Title

Post-project appraisal of year one Re-vegetation performance at the Nathanson Creek Restoration Project, Sonoma County, CA

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1. Abstract

The Nathanson Creek Parkway and Preserve project spans a 1,000 foot reach of Nathanson Creek, a tributary to Sonoma Creek next to the Sonoma Valley High School grounds (see Appendix A Figures 1-6). The Sonoma Ecology Center (SEC) entered a contract with the city of Sonoma after the creek flooded in 2006 and installed plants between November 2009 and May 2010. The purpose of this project is to analyze plant survivorship data after 1-year of growth and to establish baseline data on the channel morphology for future restoration monitoring. We recorded total plant survivorship, created 5 cross-sectional transects (one every 200ft.), and recorded the plants growing along each transect. We also documented incidents of vandalism and overall site conditions.

After one year, the restoration site showed 63.6% survivorship among the flora that were planted plus broadcast seeding of the native grass Blue wildrye (elymus glaucus). This survival rate does not meet the 80% standard set by the SEC for its restoration efforts. Without baseline morphology data, it is too early to come to any conclusions on the relationship between the planting and the channel morphology without, but observations suggest that the re-vegetation has done little to decrease back erosion or mitigate a future flood event.

2. Introduction

2.1 Nathanson Creek Geography:

The Sonoma Creek Watershed covers 170,000 square miles and empties into San Pablo Bay, the northern part of San Francisco Bay. (Figures 1 & 2, Appendix A) Within the Sonoma Creek Watershed is the Schell Creek Watershed, which empties into a tidal marsh area of Schell Slough and is located near the lower reaches of Sonoma Creek. The Tributaries of Schell Creek include, from west to east, Fryer Creek, Nathanson Creek, Arroyo Seco, and Harazthy Creek, with a drainage area of about 20 sq mi. Nathanson Creek originates on the Sonoma Napa divide North and East of the city of Sonoma, at Hogback Mountain, and drains south for 7.5 miles, through Sonoma City, where it connects to Schell Creek. (Fig 3, Appendix A). The Nathanson Creek Watershed consists of about 15 square miles. Two hundred years ago Nathanson Creek was a wetland but now is a narrow urban stream. (Fig. 4, Appendix A) Nathanson Creek is located at 38 16’ 51.94” N, 122 27’ 21.79” W.

2.2 Recent History:

Nathanson Creek has a long history of abuse due to urban development and the treatment of students at the adjacent high school and middle school. Urban development—and associated impacts on hydrology and channel conditions—has caused erosion and sedimentation, degraded water quality, altered hydrology, and degraded the riparian habitat. The water quality issues include the presence of pollutants, poor nutrient composition, and a high sediment load.

While little restoration work has been done on Nathanson Creek historically, the Department of Fish and Game (DFG) has conducted several studies (Lincoln, 1974). In 1965, DFG noted the "presence of "small" Oncorhynchus mykiss, steelhead trout, upstream from Sonoma City in the upper reaches of Nathanson Creek (Leidy, 199-202). In 1974, DFG performed a visual study of the entire stretch of Nathanson Creek, finding "juvenile" steelhead at a density of 20 per pool downstream of the natural falls" (Lincoln, 1974). In 2002 and 2005, the presence of steelhead in Nathanson Creek was recorded (Leidy, 199-202). This led the DFG to conclude that the Schell Creek watershed, and particularly Nathanson Creek, still supported "natural propagation of anadromous salmonids" that had existed prior to urban development. While the current conditions have not been sufficiently assessed since this time, it is presumed that the "anadromous life cycle is possible there (Leidy, 199-202)." The DFG recommended management of the reach downstream of the falls as a spawning and rearing habitat for steelhead (Leidy, 199-202).

On Jan. 1 2006, an intense storm dropped a large volume of precipitation in the Sonoma Creek watershed. While there are no direct measurements of Nathanson Creek's flow at the time of the storm, Sonoma Creek (of which Nathanson Creek is a tributary) had a record outflow of 20,000 cfs, from a normal bankfull flow of 2,500-4,000 (Sonoma Ecology Center (no date)). It would be reasonable to assume that there was a similar high flow in Nathanson Creek during this event. There was extensive damage to the grounds of Sonoma Valley High School, and the school's recently renovated swimming pool was destroyed (Liu, 2010).

2.3 Sonoma Ecology Center Restorative Involvement:

The SEC recognized there was a need to mitigate future flooding, and in 2007 SEC applied for a grant with the California Resources Agency, which administers the funds from proposition 50 (a voter approved fund of $100 million which was to be used for the "Acquisition, Restoration, Protection, and Development of River Parkways (State of California Resource Agency, 2007). The California Resource Agency awarded $658,000 to SEC and the restoration project, and on September 29th, 2007, SEC proposed the project to the City Council of Sonoma. Noting the success both of the plants and the educational opportunity of the earlier native plant installation the city council approved the project and SEC with the City of Sonoma, and the Sonoma Valley Unified School District, began work on the Nathanson Creek Parkway and Preserve project (Liu, 2010).

SEC has a long standing relationship with Sonoma schools. The education staff at SEC provided the students at both schools with frequent out-of-classroom site visits. During some of the visits, the students removed invasive species and installed native plants. The native plants were initially installed as an activity to teach stewardship principals to the youth of Sonoma.

In the summer of 2008, SEC began work on the project by contracting with the California Conservation Corp to install patchwork of black polypropylene weed fabric and heavy duty blue tarps in the hopes of eradicating the Himalayan Blackberry (Rubus discolor) which had completely overgrown the slopes of Nathanson Creek. The plan originally called for the tarps to be left in place for 3-6 months after which, they would be removed, and the installation of the

native plants would begin.

