley. Water remains in the moats through nesting season and into the summer in most years.

In response to a project developed under the Pine Creek EA in 1995 to retain more water in the Champs Falt area of Pine Creek, water was impounded in 1996 on the Gordon Creek tributary coming into Champs Flat from the northeast. It was constructed using an earthen fill with a corrugated metal standpipe outlet and flashboards. It proved too unstable to handle the very high water flows in January of 1997, and washed out the fill and portions of the Champs Flat road (33N12). Due to further road concerns and to the need for further contour analysis to set proper dam height, this impoundment was never rebuilt.

Fish passage was and continues to be important to the goal of providing unimpeded fish passage to and within the seven miles of perennial headwaters. Perhaps prematurely, the FS, after CRMP involvement, chose to construct a fish ladder to allow for migration from Stephen's Meadow to Leaky Louie's pond. CRMP notes indicate that discussions occurred over timing of construction (ie, ELRT were not yet in the headwaters), and the minimal amount of habitat available upstream. The ladder was constructed in 1994 using CDFG funds that were leftover from fencing projects downstream. This ladder is fully functioning and should easily allow for passage of ELRT if and when necessary.

Figure 28. Above, culvert outlet at road 31N25, the outlet of Leaky Louie's pond 1990. Below, fish ladder constructed below Leaky Louie's pond in 1994, near the headwaters of Pine Creek.

4. Changes in Grazing Management

The Pine Creek Environmental Assessment (EA), completed in 1995, became a landmark document that linked grazing management, riparian condition, and fish passage issues, with the intent of implementing restoration projects and establishing improved grazing management systems. The topics and projects identified and analyzed within this EA were derived from CRMP and grazing TRT meetings and tours, along with more formal watershed reports and assessments. Platts and Jensen's report 1991, Jones and Stokes "Hydraulic, Hydrologic, and Fish Passage Analyses for the Upper Pine Creek Restoration Plan" 1992, Steve Young's "Pine Creek Watershed Report" 1989, and various others laid the groundwork for ideas and strategies to be implemented under appropriate authority.

The National Riparian Service Team's trip report from 1998 gave a follow-up and progress report on how the strategies and projects were meeting stated objectives.

Within the Pine Creek EA, the entire length of Pine Creek was divided into sections of varying stream types and strategies applied them.

Allotment	Reach	Miles	Grazing Strategy
Silver Lake	0	.5	Exclosure No Graze
	1	1.5	Private Land
	2	2.0	No Grazing by Management
Upper Pine Creek	3	.5	No Grazing by Management
	4	.25	No Grazing by Management
	5	1.1	Occasional Graze
	6	.6	Fall Gathering Pasture
	7	.9	Riparian Pasture Prescription
	8	7.25	Riparian Pasture Prescription
Lower Pine Creek	9	.25	Short Duration, Late Grazing
	10	3.0	Short Duration, Late Grazing
Harvey Valley	11	.8	3 Pasture Rest-Rotation
	12	.75	Channel Exclosure, No Grazing
	13	.1	3 Pasture Rest-Rotation
	14	.8	Channel Exclosure, No Grazing
Champs	15	.25	Exclosure No Graze
	16	1.0	Rest 3 Years, Graze 1 of 3 Years
	17	.5	Rest 3 Years, Graze 1 of 3 Years
	18	.75	Rest 3 Years, Graze 1 of 3 Years
	19	1.75	Exclosure No Graze
	20	.6	Fall Gathering Pasture
	21A	.25	Fall Gathering Pasture
	21B	1.0	Short Duration Grazing
	21C	.25	Occasional Graze
North Eagle Lake	22	1.25	Occasional Graze
	23	2.7	Short Duration Grazing
	24	.75	Exclosure No Graze

Table 6. Reaches, mileage, and strategies applied to the mainstem of Pine Creek, from the Pine Creek Fish Passage and Riparian Improvement Environmental Assessment, 1995.
Refer to Appendix 1 for definitions of the above listed strategies.

General Description of Grazing Allotments

Silver Lake

Characterized by forested lands, forage is available in the few open meadows near the headwaters of Pine Creek, where springs account for the initial flows. Due to a short growing season from cold temperatures and high elevation, this area is sensitive to excessive hoof action and vegetative removal along the stream edge. Conditions have improved greatly since the early 1990's when cattle were grazed for long periods at Stephens Meadow. The permittee of the late 1990's and early 2000's trailed cattle from the Grays Valley Allotment to other adjacent allotments outside of the Pine Creek drainage. Without fencing to control distribution, there were some years of excessive use in the headwater springs area. No range improvements are in place within this allotment, as proposed fencing was not deemed cost effective due to winter snows and heavy timber. At the present time, the strategy is "no grazing by management", and is difficult to achieve without constant herding to prevent concentration within the springs area.

