

Information in this document was copied from a CD of a webpage created by Jim Popenoe October 16, 2000. The CD was found in the Davison Ranch/Elk Meadow Records Collection of the REDW Archive.

The information was copied and added to this document to provide an introduction to the Davison project and the Arcata Redwood Company's Mill B.

More information can be found in the REDW Archive Catalog number REDW 33541. The CD is located in Box 10 of the collection.

The Elk Meadow Project

In August 1999, Redwood National and State Parks (RNSP) began a two-year project to construct a new trail system and trailhead through the Davison Ranch. The park acquired the ranch property in 1991 and an adjoining property (the B-Mill Deck) in 1996. In August 1996, RNSP completed a Development Concept Plan (USDI 1996) and was awarded an Intermodal Surface Transportation Efficiency Act (ISTEA) grant for the development of the bike/hike trail and trailhead. On-site surveys and planning were completed by the NPS Denver Service Center in June 1997. Park staff submitted a Biological Assessment for the project to NMFS in July 1999.

A bike-hike trail west of Prairie Creek from the south end of Prairie Creek Redwoods State Park to Davison Ranch is the project's centerpiece. Most of the upper B-Mill Deck becomes a parking lot, trailhead, picnic area, and interpretive viewpoint, to be re-named "Elk Meadow".

A portion of the ISTEA grant, augmented by park-base, is earmarked to fund mitigation for the construction by restoring a lost stream channel, buried wetlands, and associated vegetation in place of the lower deck.

THE PROJECT AREA

Land use and vegetation history

As seen in the photo below, by 1941 the floodplain of lower Prairie Creek watershed had been cleared of much of its natural riparian vegetation. The floodplain was being used for agriculture and as a highway corridor. Pastures appear in uniform light shades. Remnants of the riparian hardwood canopy appear in varied soft gray. Old-growth redwood forest dominated the hillslopes around the Davison Ranch. The huge redwoods and their shadows stand out in great contrast.



View of lower Prairie Creek basin on July 11, 1941 from aerial photograph CVL-6-33.

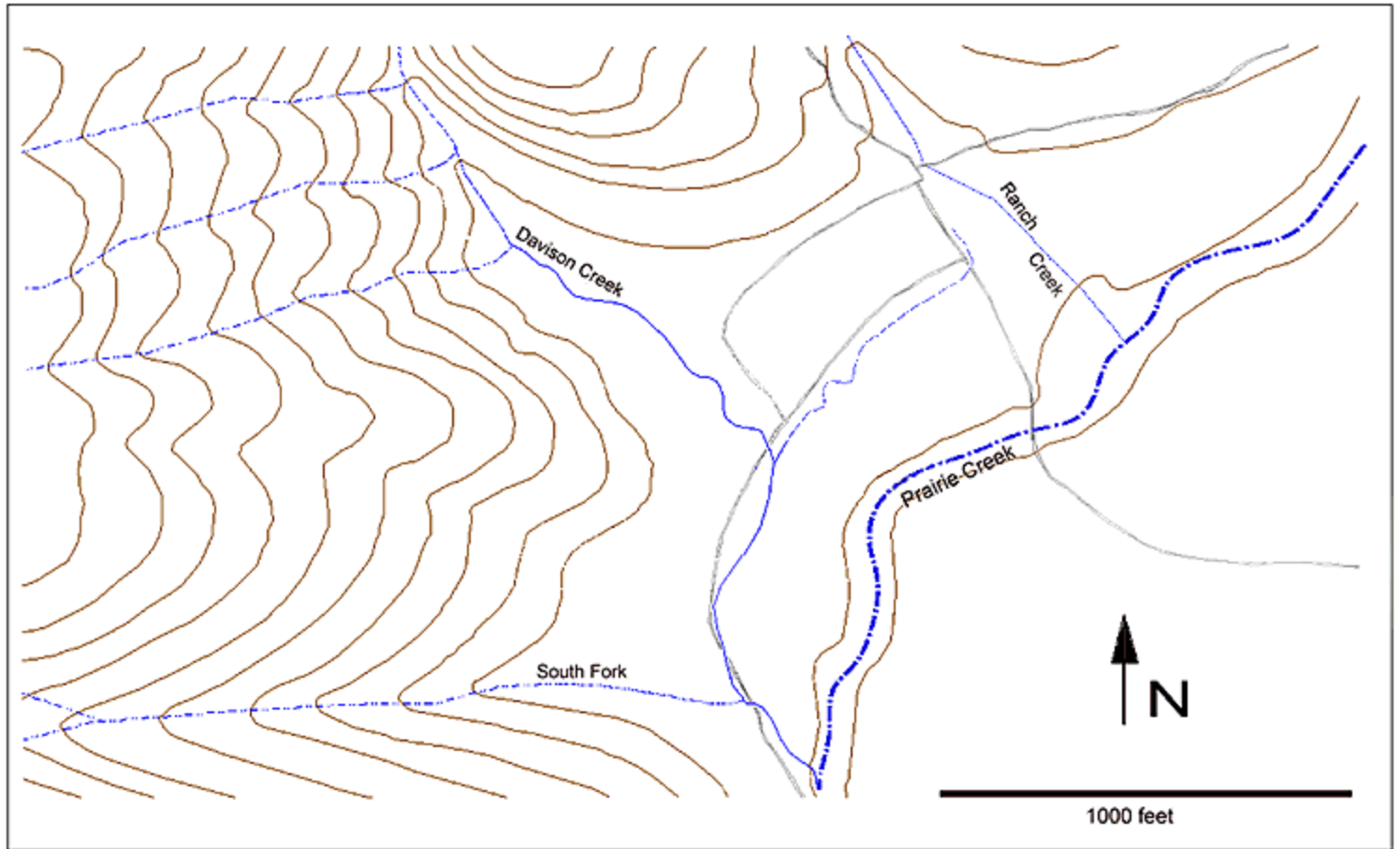
By 1948, the redwoods were being harvested on the slopes around the Davison Ranch. Later, Mill B and its associated log storage deck would be constructed to store and process the harvested timber.