On December 23rd 2008, due to a statewide budget crisis, all funds to bond-driven grants were "frozen" (Liu, 2010). The funds were not restored until July/August 2009 and SEC was unable to remove the tarps until September/October 2009. The long term goals of the project were not seriously affected by the bond freeze. However, by pushing the planting dates further back, many of the plants became root-bound and died. This increased the cost of the re-vegetation portion of the project. Once the tarps had been removed all of the plants were fertilized and installed between November, 2009 and March, 2010 (Liu, 2009). Beginning in March and continuing through April each plant was mulched and had a drip irrigation line installed next to it.

3. Problem Statement

The Prop 50 Technical Analysis and Plan Performance paper (11/2006) states that the success of the Nathanson Creek Parkway and Preserve is dependent on two criteria: "increase in linear feet of riparian corridor," and "reduction in flooding extent." There still has not been a significant flood to test the ability of this restoration project to mitigate floods and there is no baseline channel morphology data. Therefore, this report will offer baseline channel morphology data and investigate the success of the first criteria: "increase in linear feet of riparian corridor."

The goal of this review process is to *assess the performance of the re-vegetation efforts, establishing a baseline for channel morphology monitoring, and assess linkages between channel morphology and vegetation survival*.

4. Methods

We conducted two days of field work, October 25th and November 8th, 2010. During the initial installation the plants had been separated into general habitat types (upper bank, mid bank, lower bank) and planted randomly within the appropriate habitat. A color coded pin flag with a 4 letter code was placed next to each plant. We collected the survival data by finding plants by following the drip irrigation lines to each plant, and where possible, using the associated pin flags. As we encountered each plant, it was identified, and the marked in a ledger along with its general location on the site, and whether it was alive, dead, or dormant.

We also surveyed channel transects every 200 feet starting at the Northern border (MacArthur bridge). A control elevation of 100 feet was established on the sidewalk off MacArthur Avenue (near the Northernmost transect) and all subsequent elevations were referenced to that elevation. For each transect, we took a cross-section by stretching a tape measure across the creek and recording elevation data at each change in slope with a surveying instrument. We recorded the location of the thalweg and the depth of the water at the thalweg.

5. Results

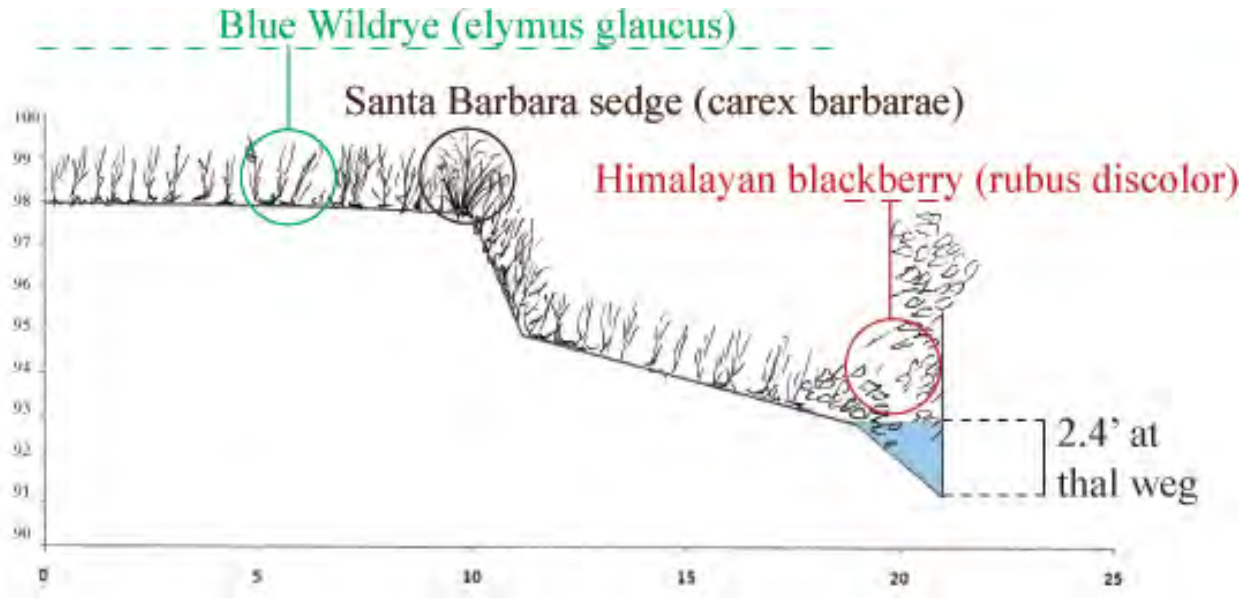
5.1. Nathanson Creek Transects and Morphology Observations:

We split the project area into five zones. We surveyed a transect every 200 feet so that we had one transect for each of the zones of the restoration project area. (Fig. 5 & 6, Appendix A) We documented and photographed the current conditions along each transect.

Transect 1-5: Elevations are relative to a chosen 100 foot point (MacArthur Ave.) and are listed on the Y-Axis. Distances are at every significant change in channel slope and are listed on the X-Axis. All units are in feet. The surviving plants that were noted along each transect are noted.

Transect 1:

From left to right: Himalayan blackberry growing over the bank stabilizing wall, a healthy Santa Barbara sedge at Transect 1, and the general condition of the grasses around Transect 1 (a protective screen over some of the plantings)