Upper Pine Creek
The western portion of this allotment borders the 32N22 road and is close to the transition from forest to broad valley. Extensive aspen stands line Pine Creek and Bogard Spring Creek and adjacent meadows. Bogard Campground lies within the allotment and is fenced to prevent cattle entry. Historically, the meadow where Bogard Barn now stands was a cow camp known originally as Cone Headquarters (see range atlas from 1927 at ELRD), now known as McKenzie Cow Camp. It was also the site of the first Bogard Ranger Station, and considerable activity including grazing and irrigation was associated with the facility. Grazing in that portion of the meadow was stopped in 1993, when numerous concerns over stream channel conditions were raised. Between Highway 44 and the Cow Camp, the strategy calls for a fall gathering pasture to be grazed only as animals are collected from other portions of the allotment before they are moved off. Use has been light in most years, with no use in others. Due to concerns with cows on the highway, fencing was completed in 2001 to ease in herd management by excluding the portion of land between the highway and the railroad grade. After Pine Creek was re-routed in 1999 to send flows to a southern branch of the system, a large exclosure of 350 acres was constructed in 2002 to allow the channel to heal without cattle pressure (CalTrans 2002). Use has shifted to the area downstream of the railroad grade.

Lower Pine Creek
A broad valley with an extensive floodplain and riparian area makes up the bulk of the acreage of this allotment. Both reaches are run under a short duration late grazing strategy. Pine Creek within this allotment can be characterized as an intermittent stretch that would serve as a migration corridor for ELRT. Platts and Jensen (1991) characterized this stretch as an alluvial/graded valley bottom type, but no examples of the stream in its natural state can be found. Heavy cattle grazing of the past along with water drainage for road grade construction led to degraded stream channels and a conversion from mesic grass meadows to sagebrush dominated communities. Maximum utilization is set at 30%, and numbers generally come close to or have exceeded the maximum. The National Riparian Service Team in 1998 assessed the conditions of the stream channel downstream of the 105 Road crossing and gave a "Functioning at risk – no apparent trend" rating. Recommendations were to monitor the sedge/rush communities and water availability, concluding that grazing strategies did not warrant change in this complex intermittent stretch of Pine Creek. Cattle have had free access to water that remains in the stream channel at the 105 Road culverts. Discussions have taken place for years to create off-site water, but complexities with fencing and boundaries have precluded change. With new monitoring efforts or adaptive management strategies in place, potential exists for a new CRMP project to address the issue.

Harvey Valley
Only a small portion (approximately 2 miles) of Pine Creek actually lies within the Harvey Valley allotment. Within this short section of stream are two small valleys with

available forage. The upper end of Logan Springs is a transition from a steeper, rocky segment bordered by a large aspen stand. Harvey Valley Creek empties into Pine Creek below an old road grade, which has been an area of restoration work for many years in trying to restore the natural hydrology in that location. Logan Springs and the meadow above Bradford Crossing are the two main areas where livestock graze, under a strategy of three-pasture rest-rotation. Of the four reaches of Pine Creek within this area, two are in exclosures and are designed to be ungrazed so stream channels will stabilize. Water sources are scarce in the vicinity, leading to grazing within the fenced area in numerous years. The NRST in 1998 recommended that off-site water be provided to allow the exclosure to function properly. After that recommendation, a solar powered water source was constructed to aid in livestock distribution, with funding through the EPA 319 grant. Additionally, numerous windmills on the ELRD have been retrofitted or rebuilt to once again provide an off-channel source of water for grazing animals.