View of Davison Ranch area on June 23, 1948 from aerial photograph CDF2-16-154.

Drainage patterns

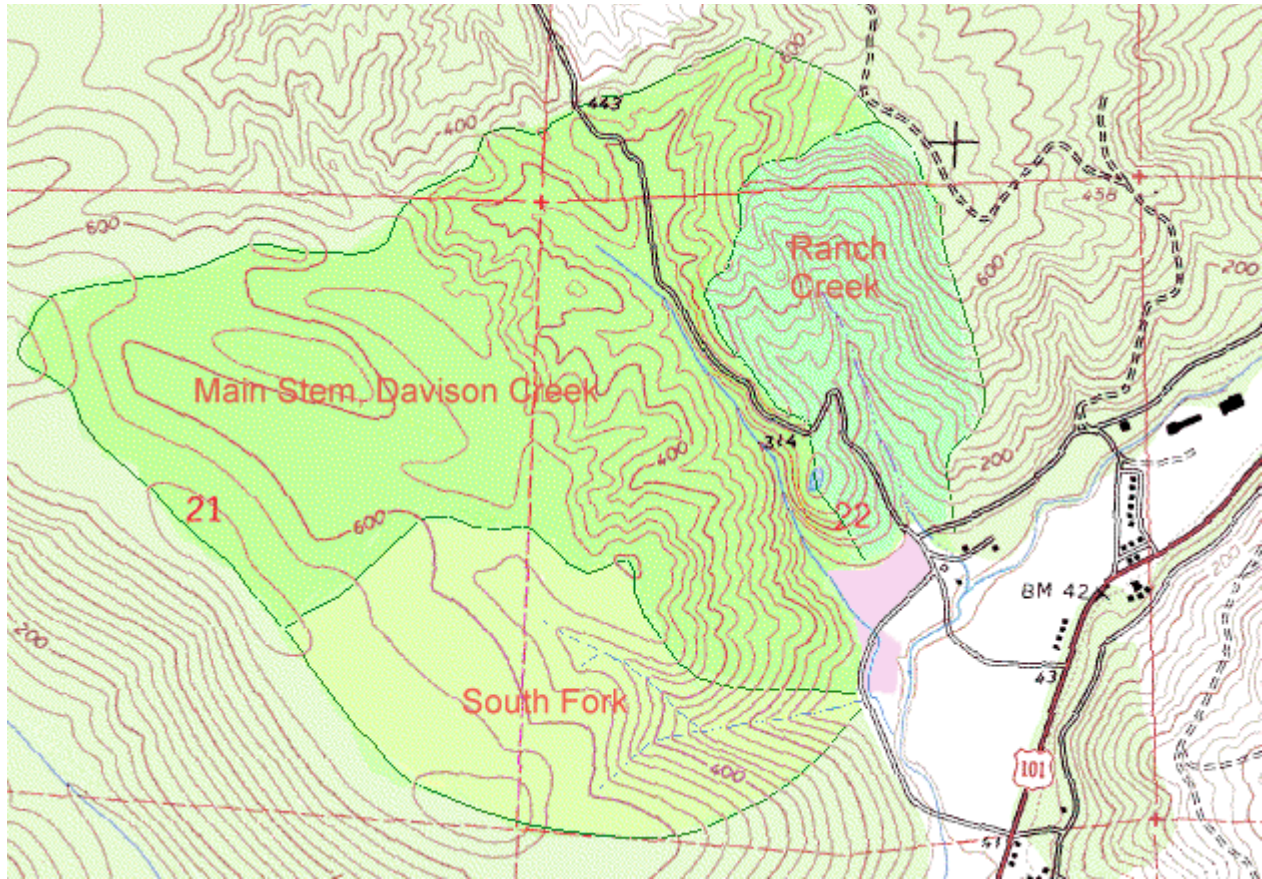
Historic aerial photographs show that, before the lower deck at Mill B was constructed, the main stem of Davison Creek joined a south fork. The shape of the land and water springing downslope from the Davison Ranch barn suggest that Ranch Creek may have joined Davison Creek at one time, too.



Sketch of drainage network prior to 1967, with roads in light gray for orientation.

The drainage areas of the three creeks are

- 1) South fork of Davison Creek, 160 acres
- 2) Main stem of Davison Creek, 440 acres
- 3) Ranch Creek, 100 acres



Drainage areas of Ranch Creek, the main stem of Davison Creek, and the south fork of Davison Creek, based upon USGS topographic map with drainages modified to reflect completed restoration.

When combined, the main stem and south fork of Davison Creek had a drainage area of 600 acres. If Ranch Creek also joined Davison Creek, the combined drainage area would be 700 acres.

The B-Mill Deck grew in stages. An upper deck was built first, partly cut into a spur ridge and partly built on fill pushed into the valley of Davison Creek. Davison Creek was moved into a ditch on its southwest side. The photo below shows the situation in 1962. The upper deck was finished but a lower deck was not yet started. Drainages are clearly visible on the floodplain because it was still open pasture. Stream reaches on the floodplain were affected by a portion of the "200 Road", a new haul road west of Prairie Creek. The haul road was elevated on fill above the floodplain surface. The fill encroached into floodplain backwaters, displacing and elevating the creek beds. It looks like someone dug ditches next to the elevated 200 Road, probably to facilitate drainage of the pasture and wetland. The ditches appearing in 1962 just north of the large tree shadow look like what exists at the confluence of the main stem and south fork today.