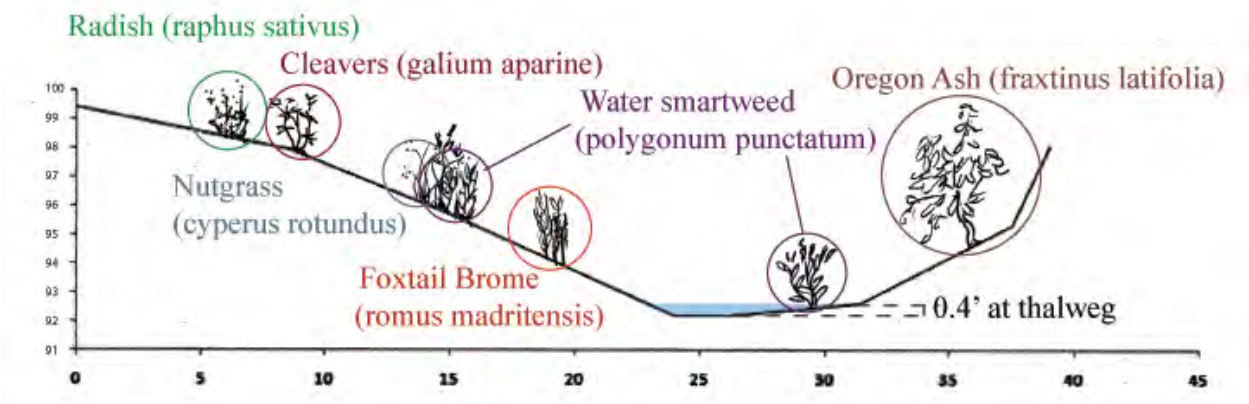


The Northernmost transect is thirty feet south of East Macarthur road bridge. A rock wall stabilizes the right bank and Himalayan blackberry bushes spill over the top of the wall

providing partial cover over the primary area of flow. Higher flow on the right side has continued to erode the streambed next to the rock wall so that the thalweg (2.4’ deep) is immediately adjacent to the wall, with deposition building up on the left bank. The upper left bank is eroding and the root systems are exposed where the land drops off. On the higher and flatter ground on the left-bank there is evidence of re-vegetation, but the plants are still small and don’t appear to impact the channel morphology. Blue Wildrye has sprung up on its own and dominates the landscape around the transect.

Transect 2:

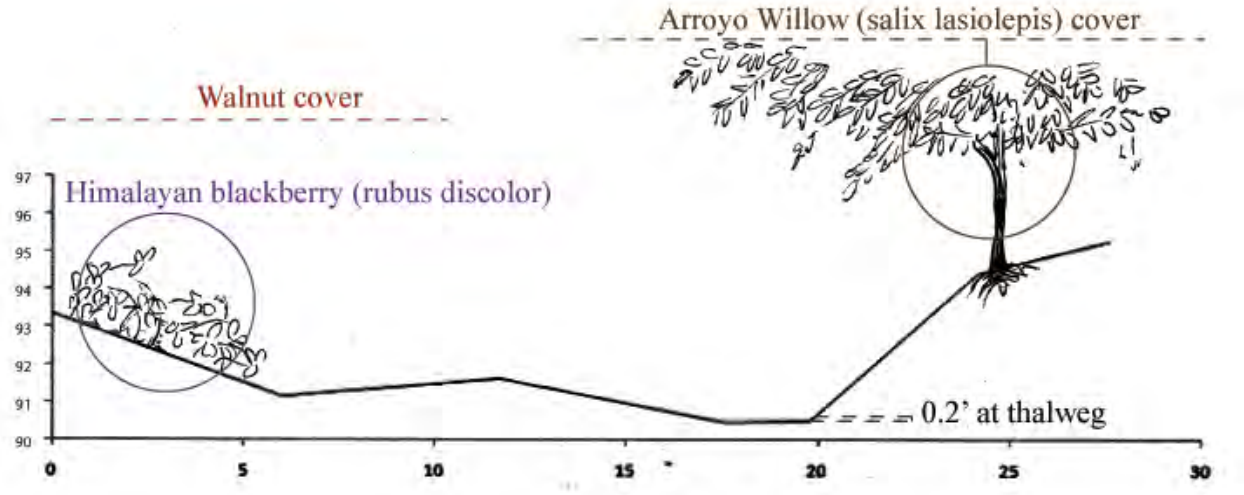
Left to right: Next to Transect 2 the bank had eroded out from underneath this tree, one of several footbridges passes over the stream just North of Transect 2 (looking upstream), the Oregon Ash tree at Transect 2 at the water's edge



The next transect was also just downstream of a bridge crossing (a footbridge in this case). The bank here was much more stable with little evidence of stream-flow erosion or deposition. The depth of the water at the thalweg was 0.4 feet. Invasive species are not visibly apparent. The flow was slower than at Transect 1 with some ripples along the large aggregate in the bed.

Transect 3:

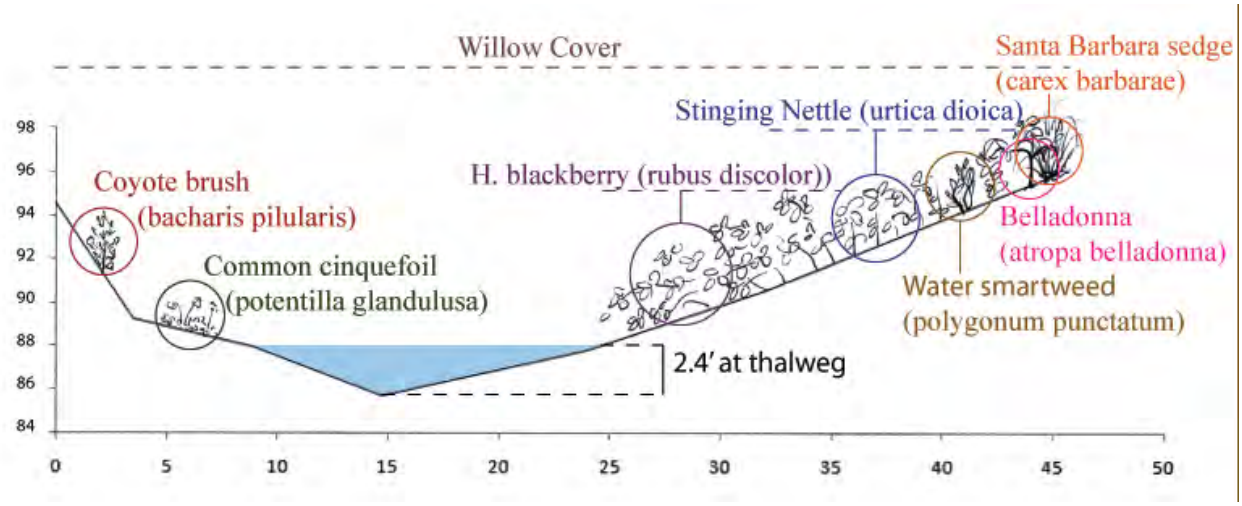
Left: H. blackberry on the left bank with erosion occurring underneath; Right: thin stream width (stream flow to left)



The left bank at this transect was visibly eroded. To the left of the main channel was another channel for overflows with a loose sediment sand-bar formation in-between. The right bank was also actively eroding. On both banks, the root systems were exposed. Although the banks upstream and downstream of this section were re-vegetated, this particular stretch did not have any recent plantings. The depth of the channel at the thalweg was 1.85 feet and the flow was relatively slower than at transect 1 and 2.