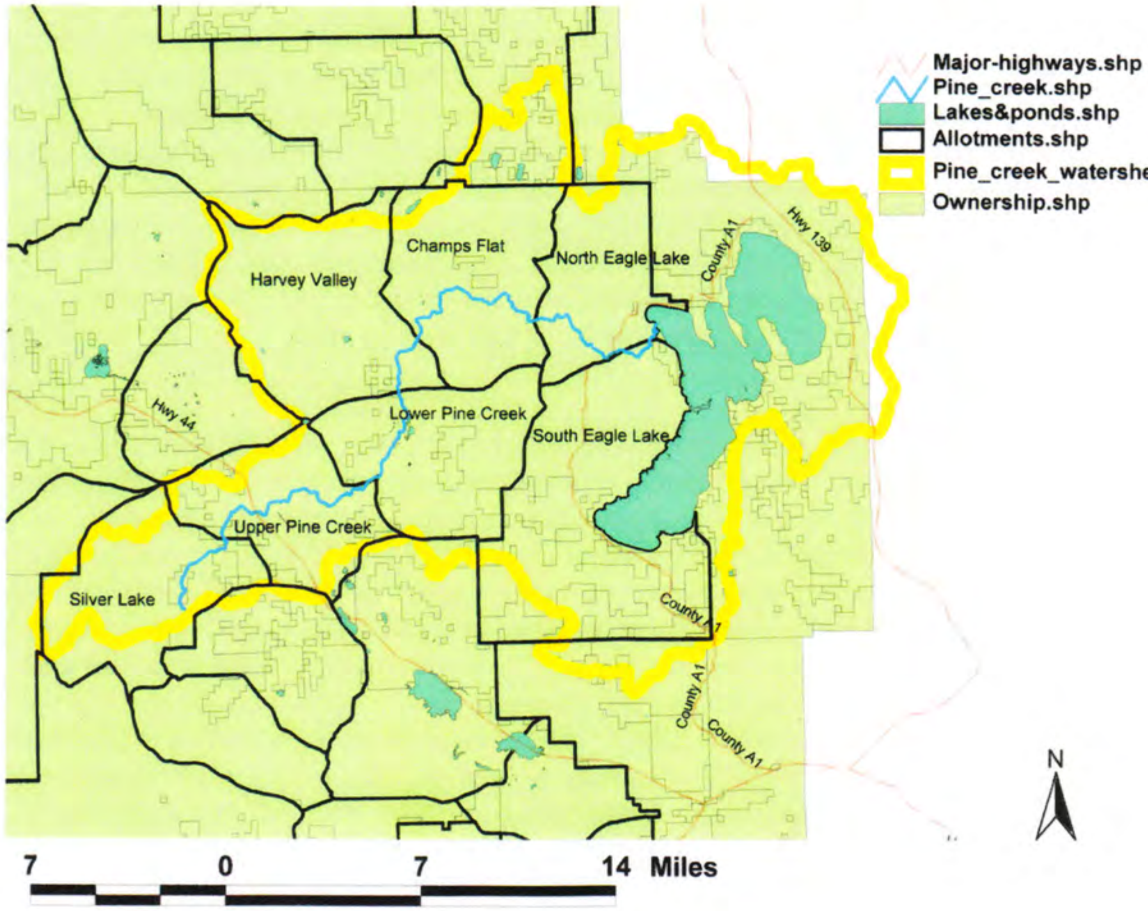
Champs Flat

Within the Champs Flat allotment are seven reaches of Pine Creek that are all part of a very flat, broad valley. It is within this area that the greatest impacts to Pine Creek from past activities are seen, as overbroadened and incised channels are now showing signs of recovering and stabilizing in most locations. Approximately 2.5 miles of the stream are grazed under a strategy of rest three years; then graze one of three. Two other stretches of the stream (2 miles) are in exclosures, and two other areas are grazed under a fall gathering strategy. Downstream near the McCoy gap are two pastures that are grazed under short duration or occasional graze strategies. Because of the recovering status of the stream, the fencing projects to create pastures have allowed improvement in stream channel conditions, as evidenced by increases of sedges within the stream channel, as well as willows and other early seral vegetation elsewhere. Recovery of this stream channel will be measured over the long term, and although extended periods of very wet or very dry conditions may affect recovery in the short term, the strategies present will still allow for healing (NRST 1998).

North Eagle Lake

The majority of the grazing within this allotment occurs on the shores of Eagle Lake, as well as along the last large valley within the Pine Creek drainage at McCoy Flat. Downstream of McCoy is an extensive aspen stand that occupies a rocky stretch of Pine Creek. Strategies of short duration graze and occasional graze have allowed considerable improvement in the vegetation especially near McCoy and adjacent to the aspen stand. Further downstream and below the County Road A1 Bridge is another very rocky section of stream with little forage available.