Aerial photograph HCN-1 16-82 for Humboldt County Timber Assessor

In 1967, a lower deck was constructed. The main stem of Davison Creek was diverted through a culvert and ditch north of the lower deck into Prairie Creek (Please click [here](#) for details). By itself, the south fork of Davison Creek had only 27 percent of the combined drainage area to supply the lower reach. From 1967 to 1999 the main stem and south fork emptied separately into Prairie Creek. Successfully re-connecting them would restore and normalize both the winter peak flows and the summer base flow in the lower reach of Davison Creek.



B-Mill Deck, December 14, 1992

Wetlands

Perennial marshes (palustrine emergent persistent permanently flooded in [Cowardin, et al. 1979](#)) are readily identifiable on aerial photos in the pastures as dark areas representing lush growth. No part of the lower deck occupied the perennial marsh south of Davison Road. This marsh is visible in both the 1962 and 1992 photos. There were no perennial marshes where the lower deck was built. It may be that the engineers chose to avoid permanently wet areas when they built the lower deck in 1967. Seasonal wetlands (palustrine emergent seasonally flooded or temporarily flooded) tend to occur in the pastures in depressions and backwater areas of the floodplain, but they are not always reliably identifiable on aerial photographs. Therefore it was probable but not certain that seasonal wetlands had been buried beneath the lower deck. The wetlands along Davison Road that were to be paved for elk viewing were seasonal wetlands.

A concern and challenge in restoring this landscape was to preserve the hydrology of the existing perennial marsh. The surface water and groundwater regimes varied little through the year, at least in part stabilized by water in the drainage ditch carrying Davison Creek. Lowering or raising the water level a few inches could disrupt the fragile hydrologic regime. Hydrologic sensitivity was a reason to give extra attention to elevations during planning and implementation of the project. The challenge was how to restore Davison Creek in a way that retained both the level of water and the hydrologic connection that may have helped to stabilize the water regime of the existing wetland.

Elevations, stratigraphy, and gradients

According to [Klein \(1996, p. 2\)](#), Prairie Creek has an average gradient of about 0.14 percent through the Davison Ranch. It meanders over the floodplain with a sinuosity of 1.2 (channel length / valley length). There are two distinct stream segments of differing slope. The gradient averages 0.10 percent above the Davison Road and 0.17 percent

below. The floodplain on either side of Prairie Creek is nearly level, marked with some old meander scars. Broad natural levees occur next to the channel and range to 3 feet higher than the average elevation of the floodplain. [Klein \(1996, p. 3\)](#) interprets the upper margin of B-Mill Deck as an alluvial fan deposit emanating from Davison Creek. He states,

"While the upper (western) margin of the deck is clearly an alluvial fan, the lower margins of the deck may have been elevated with fill material when the deck was constructed. This cannot be determined without soils analyses of the materials beneath the pavement. In any case, the bank height along the streamward edge of the deck (right bank) is several feet higher than on the opposite (left) bank."

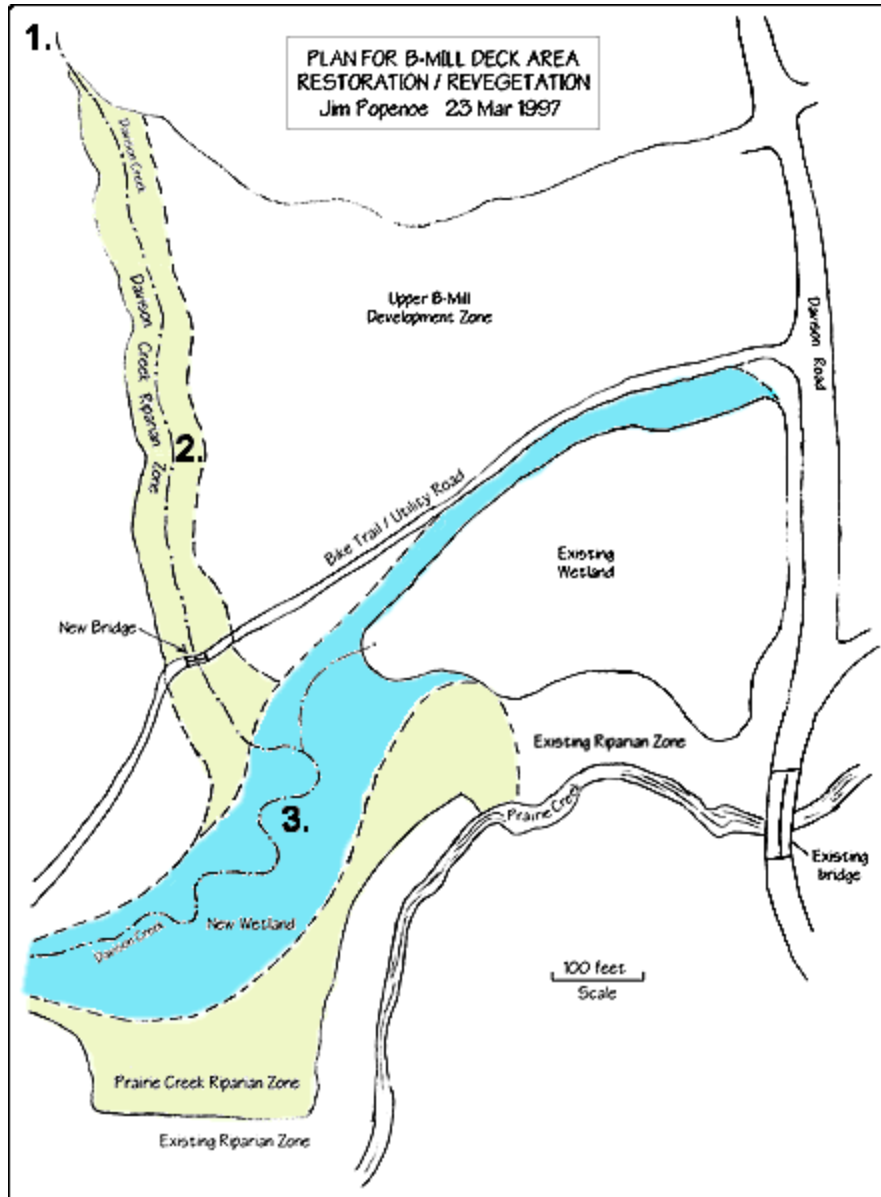
A test trench was dug into the lower deck in January 1997 in search of the assumed former channel and a possible stratigraphic contact with original ground. A contact was encountered at some locations where it was within reach of the backhoe bucket (depth of about 10 ft. or less). Material above the contact was unsorted brown cobbly clay loam full of angular clasts, indicating that the fill probably originating from the rock pit. Material below the contact was gray, nearly rock-free silt loam or silty clay loam, indicating alluvium.