Transect 4:

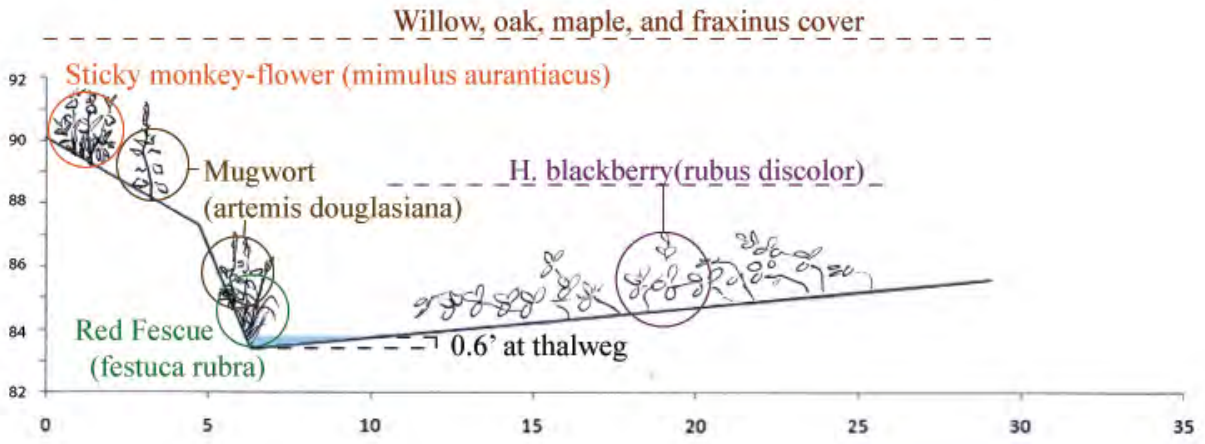
Left: H. blackberry growing up and over the eradication tarps; Right: root systems stick out of the eroded left bank



This transect ran through one of the larger pools along the creek. Both sides had been planted. H. blackberry bushes overwhelmed the right bank, reaching out over the pool. Stinging nettle was also prevalent on the right bank and grew up and around the plantings. The left bank had some larger aggregate and both banks were actively eroding despite the plantings. A few large trees provide almost complete cover and their root systems dominate the lower left bank and part of the pool floor. Flow is hardly noticeable. The depth at the thalweg was 2.4 feet.

Transect 5:

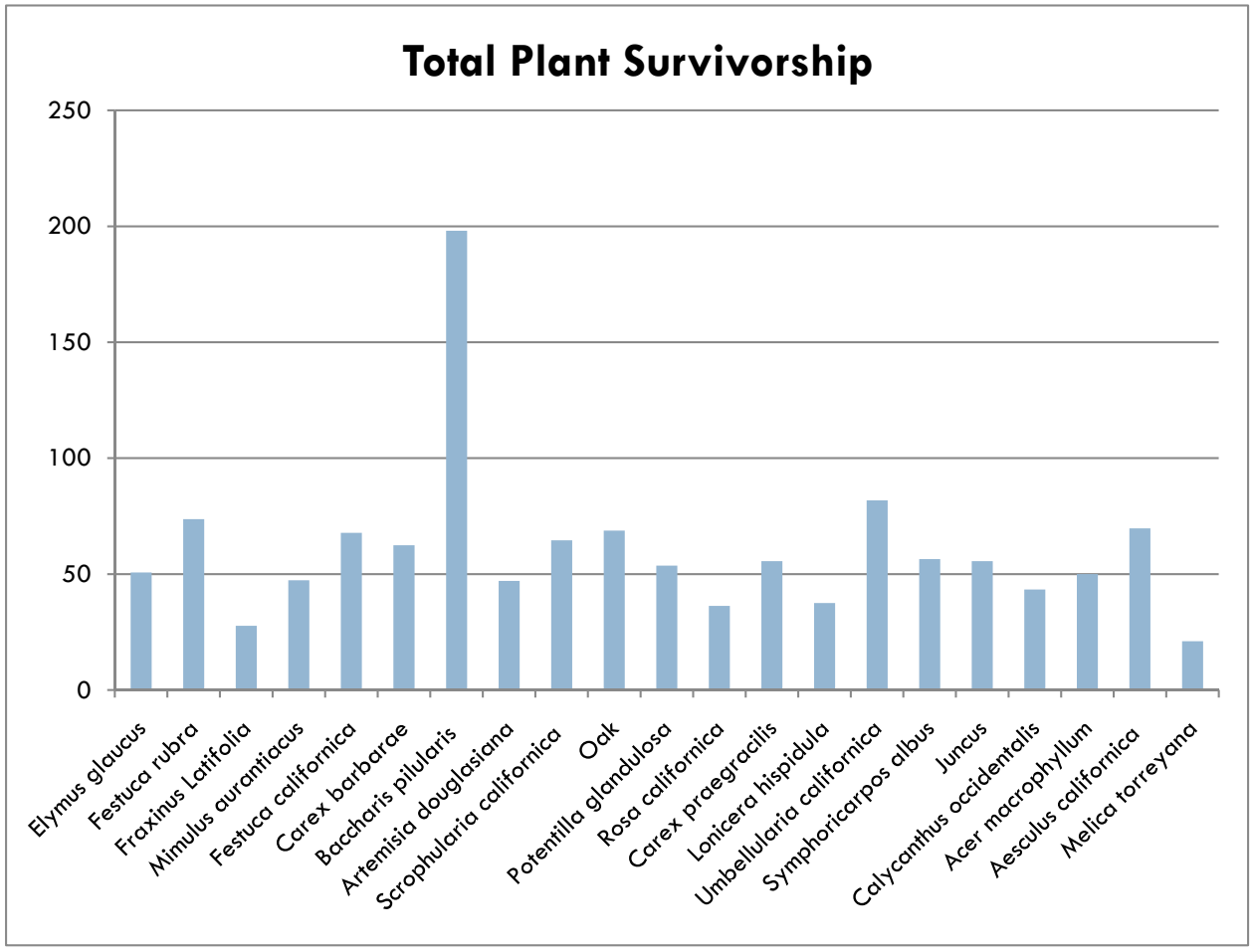
Left: right bank is covered in blackberry and the flow is very slow; Right: looking across to the right bank from the top of the left bank—the ground cover changes from leave litter and small grasses on the planted side (left/foreground) to the full cover of H. blackberry on the unplanted side