Grazing Allotments with Pine Creek/Eagle Lake Watersheds



5. Related Riparian Improvement Projects

Changes to riparian habitat on a broad scale have occurred within the last decade with the shift to management of aspen within the stream or riparian zone. These areas were generally considered off-limits for timber harvest or other entries of mechanized equipment since the early 1980's. Information relating to soil chemistry, water quality, hyporheic zone influences, and detrital input has resulted in planning of projects to achieve a range of natural conditions. Studies to determine effects of conifer removal in aspen stands, as well as elimination of grazing along the newly re-established channel of Pine Creek below the railroad grade are underway, but only preliminary and early data are available (Tate 2005, Jones et al 2005).

D. Monitoring

Monitoring can generally be divided into two types. Trend monitoring reflects changes in vegetative, soil, or riparian habitat conditions over periods of several years. It records the degree ecological objectives are being met and whether the plant community or landscape in question is moving toward or away from such objectives. Both data and photos can be effectively used in trend monitoring. The time required to observe noticeable change depends on the parameter being monitored. The response of riparian vegetation can be rapid (easily detectable in 2-3 years) where changes in stream channel morphology can be extremely slow (>20 years).

Implementation monitoring estimates whether the action taken has been effective, and if necessary, changes can be undertaken immediately to correct an action that may be detrimental. A good example of this is utilization monitoring for livestock. Usually grazing use is estimated as the percentage of forage eaten by livestock. Stubble height of key vegetation at the end of the season is also a common parameter. Utilization monitoring is a management tool based on the assumption that if certain use standards are not exceeded, there is a greater likelihood that the ecological trend will be positive. Depending on the site, 30 - 45% of forage use, or 4 - 6" of stubble height are common utilization objectives. Utilization data alone has marginal value, but when combined with trend data collected in the same allotment, it can help determine how well a management system is working. Utilization standards should be viewed as a management tool to achieve long-term resource objectives.

The Pine Creek EA outlined an ambitious monitoring plan that included photo-points, ground cover, bank stability and channel cross sections of the identified reaches of Pine Creek. Some of the following information was collected in accordance with the document; however, other data were only collected sporadically or could not be found in the Forest Service files.

1. Channel Morphology

Channel Cross-Section Points
An early advocate not only for establishment of the CRMP process but also for an assessment of long-term trends was Tom Troxel of the USFS. Troxel established channel cross-section points along Pine Creek in 1988. The intent was to read the cross-sections every 2 years in order to determine whether or not the stream channel was changing, hopefully in response to better management practices or projects to improved ecological conditions. Read initially in 1988, follow-up data were collected in 1992, 1995, and 1997. More cross sections were added in 1995 in order to monitor sites further upstream. The National Riparian Service Team (1998), recommended reading the cross sections every five years, or further, apart. Channel changes at the scale measured aren't likely to present themselves at two-year intervals. Some very useful data that is available from these locations are the photos that are taken from a known point. Visual estimates of change are easily discernible. Funding for this monitoring came from EPA 319 grant funds for 1992 and 1995, and FS appropriated dollars were used in 1997.

Figure 29. Champs Flat channel cross section. Top, 1997. Bottom, 2006.

Stream Type and Condition Inventory

Various methods of stream monitoring or inventory have occurred. The USFS has stream data from 1979, stream channel typing (Rosgen) from 1987, Stream Condition Inventory data from 1996, Sierra Province Aquatic Monitoring data from 1997, Proper Functioning Condition Assessments from 1998, and CDFG data from 1998 on stream type, springs and barriers. Each method of stream inventory listed above provides a snapshot in time of certain parameters, and some can be compared over time to assess trends in channel particulars.

2. Riparian Vegetation/Rangeland

The Weixelman Plots

The Forest Service has established vegetative plots to be read every 5 years in order to look at long-term trends of vegetative conditions in the Sierra Nevada region. The protocol uses a rooted frequency or greenline approach, and is considered repeatable and reliable. Seven of the twelve plots in the Pine Creek watershed established in 1999 and 2000 have been re-read once, with four showing a stable trend and three showing a downward trend. Weixelman (2006) summarized the approach:

> *"The range protocol measures the ecological status of meadows. Ecological status is defined by the Forest Service (paraphrase) as the degree to which the plant and soil conditions reflect the potential natural conditions and is expressed as either high, moderate, or low. The range protocol addresses the herbaceous plants and the soil conditions for meadow systems and does not measure the shrub component. This protocol measures herbaceous plant composition, depth and density of fine roots in the soil, and amount of bare ground. A high ecological status means that: (1) the herbaceous plant composition is made up of mostly late successional plant species; (2) there is a deep sod layer capable of holding streambanks together; and (3) there is very little bare soil. A low ecological status means that: (1) the herbaceous plant composition is made up of mostly early successional plant species; (2) there is a shallow sod layer that is not capable of holding streambanks together; and (3) there is generally greater than 10% bare soil."*

A moderate ecological status falls in between the "high" and "low" categories listed above.