Sources of [elevation data](#) during the planning phase were [USDI \(1996b\)](#), [Klein \(1996\)](#), [Popenoe \(1997\)](#), and Neal Youngblood's unpublished field notes. The numbers differ slightly from qualitatively similar data collected after implementation, but probably not enough to have influenced planning decisions. However, if a [more thorough survey](#) had been completed prior to detailed planning, the resulting plan seems likely to have been different.

Alternative Concepts of Restoration

March 1997 revegetation / restoration plan

The [restoration / revegetation plan](#) includes a sketch of what Jim Popenoe envisioned:



Davison Creek stream segments in the project area

Implicit to Jim's sketch is the concept that Davison Creek originally had three distinct major stream segments. These would be functionally re-integrated by the geomorphic restoration, and the resulting hydrogeomorphic zones would provide the template for the planned revegetation:

1. The segment above the upper deck is an incised stream in the bottom of a V-shaped mountain valley. The stream is sharply confined by the narrow valley bottom and the sidewalls are shaped by infrequent landslides. Prior to logging, the natural streambed was probably armored with coarse woody debris and clasts of mainly boulder, stone and large cobble size. The upper stream segment is the kind usually treated in the park's watershed rehabilitation program. It is the steepest of the three stream segments.
2. The segment through the upper deck where the valley widens is an alluvial fan. Here, the stream

oscillated back and forth across the fan as it deposited its bedload. Examples of other fans include the one where SOC is situated and adjacent fans. A fan is a depositional surface. The stream moves back and forth seeking the lowest path. The effect is to fill the lowest places. Over time, the stream tends to deposit a cone of constant gradient. The clast sizes deposited are mostly small cobbles, pebbles and sand. The fan segment is gently to strongly sloping. Park development was planned along this stream segment. The challenge when developing on a fan is to anticipate and deal effectively with the oscillating stream movement.

3. The lowest stream segment is on the floodplain of Prairie Creek. Jim imagined that the stream meandered here behind the natural levee of Prairie Creek before it was confined to a ditch. An example of another stream segment of this kind is the small drainage in the pasture next to Highway 101 on the east side of Prairie Creek. The grain size deposited in the floodplain backwaters is mostly silt, but grain size ranges from very fine sand to clay. The floodplain segment is nearly level.

In this plan, the main stem of Davison Creek is reconnected to the south fork and the hydrologic connection with the existing wetland is maintained. Fill is excavated down to the native alluvial substrate. Jim expected that an upland riparian zone would be exhumed on the natural levee next to Prairie Creek and wetlands would be exhumed behind the natural levee along Davison Creek. Details of the re-constructed stream system, floodplain, and wetlands would emerge as the original surfaces re-appeared.

May 1997 HSU student "wetland creation project"

Three Humboldt State University students followed up on the park's plan by conducting additional independent research, developing their own alternatives, and submitting a report ([Anderson, et al., 1997](#)) to the park and to their academic advisor as a senior project in Resource Planning and Interpretation. Their report is a source of considerable information and concepts.

The authors propose three alternatives. Common to all three alternatives, i) the main stem of Davison Creek empties into Prairie Creek near the downstream end of the deck (it does not re-connect to the south fork); ii) there is a berm with Davison Creek on one side of the berm, and with the existing wetland and Prairie Creek on the opposite side (breaking the hydrologic connection between Davison Creek and the existing wetland). The alternatives explore varied goals, and propose to achieve them by varying the depth and width of the excavation and height of the berm:

1. This alternative creates a pond for migratory waterfowl. Deep excavation produces a closed depression which, fed by Davison Creek, becomes a pond. A high berm (maximum elevation 52 feet) largely shields the pond from interaction with Prairie Creek. A weir controls the water level.
2. This alternative creates a wet meadow with a small island. The excavation is open ended so that it drains, but the gradient is nearly flat. The island or berm produces a combination of upland and wetland habitat. The maximum elevation is 50 feet.
3. This alternative follows the current grade of the site and is designed to facilitate formation of an alluvial fan. The excavation is broad with a gentle taper. The berm has a maximum elevation of 48 feet.

June 1997 DSC grading plan

This grading plan for Davison Creek ([Urbanowski 1997](#)) depicts a V-shaped ditch of constant (0.8 percent)

gradient from the culvert inlet (thalweg elevation 42 feet) to the downstream end of the B-Mill Deck (designed thalweg elevation 38.5 feet). Upon exiting the ditch, flow would join with the south fork and enter the lower historic reach of Davison Creek. Contour lines are drawn to an elevation of 44 feet, indicating that at least some, and probably most of the fill beneath the asphalt is planned to remain in place. The width of the ditch on the 44-foot contour is about 30 feet. In this plan, the hydrologic linkage between the existing wetland and Davison Creek is lost. There is no evidence from the grading plan that any additional wetland area or any former native substrate supporting wetlands would be necessarily restored.

July 1999 Biological Assessment

The 1999 Biological Assessment (Wallen, et al. 1999) was the guiding document for implementation of the project. It seems to include just about all of the restoration concepts:

1. An updated restoration / revegetation plan is in Appendix 1.
2. Reminiscent of the HSU student project, there is reference to a "... natural berm at the confluence of Davison Creek to the lower tributary ... [that] ... will pool water and act as a settling pond ...".
3. Figure 4 and several of the elevations and gradients in the text match the DSC grading plan.