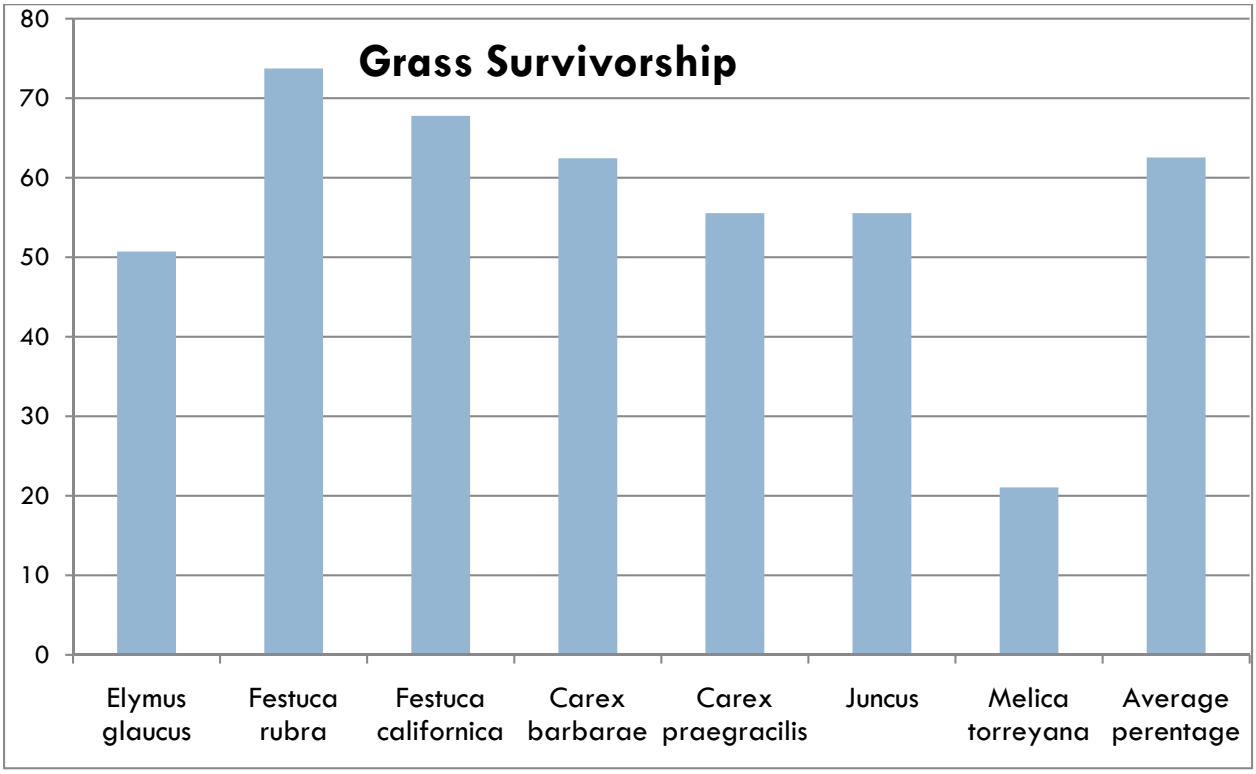
The left bank has been planted but the plantings seem to do little to alter the course of erosion. On the left bank trees (of a range of maturity) hold onto the eroding bank with their roots. Some blackberry bushes remain. The right bank showed some evidence of erosion and was dominated by the spontaneous growth of understory native species, some debris from trees, and Himalayan blackberry. Large trees grew on the upper right bank. The depth at the thalweg was 0.55 feet.