Harvey Valley Study

In the 1950's, Gus Hormay was reading range conditions in a rest-rotation grazing system in Harvey Valley. At the time, his work was one of few studies of conditions and trends on grazed lands. The Harvey Valley allotment continues to be grazed under the rest-rotation system, but has been modified in recent years to determine whether or not vegetative recovery is occurring using high intensity, short duration without providing rest in one of the three pastures. This grazing system has drawn much interest through the years, and vegetative data has been collected to determine condition. Ratliff (1997) re-read Hormay's original plots and concluded the following (interpreted by UC Cooperative Extension Farm Advisor and CRMP coordinator David Lile):

> *"The Harvey Valley grazing allotment was a chosen site to field test the rest-rotation grazing system developed by Gus Hormay in the 1950's. Rest-rotation grazing sought to control the timing, frequency, duration and intensity of grazing and incorporate time periods of rest in to the grazing scheme. While many concepts and derivations of rest-rotation grazing are today in widespread use, it is not commonly practiced in it's pure form as originally implemented in Harvey Valley.*

Approximately 80 transects were established and extensive plant cover data was taken on the allotment in 1956 and 1957 when rest-rotation grazing was first put in place. For comparison purposes, these transects were established in both grazed areas and exclosure protected from grazing. They were re-read in 1963 and '68. As part of the CRMP effort, the Honey Lake Valley RCD contracted with retired PSW Range Scientist Ray Ratliff to read the Harvey valley transects once again in 1996 and 1997. Ratliff compiled a report titled "40 Years of Rest-Rotation Grazing on the Harvey Valley Allotment".

Some of his findings are summarized in **Appendix 4**.

Condition and Trend (Parker 3-Step)
Range conditions were read in 1965 and again in 1990 using the Parker 3-step method. The conditions of forage and soil were determined with a reading that indicated whether the cluster was in a "good", "fair", or "poor" category and whether there was un upward, downward, or static trend. Twenty-three clusters were established across the district and across each of the present day allotments. Of the 23 clusters read during each year, 14 showed a downward trend in soil, while 15 were downward for forage. Four of the clusters showed an upward progression in soil, while 5 were upward for forage. No change in trend was apparent in 4 of the soil plots, while only 2 remained unchanged for forage. One site was not read in 1965, so no trends were recorded.

Limitations of the Parker 3-step method have been made known. In a report to the Governor of Arizona in 2001, Lane et al, in "Assessment of U.S. Forest Service Methods for Determining Livestock Grazing Capacity on National Forest in Arizona" wrote that many of the transects across most of the forests "were not established based on ecological units stratified to represent entire allotments and they have not been monitored regularly." It is unknown if the same holds true for those established on LNF. This report showed concern that data from the Parker sites was extrapolated for the entire allotment, and that other data (such as precipitation data and forage utilization) and observations were absent that were necessary for good cause and effect analyses.

Streambank Trampling or Green-Line Method
Streambank trampling and bank disturbance were measured on grazing allotments in 1998 through 2001, in an attempt to refine a method to use to measure grazing disturbance and green-line recovery. Due to wide variations in the methods and variation along stream types, this annual monitoring is no longer used by LNF to determine when cattle should be moved from one area to the next (Frolli pers. comm. 2006). However, a protocol to measure expansion of the riparian vegetation along streambanks has been under study since 1999, with further additions of locations along Pine Creek in 2005. This "Recolonizing Plant Protocol" is part of a wider study by the USFS in Region 5 to address the response of streamside riparian vegetation to livestock use (Jones, pers. comm. 2007).

3. Livestock Utilization Data

In the years following the publication of the Pine Creek EA in 1995, data on grazing use were collected and are displayed in **Appendix 7**. From the data displayed, the areas that were grazed beyond the utilization standard in multiple years are apparent. The headwaters of Pine Creek, the bottom end of Stephens Meadow, Camp 10 area, the Logan Springs exclosure, and the Bradford Crossing area exceeded the set standard in numerous years after the levels were set in the Pine Creek EA. Due to the absence of fencing in the headwater area, cattle drifting from one allotment to the next would end up with excessive use and trampling along the spring dominated upper channel of Pine Creek. A fence to exclude cattle from the Logan Springs area failed due to fallen trees, and in one case, the fence was cut and cattle entered to use the water. Drift of animals through the Bradford Crossing area resulted in overuse in multiple years when animals weren't monitored closely and/or moved through rapidly enough.