Operationally, the Biological Assessment calls for the excavation to be implemented as follows:

"The lower deck will be removed, restoring the original Prairie Creek floodplain elevations."

"The geologist will be visually tracking the excavation to determine original landform. The original land is verified by exposing topsoil and buried indicators such as: stumps, buried organics, and nonconformity's in the soil profile. The lower channel, the Humboldt crossings and the Prairie Creek floodplain will be excavated in this manner."

ELK MEADOW REVEGETATION

FY2001 Progress Report

James H. Popenoe
October 2001

Introduction

This report follows up on the first-year (FY2000) Elk Meadow wetland and riparian revegetation project annual report. It documents the second-year planting and weeding, describes vegetation development the second year (of a two-year project), and it updates the list of vascular plant species found on the Elk Meadow restoration site.

Initial Status and Plan of Action

At the end of FY2000, the conditions and FY2001 plans for the Elk Meadow restoration site were as follows:

1. Along the left bank of Davison Creek next to the parking lot, and on the steep slope between the utility road and the pond, most of the native riparian trees planted in FY2000 had survived and grown. In addition, many more native tree seedlings had volunteered. In FY2001, the plan was to plant contract-grown salmonberry (*Rubus spectabilis*) and big-leaf maple (*Acer macrophyllum*) that had been unavailable in FY2000. No replacement of tree species planted in FY2000 appeared necessary.
2. In the wetlands around the edge of the pond, herbaceous cover was already greater than 80 percent, and native emergent plant species dominated. One problem was that seedlings of an aggressive exotic, reed canarygrass (*Phalaris arundinacea*), had colonized the new wetland. In FY2001, the plan was to weed out the reed canarygrass and to plant salmonberry. No other planting appeared necessary, unless flooding produced bare ground, in which case native slough sedge (*Carex obnupta*) would be planted that was being multiplied under contract.
3. As of September 2000, the portion of the restoration site on the floodplain next to Prairie Creek was still mostly bare ground, and it was not clearly heading toward reference conditions. Most cuttings of willow (*Salix* spp.) had sprouted, only to be decimated by browsing. Problems included few tree seedlings, lack of protection from browsing, and lack of a developing deciduous tree canopy. In FY2001, the following actions were planned:
 - a) Plant additional red alder (*Alnus rubra*), unless colonized by new volunteer seedlings.
 - b) Spray or dip planted trees in Ropel®, a non-toxic animal aversion agent, to discourage browsing.
 - c) Plant clumps of long willow poles to place the treetops above the browse line from the start.

Implementation

Planting.

Planting was completed by a California Conservation Corps (CCC) crew between February 26 and March 1, 2001. The crew planted a total of 400 one-year-old big-leaf maple: 200 along the left bank of Davison Creek next to the parking lot, and 200 on the steep slope between the service road and the pond. They planted 100 two-year-old bare-root red alder on the floodplain next to Prairie Creek. The alders and maples were sprayed with 0.5 gallon of Ropel® on March 12. For the second year in a row, no salmonberry was available to be planted.

The same week, the CCC planted 46 willow pole clumps. Robust, straight cuttings, 10 to 15 feet long, were collected from willows along the road to the Redwood Creek Trail. A soil auger was used to make planting holes about four feet deep. Clumps of poles were jammed tightly into the holes, re-filled with soil, and tamped in from the sides. After planting, the tops protruded 6 to 10 feet above ground. The

clumps were sprayed with Ropel® after planting, 0.5 gallon on March 12, and 2.0 gallons on March 19.

The one-year-old big-leaf maple cost 28¢ apiece. The two-year-old bare-root red alder cost 45¢ apiece. Ropel® animal repellent cost \$51.49 per gallon. CCC labor cost \$12.00 per person-hour. Table 1 provides a cost breakdown for the tree planting:

Table 1. Cost breakdown for second-year tree planting at Elk Meadow, February 26 to March 1, 2001.

Tree species	Number	Tree cost	Person-hrs	Labor cost	Ropel® (gal.)	Ropel® cost	Cost Total	Cost/tree
Big-leaf maples	400	\$112	15	\$180	0.25	\$12.87	\$304.87	\$0.76
Red alders	100	\$45	10	\$120	0.25	\$12.87	\$177.87	\$1.78
Willow clumps	46	\$0	80	\$960	2.50	\$128.73	\$1,088.73	\$23.67

The cost total for all of the trees in FY2001 was \$1,571.47, including materials, labor and Ropel® animal repellent.

Weeding.

Reed canarygrass was hand-pulled from the wetlands by CCC and NPS personnel, with the effort concentrated during the spring. The crews were instructed to pull the grass completely out and to remove as much of the sub-surface rhizome as possible, weeding in a [straight line](#) in order not to miss any plants. CCC labor cost \$12.00 per person-hour. NPS labor averaged \$20.00 per person-hour. Table 2 provides a breakdown of labor and dollar costs:

Table 2. Timing and cost breakdown for reed canarygrass removal at Elk Meadow, February 27 to May 31, 2001.