5.2. Plant Survivorship Results:

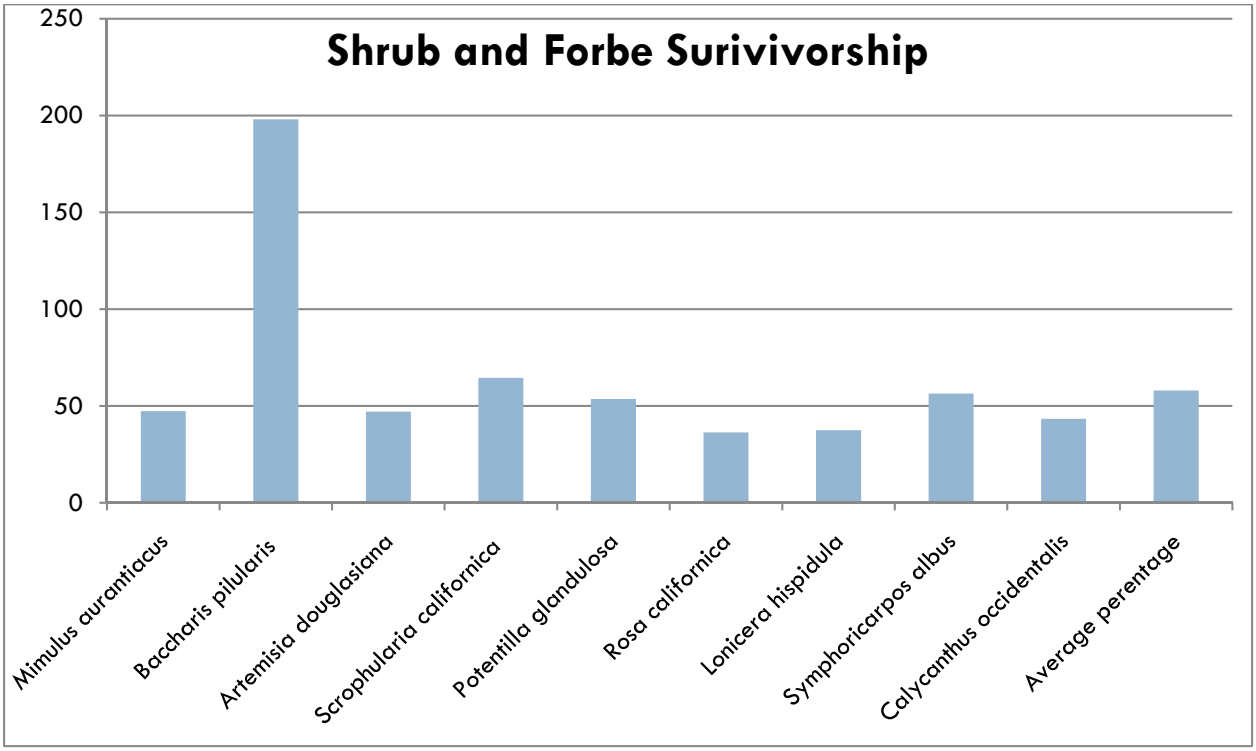
Of the 3,676 plants installed in the winter of 2009 and 2010, 2,321 plants were found either alive or dormant, making an average plant survival of 63.6%.



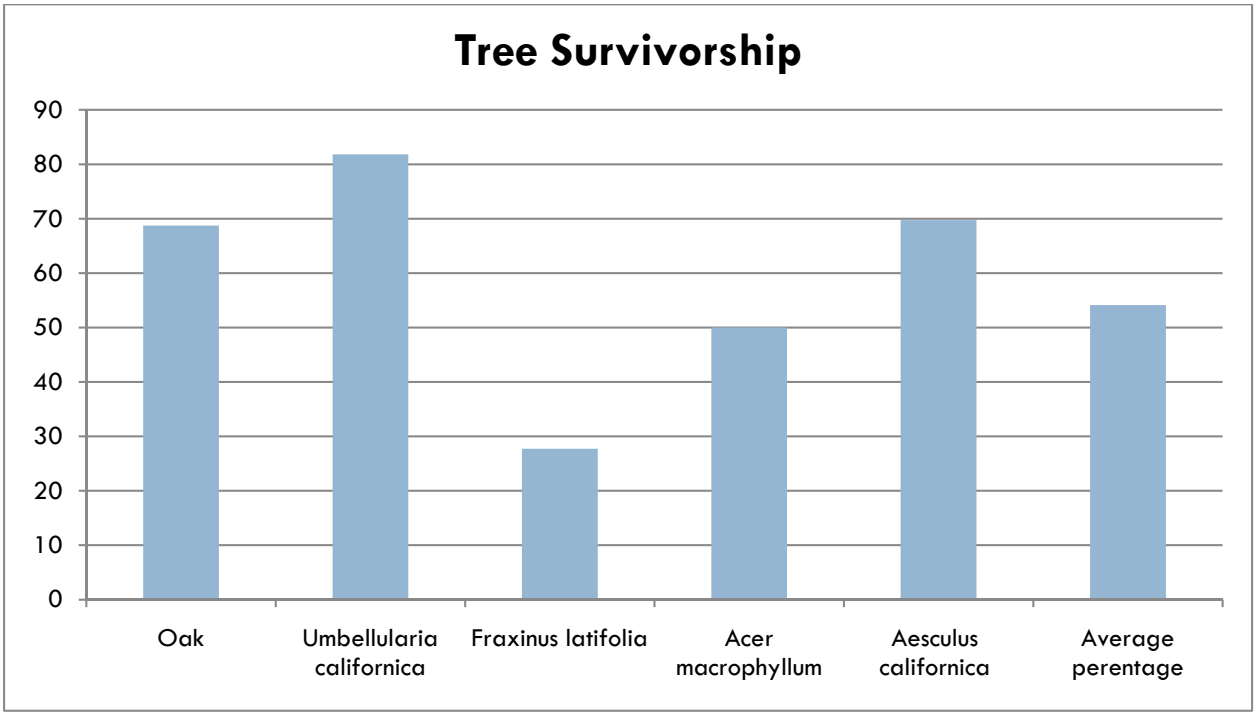
Grasses averaged 62.5% success after one year



Shrubs and forbes presented a 57.1% success rate.



Trees had a averaged a 55.7% success rate after the first year



We also found a young native blackberry (Rubus ursinus) and seven boxelder (Acer negundo) saplings. These two plants are important because neither was included in the initial restoration plantings, and may represent a broader rehabilitation of the project site.

There were a great deal of young Himalayan blackberry (rubus discolor) plants in the upland section of Zone 2 on the right side of the bank (see map). There were also well developed H. blackberry plants, which were presumably missed by the initial weed control effort, closer to the bank along a great deal of the restoration site.

6. Discussion

It is important to note that this restoration project, by design, is in an exposed area with heavy pedestrian traffic and is immediately adjacent to both a high school and middle school. As a result vandalism such as removing pin flags, up-rooting plants, and damaging the drip irrigation lines has been a constant problem.