Debate will persist about assigning the appropriate levels of use and the method used to assess that utilization of forage or measuring effects to streambanks. Currently, the ELRD uses the Landscape Appearance Method (USDI 1996) to determine use of the vegetation and impacts. Actual use data prior to 1994 were not found in the FS records. However, there is consensus that grazing use of riparian areas prior to the Pine Creek EA was much heavier than what we've seen within the last decade.

4. Water Table/Wetland Monitoring

Due to contract violations during the Highway 44 realignment in 1999, CalTrans was obligated to fund a wetland-related project in the vicinity of Highway 44. A site was selected along the newly realigned Pine Creek channel, where cattle had access to the poorly vegetated streambanks. CalTrans funded the cost of fencing, the purchase of water table monitoring equipment, and partial salary funding to cover some of the initial costs of establishing and reading the data. Vegetative plots and water sensing equipment were established in 2003. A monitoring report prepared for the study cited *"a significant increase in rhizomatous graminoid species"* in the ungrazed and restored stream location, and continuing, *"The three years of data collected thus far indicate a positive trend towards the objective of wetland vegetative recovery"* (LNF 2005).

5. Hydrologic

Snow Surveys

Snow surveys have been performed since 1940 at Silver Lake and at Norvell Flat, both within the Susan River watershed, but very close to the boundary with the Pine Creek watershed. These are currently being evaluated to determine if a predictor of runoff, flows and possibly stream temperatures can be made. In 2002, the ELRD added two survey routes to the program, located at Stephens Meadow and in Pine Creek Valley. Early results indicate a good correlation between the snow depth and water content at the corresponding locations (i.e., Silver Lake to Stephens Meadow and Norvell Flat to Pine Creek Valley). Unfortunately at this point, there do not appear to be any one set of data or even a range of data that correlate with successful or known fish passage to the vicinity of Highway 44 and upstream.

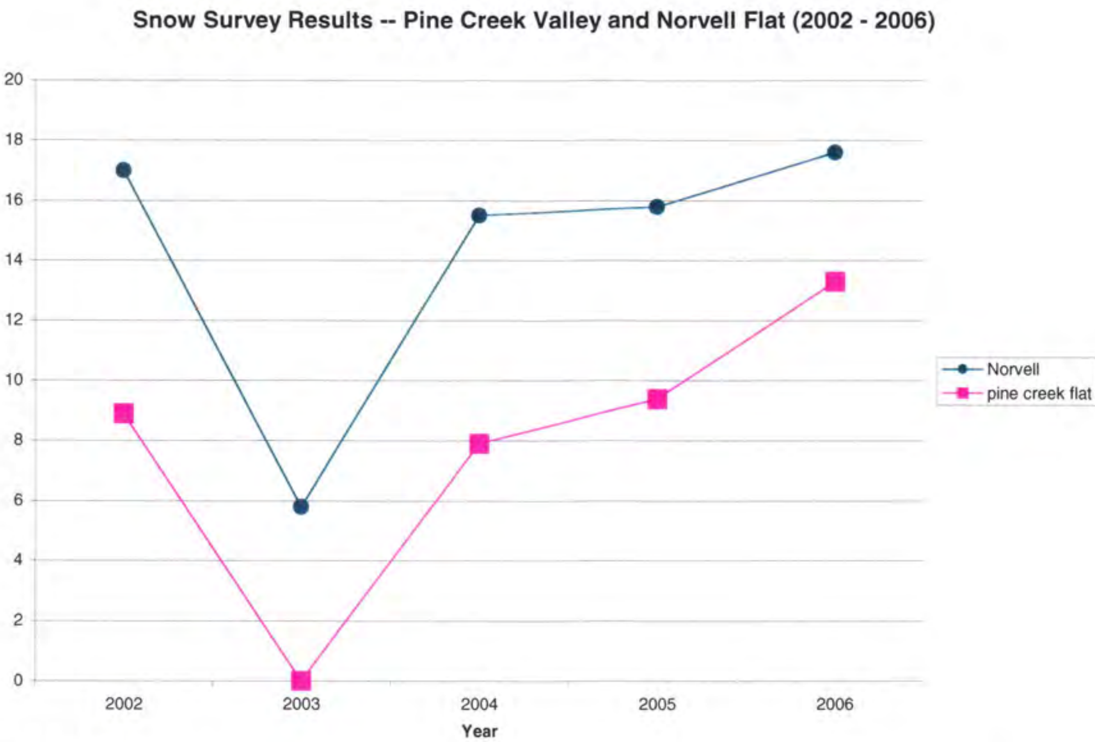


Table 7. Snow survey results from lower elevations of Pine Creek and Susan River watersheds, in inches of water equivalent.