Day and date	CCC		NPS		Total	Dollar
	persons	hours	persons	hours	Person-hours	Cost total
Tue Feb 27	12	2.0	1	1.0	25.0	\$308
Mon Mar 26	10	3.0	1	1.0	31.0	\$380
Tue Mar 27	10	3.0	1	3.0	33.0	\$420
Thu Apr 26	9	4.5	2	4.5	49.5	\$666
Mon Apr 30	13	6.5	1	6.5	91.0	\$1,144
Tue May 29	10	6.0	1	2.0	62.0	\$760
Wed May 30	10	6.0	0	0.0	60.0	\$720
Thu May 31	10	6.0	0	0.0	60.0	\$720
Total					411.5	\$5,118

Vegetation Development

I took notes and photographs to track the fate of the plantings and the overall development of vegetation on the restoration site. On March 6, soon after planting, four of the willow pole clusters had been heavily rubbed and broken, apparently by bull elk. These particular willow clusters were on the floodplain in the small pasture between the restoration site and Davison Road west of Prairie Creek. On March 19, four more clusters had breakage, this time inside the restoration site itself, but the breakage was less severe. In addition, three big poles were entirely girdled between 3 and 4 ft. above ground by antler rubbing. Soon after March 19 the bull elk dropped their antlers, and the girdling and breakage ceased. The willow poles began to sprout in April. By May, all of the willow clusters had vigorous sprouts. The willow tops grew bushier through July, although foliage and side branches less than 7 ft. above ground were heavily browsed (Figure 1). By the middle of August, the bull elk had grown new antlers and lost their velvet. When observed again on September 6th, many more of the willow poles were girdled by bull elk. In addition, the bulls had twisted and broken many more small branches. The breakage reduced some of the willow cluster plantings to single stems, which made them more vulnerable to subsequent rubbing. By September 19th, 37 of the 47 willow poles were girdled to a height of 6.5 ft. and had dead tops.



Figure 1. Willow pole clusters, August 1, 2001.

Trees grew rapidly near the culvert inlet on Davison Creek and near the pond where there was plentiful moisture (Figure 2). By the end of September 2001, trees in these locations were 10 to 13 feet tall. Nearly every one-year-old big-leaf maple planted in February 2001 along Davison Creek and along Prairie Creek was heavily browsed.



Figure 2. Alders along Davison Creek, August 1, 2001.

To document changes in herbaceous vegetation, I monitored the five [transects](#) that I established in 2000. (See [Appendix](#) for details.) Figure 3 summarizes the trends from June 17, 2000 to July 23, 2001. Little bare ground remained on July 23, 2001. Native wetland and riparian species as a group accounted for most of the increase in plant cover. Exotic pasture species increased only slightly as a group. Competition from taller native emergent species probably accounts for the slowed advance of exotic pasture plants other than reed canarygrass.

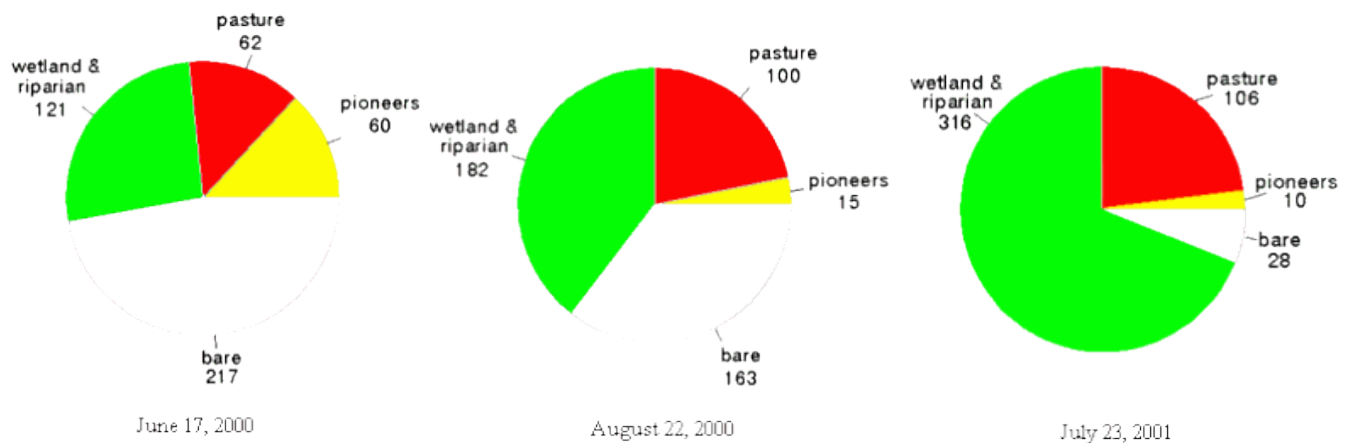


Figure 3. Vegetation cover on the floodplain based upon 460 sample points along five transects, 2000-2001.

[Cattails](#) that had volunteered in shallow margins of the pond in 2000 multiplied in 2001. Elk browsed them and pulled some out. [Tules](#) planted in August 2000 multiplied into clumps. Elk heavily [browsed](#) most of the clumps.

I noted new species when they came into flower. Additional species identified in 2001 that were not yet flowering in 2000 included [spike rush](#) (*Eleocharis macrostachya*), spreading rush (*Juncus patens*), [bur-reed](#) (*Sparganium emersum* ssp. *emersum*), and tumble mustard (*Sisymbrium altissimum*). I also found a mature [Oregon ash](#) (*Fraxinus latifolia*) that I had overlooked in 2000. Table 3 lists the plant species recognized at the restoration site in 2000 and 2001 combined.

Table 3. [Plant species](#) recognized at restoration site, 2000-2001.