The SEC strives for an 80% first year survival rate (Liu, 2010). By that metric the restoration plantings would be considered a failure. It is important to note, however, that while the first year survivorship is not up to the standards set by the SEC, there is a clear increase in native flora on the restoration site, and it seems, without quantifiable data to confirm this point, that target non-native plants continue to make up only a small percentage of the flora on site.

The first year plant survivorship is deceptively low. In an effort to minimize erosion on the denuded soil the SEC broadcast seeded blue wildrye over the majority of the restoration site (Liu, 2010). While it did not propagate everywhere it was seeded, there are areas where blue wildrye is the primary ground cover. These plants were not included in the initial plant list, and so were also not counted in the plant survivorship, but, by casual observation, seem to comprise a majority of the plants the SEC installed on site.

Though there was no real pattern regarding where along the bank the plants were placed, there were some general trends; forbs and shrubs tended to be planted along the mid to upper bank, most of the trees were planted along the upper bank, and the grasses were largely spread evenly

across the riparian zone (Liu, 2010). That, in combination with the relatively consistent survivorship numbers across plant types, it can therefore be surmised that whatever factor, or combination of factors, is leading to higher than expected mortality, it is affecting all the plant species equally. Further inquiry would be required to discover the cause(s) of the plant mortality, but with the general survivorship numbers SEC can accurately estimate the proper number of replacement plants needed to fulfill the desired number of successful plants.

7. Conclusion

The restoration component of the Nathanson Creek Parkway and Preserve was designed to accomplish two major goals: To increase the area of functional riparian ecosystems and for flood control (Technical Analysis and Plan Performance Paper, 2006). It is difficult to say if the project is successful after only a year. While a 63.6% first year survival rate is not normally a successful percentage, it is clear that the surviving plants are in the early stages of increasing riparian ecosystem functionality. While the success of the individual plants is an important metric, it is also important that the existing plants seed and expand to create a sustainable, functioning riparian ecosystem. The ultimate success of this restoration project will be determined by the sustainability and growth of the installed native plants along the restoration site (Liu, 2010).

The majority of plants were installed during the winter of 2009-2010 and were not well established during the high-flow events on Nathanson Creek that winter. There were no major flood events that winter, so it has yet to be determined if the restoration effort has had any effect

on the flood regime of Nathanson Creek.

The banks of the creek show significant erosion and are even undercut in places. We suggest that major channel geometry enhancement and bank and bed stabilization be included in future restoration efforts if for flood control and habitat restoration. The plan to install pathways and viewing platforms should be postponed until proper channel reformation has been completed to avoid deconstruction.