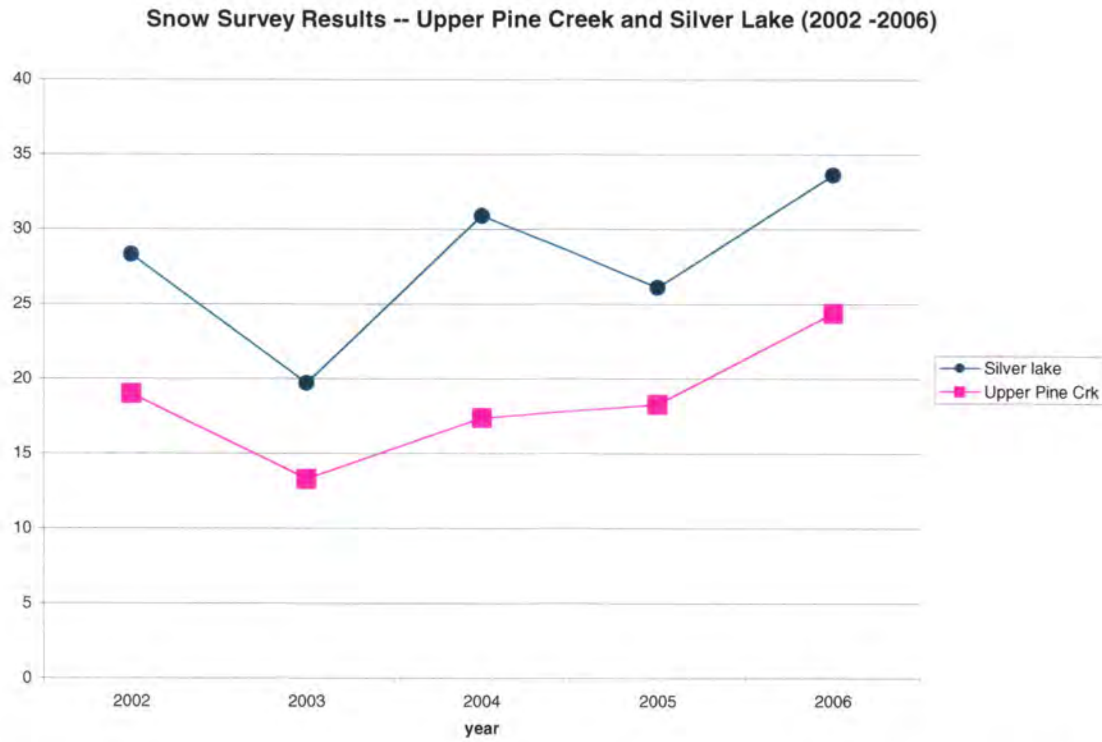


Table 8. Snow survey results from upper elevations of Pine Creek and Susan River watersheds, in inches of water equivalent.

Water Quality

Data collection of water quality parameters began in 1969 at Eagle Lake. Through an agreement between the California Department of Water Resources and the USFS, a continuous annual set of data is collected and available for review. Typical water chemistry data components such as temperature, alkalinity, pH, dissolved oxygen, total dissolved solids, turbidity, and electroconductivity are measured approximately 5 times per year, from April through November. Other data are collected that include secchi disk readings (water clarity), phytoplankton, zooplankton, and in some years, heavy metal and methyl tert-butyl ether (MTBE) readings. Locations have been added and/or removed through the years, but some stations have been consistent since 1969. Water quality data have also been collected in Pine Creek with a study of the aspen release projects beginning in 2001 (Tate 2005).

6. Eagle Lake Rainbow Trout

Radiotelemetry

Tracking of Eagle Lake trout began in 1999 after a multi-year process to procure funding and find suitable equipment to accomplish the task. In 1994, LNF, at the recommendation of CDFG and with support of the CRMP, requested funds through a program then known as "Bring Back the Natives" (BBTN). The purpose of the radiotracking study was to evaluate the effectiveness of stream channel restoration efforts. Approximately $19,000 was allocated based on matching dollars, which included time from CRMP participants. At that time, the question to be answered was whether or not ELRT could make it to the perennial portion of Pine Creek.