Pioneer Group	Wetland and Riparian Group
<i>Aira caryophylla</i>	<i>Acer macrophyllum</i>
<i>Anagallis arvensis</i>	<i>Alnus rubra</i>
<i>Anaphalis margaritacea</i>	<i>Athyrium filix-femina</i>
<i>Baccharis pilularis</i>	<i>Callitriche marginata</i>
<i>Cerastium arvense</i>	<i>Carex leptopoda</i>
<i>Collomia heterophylla</i>	<i>Carex obnupta</i>
<i>Deschampsia elongata</i>	<i>Clintonia sibirica</i>
<i>Erechtites glomerata</i>	<i>Cyperus eragrostis</i>
<i>Erechtites minima</i>	<i>Dicentra formosa</i>
<i>Gnaphalium purpureum</i>	<i>Digitalis purpurea</i>
<i>Hypochaeris radicata</i>	<i>Eleocharis macrostachya</i>
<i>Juncus bufonius</i>	<i>Equisetum arvense</i>
<i>Lotus micranthus</i>	<i>Fraxinus latifolia</i>
<i>Lupinus rivularis</i>	<i>Glyceria occidentalis</i>
<i>Lythrum hyssopifolium</i>	<i>Hydrocotyle ranunculoides</i>
<i>Navarettia squarrosa</i>	<i>Juncus bolanderi</i>
<i>Poa annua</i>	<i>Juncus effusus</i> var. <i>effusus</i>
<i>Polygonum arenastrum</i>	<i>Juncus effusus</i> var. <i>pacificus</i>
<i>Polygonum persicaria</i>	<i>Juncus patens</i>
<i>Sisymbrium altissimum</i>	<i>Lonicera involucrata</i>
<i>Sonchus asper</i>	<i>Lysichiton americanum</i>
<i>Spergula arvensis</i>	<i>Mimulus guttatus</i>
<i>Taraxicum officianale</i>	<i>Oenanthe sarmentosa</i>
Pasture Group	<i>Polygonum punctatum</i>
<i>Agrostis stolonifera</i>	<i>Polysticum munitum</i>
<i>Alopecurus geniculatus</i>	<i>Rhamnus purshiana</i>
<i>Anthoxanthum odoratum</i>	<i>Rorippa nasturtium-aquaticum</i>
<i>Brassica nigra</i>	<i>Rubus discolor</i>
<i>Cirsium vulgare</i>	<i>Rubus parviflorus</i>
<i>Dactylis glomerata</i>	<i>Rubus spectabilis</i>
<i>Holcus lanatus</i>	<i>Rubus ursinus</i>
<i>Lolium multiflorum</i>	<i>Salix</i> spp.
<i>Lolium perenne</i>	<i>Sambucus racemosa</i>
<i>Mentha pulegium</i>	<i>Scirpus acutus</i>
<i>Phalaris arundinacea</i>	<i>Scirpus microcarpus</i>
<i>Plantago lanceolata</i>	<i>Sparganium emersum</i> ssp. <i>emersum</i>
<i>Plantago major</i>	<i>Tolmeia menziesii</i>
<i>Ranunculus repens</i>	<i>Typha latifolia</i>
<i>Raphanus sativus</i>	<i>Urtica dioica</i>
<i>Rumex acetosella</i>	<i>Veronica americanum</i>
<i>Rumex crispus</i>	
<i>Rumex obtusifolius</i>	

Discussion

Objectives for the second year of the Elk Meadow restoration were to 1) document how the vegetation was developing and 2) take steps to re-direct vegetation change toward long-term target conditions as needed, insofar as possible. Long-term target conditions had been defined by a planning sketch (Figure 4), and by the conditions within developing and mature native wetland and riparian vegetation on nearby reference sites.

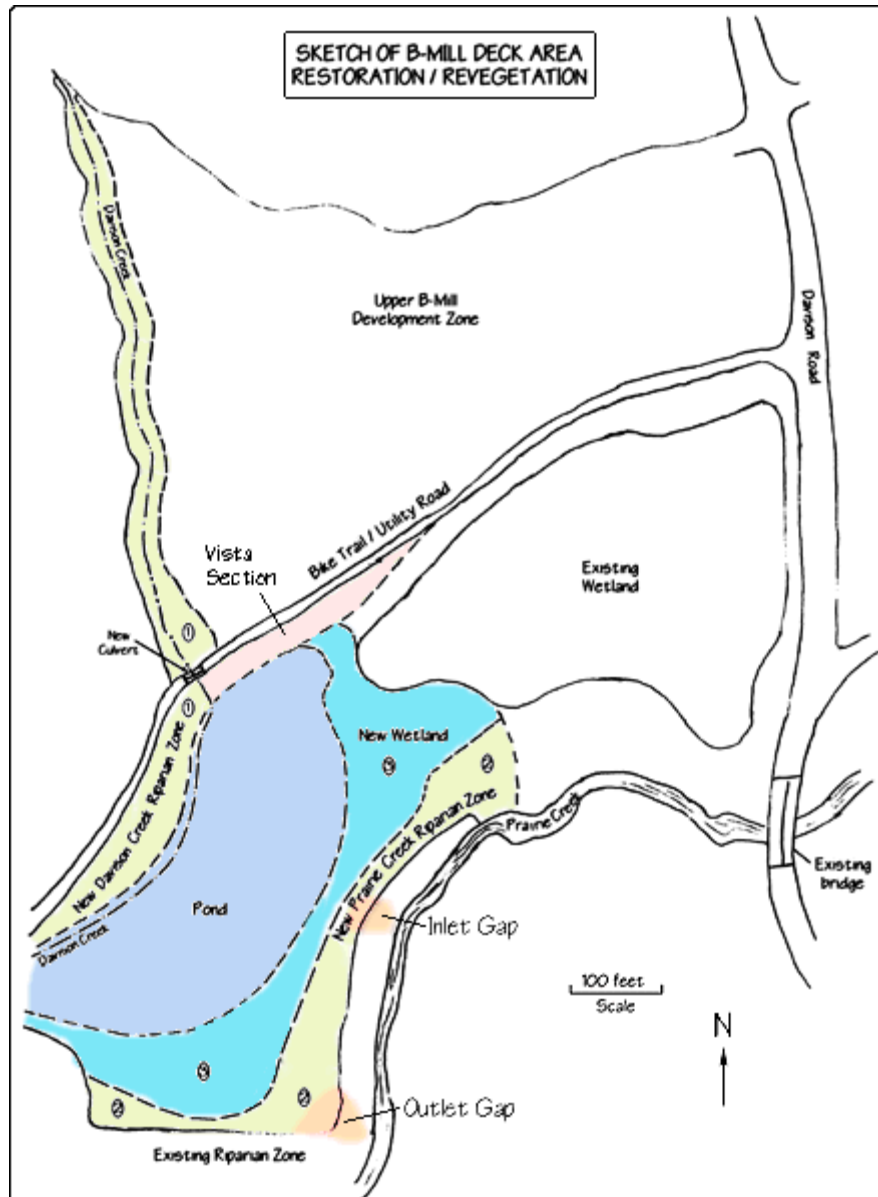


Figure 4. Restoration / revegetation sketch of January 2000.