The transmitters that were selected would emit a radio signal and collect water temperature data in order to provide information on water temperature of holding places or travel corridors, as well as to provide an electronic trail fish migration. The mortality signal option allowed for retrieval of the transmitter if/when mortality occurred. When the carcass was found, biologists could examine the condition of the carcass and determine possible cause of mortality.

ELRT were collected during the spawning season at the Pine Creek fish trap and transmitters were surgically placed in selected migrating fish. Tracking crews searched for signals of tagged fish to accurately monitor their upstream progress. Transmitters were first implanted in ELRT in 1999, but results were difficult to interpret, as it was discovered that other electronic equipment within the Pine Creek corridor easily interfered with the frequencies chosen. Fish that were released were "lost" for a period of two weeks, during which time their whereabouts were completely unknown. Ten unmarked, untransmittered fish were released along with the 10 fish, and two of these may have been seen in upper Pine Creek Valley in mid-May on a canoe trip downstream from Highway 44 to track the transmittered fish. In early June, a single radiotransmitter, sans trout, was recovered in Bogard Spring creek above the 32N22 road, a distance of 3.6 miles above Highway 44.

Efforts at releasing and tracking fish in subsequent years has resulted in the following summary:

Year	# Of fish radiotagged	Date(s) released	Farthest distance confirmed
1999	10	4/10/99, 4/15/99	2 fish 3+ miles, and 1 fish suspected 20+ miles (above Hwy 44)
2000	51	3/28/00	2 traveled 17 miles, 5 others went 10+ miles
2001	19	3/27/01	7 traveled 10+ miles, 4 traveled 13+ miles
2002	19	3/28/02, 4/01/02	4 fish went 2+ miles
2003	0	No tagging done	
2004	30	3/23/04, 3/30/04	4 fish traveled 7+ miles, 2 traveled 17 miles
2005	10	4/06/05	3 fish traveled 3+ miles, 4 traveled 2+ miles
2006	20 (Passive Integrated Transponder (PIT))	4/22/06, 5/06/06	Not known, new tracking method tested

Table 9. Tracking data for Eagle Lake trout released upstream of fish trapping facility near Spalding.

Comparing this information with streamflow, both 1999 and 2003 had the best runoff in terms of quantity and duration of flows, which unfortunately is impossible to predict. No fish were implanted with radiotags in 2003 due to perceived poor runoff conditions at the time and a lack of personnel available to perform the tasks.

With the inherent limitations and lack of positive results associated with the radio-tracking (i.e., no fish confirmed upstream to Highway 44), concern developed over the high post-surgery mortality as well as potential impacts to the behavior of the fish that were implanted. It was in 2004 that the Fish TRT first considered adapting the method to using new available technology that required a less invasive procedure for the fish. The new technology relies on passive integrated transponder (PIT) tags that carry no battery (hence a much smaller size), and the tags within the fish are electronically recorded as they pass through a charged antennal loop. In 2006, this procedure was used as a pilot program to test the effectiveness of fish passing by an antenna array. The test showed encouraging results, in that PIT-tagged ELRT released at Highway 44 were individually recorded onto a Scan-disk card as they passed through the antenna array set up for the season. More antenna arrays are planned for the future to prepare for a potential larger release of the tagged fish. Timing and quantity of released ELRT may be important to migration success if stream conditions, runoff, and temperatures are adequate.

Figure 29a. Two methods used to track upstream fish migration. Left, radiotransmitter surgically implanted into body cavity. Right, PIT tag inserted under skin.

Instream Populations

Monitoring of fish populations in Pine Creek has been sporadic. Information comes from student reports from UC Davis, snorkeling during Sierra Aquatic Province Monitoring (1997), and incidental sightings of species. In 2006, a meadow survey crew from UC Davis conducted fish population surveys, but written results are not yet available. However, preliminary information showed that it is very likely that the larger, planted ELRT were able to successfully spawn in 2004 and 2005 based upon two size classes of juvenile rainbows collected in September of 2006 and subsequently released. Three juvenile ELRT were collected in a 100+ meter section of Pine Creek near Bogard Barn, below Bogard Campground. Of even greater interest was the collection of 10 ELRT juveniles, likely aged at 1+ years from Bogard Springs Creek, in a 100-meter section of stream. Data collected from these sites will be reported at a later date. Other data sampled included vegetation, macro-invertebrates, fish and other aquatic fauna, and physical characteristics of the stream habitat.