Long-term target conditions, vegetation development, treatments, and proposed actions are summarized as follows:

1. Along Davison Creek and between the pond and utility road, plans called for native deciduous riparian forest. In 2001, deciduous riparian forest was developing on its own. Alder and willow were dominant. Growth was rapid where moisture was plentiful, such as near the culvert inlet on Davison Creek and near the pond. Trees in these locations reached 10 to 13 feet in height by the end of summer. Elsewhere, the trees were smaller. For each tree planted, there were many volunteer alder and willow seedlings. No further treatment is recommended.

Plans called for a Vista Section to be kept free of trees. Trees were to be excluded to ensure that the wetland could be seen from the viewing platform. No trees were planted, but alders and willows volunteered. Trees adjacent to the pond reached 5 to 8 feet in height by the end of summer 2001. Volunteering trees will need to be removed on a regular basis if it is desired to retain a permanent Vista Section.

2. Plans called for native deciduous riparian forest on the floodplain along Prairie Creek ([Figure 4](#)). In 2000, riparian trees were planted, and pasture exotics were weeded out to make space for native volunteers. The new plantings grew vigorously and, for every tree planted, many tree seedlings volunteered. However, steady browsing kept the alders small and killed most of the willow stakes on the floodplain. In 2001, long willow pole clusters were planted in a renewed effort to establish willows. Foliage high in the treetops escaped browsing through July, but when the bulls' antlers matured in August, the bulls rubbed and girdled the willow poles, and twisted and broke the willow tops. Coarse woody debris sheltered a few trees from the bull elk but, overall, succession toward riparian forest was held back.

One of the concerns when the project was planned was that the floodplain might revert back to exotic pasture. Although not moving toward riparian forest, the [trend from 2000 to 2001](#) was not toward pasture. Rather, native wetland emergents became increasingly dominant, with *Juncus effusus* var. *pacificus* and *Scirpus microcarpus* the two most abundant species. Dominance by native emergents was not envisioned as the outcome of restoration along Prairie Creek in the original plans. Still, it was probably the closest approximation to those plans achievable in two years without erecting fences, given the large elk herd and the physical setting that existed at the time.

Geomorphic, hydrologic, structural and biological factors all affect the survival and growth of riparian trees. Physical processes, events, and conditions act as exogenous drivers that can change the trajectory of succession over time. Removal of massive fill left a floodplain surface at Elk Meadow that was compacted and two feet lower than the surrounding terrain. Logs, branches, and "hog fuel" were placed on the bank of Prairie Creek in 1999 to prepare the way for riparian restoration. These were intended to favor woody riparian plants and to discourage pasture plants and elk. However, on a surface two feet lower than its surroundings, most of the wood washed away. Wetland emergents came in instead. Emergents tend to slow flooding and trap sediment. As sediment re-accumulates in future floods, the flotation dynamics will change. Woody debris will accumulate on high spots. Berry thickets will advance and trap more sediment. Eventually, a buildup of logs, branches and dense tangles may impede and discourage elk. Trees may then grow to maturity. Given time for natural processes and events to work, riparian forest may develop wherever young trees grow that are protected from herbivory by accumulations of woody debris and berry thickets.

If it is desired to actively speed the succession toward riparian forest along Prairie Creek, further steps could be taken at any time. Fences could be erected to exclude elk from the designated riparian zone. Riparian trees would survive and grow if elk were excluded. If fences were erected, removing Himalaya berries would speed the growth of trees by reducing competition for light, water, and nutrients. With fencing and without berries, tree planting would further accelerate succession toward riparian forest. Rubbing by bull elk has not killed trees larger than about 12 inches dbh at the Davison Ranch, so fences could be removed after trees were that size.

3. Other than follow-up monitoring and maintenance, the task of creating a wetland east of the pond ([Figure 4](#)) has been accomplished. When monitored on July 23, 2001 ([Appendix](#)), the herbaceous cover was 100 percent, and native wetland species predominated. Unlike the reference sites, the wetland was entirely herbaceous and lacked a shrub-scrub component. Elk had apparently eaten all of the planted and volunteering

woody plants.

CCC crews devoted over 400 person-hours from February to May 2001 to remove reed canarygrass, an aggressively invasive non-native grass, from the new wetland. Most of the wetland was lightly infested, but there was a center of concentration immediately west of the Inlet Gap. I interpreted the location of the concentration as an indication that the seed was most likely carried through the Inlet Gap in floodwater. High flows through the gap occurred in January 2000. The CCC crews were not able to remove all of the reed canarygrass. In the July 2001 monitoring ([Appendix](#)), I recorded reed canarygrass at 25 of 100 sample points along Transect 4 near the pond west of the Inlet Gap. Reed canarygrass can quickly exploit new bare ground and altered hydrology, so it has the potential to spread with each new flood. Winter storms were unusually small in 2000-2001 and no new bare ground was exposed. However, because the pond is out of balance with its surroundings, a future storm could leave large exposures of bare ground and shifts in hydrology. In an effort to preempt space from colonization by reed canarygrass, 200 contract-grown native slough sedge will be planted in February 2002 wherever bare ground is present.

Future follow-up monitoring should be done to identify any new bare ground and infestations of invasive plants. Bare ground should be planted and invasive plants removed. Planting natives on bare ground as it develops and removing reed canarygrass until the pond disappears will help ensure that native species remain dominant in the new wetland.