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Appendix A

Figure 1

Sonoma Creek Watershed Area

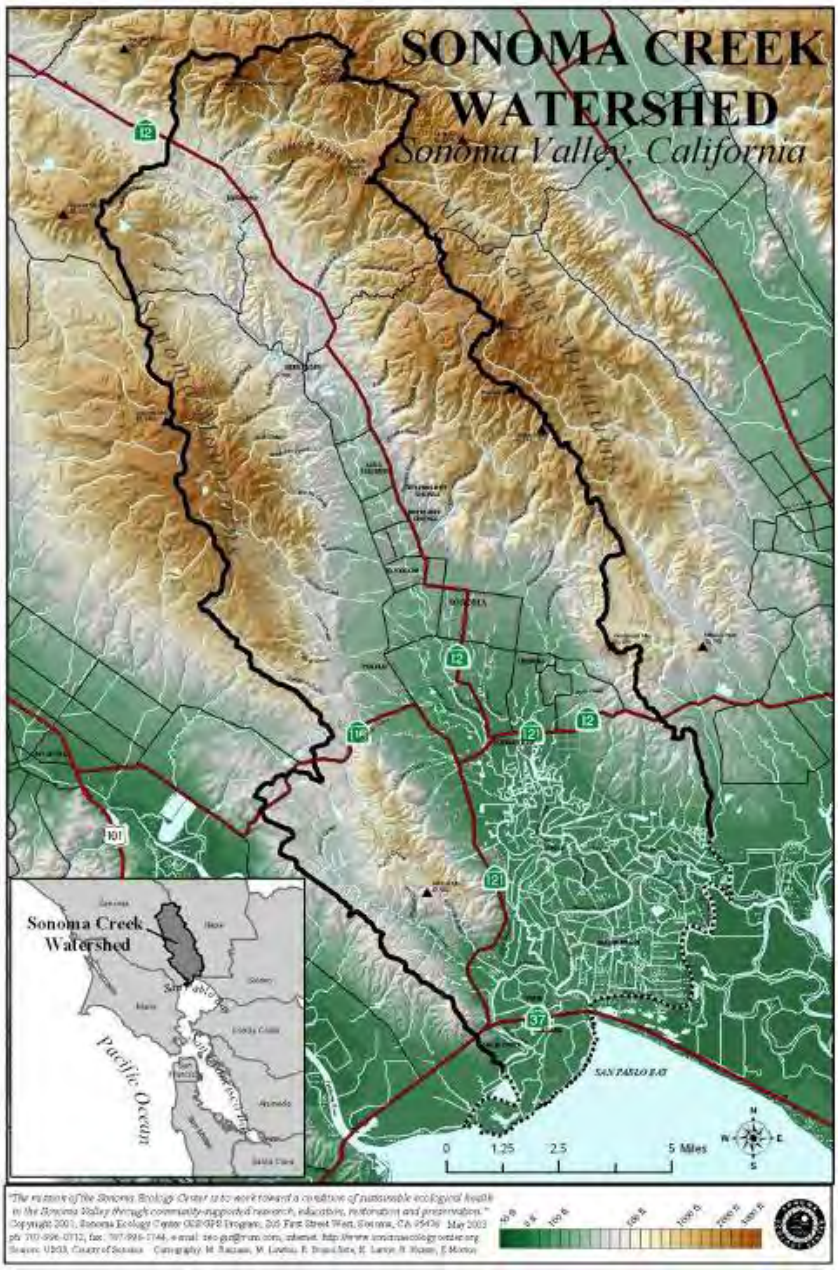

Figure 2

Sonoma Creek Location

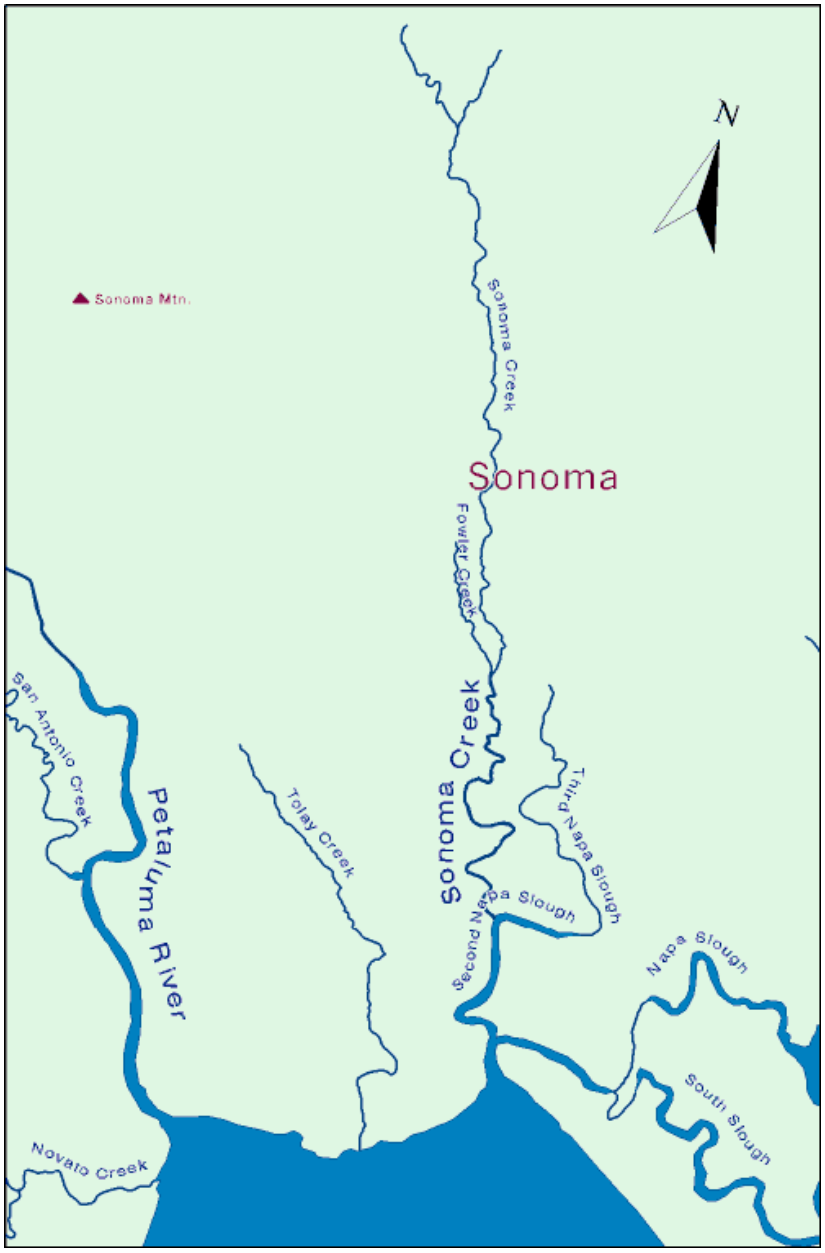

Figure 3

Nathanson Creek Highlighted in Blue

Figure 4

Sonoma Valley Historic Wetlands

Figure 5

1993 Historical Map of Project Area Highlighted in Green

Figure 6

2010 Map of Restoration Project Area

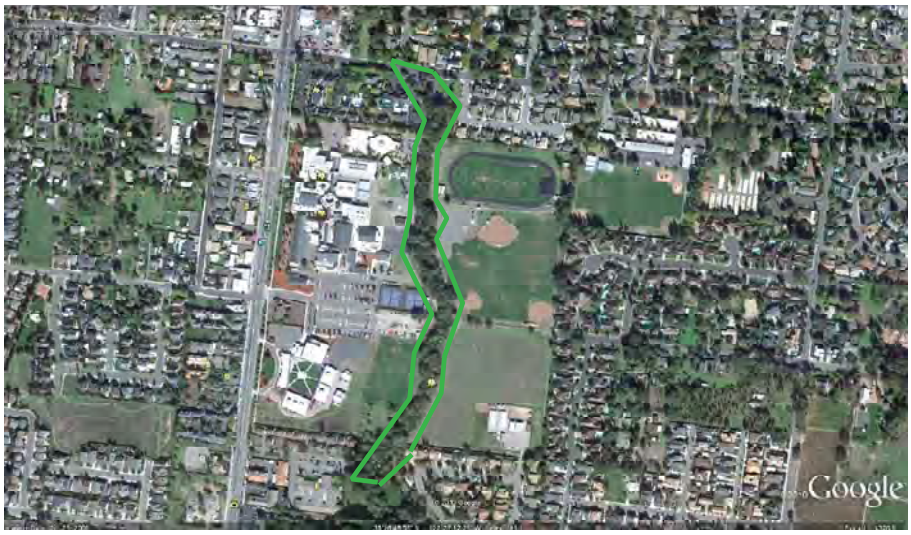

Figure 7

Transect Locations

Appendix B

Figure 1

Sonoma Valley Ecology Center Project Proposal

EXHIBIT A

STATE OF CALIFORNIA RESOURCES AGENCY
GRANT AGREEMENT

California River Parkways Grant Program
California Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50)

Grantee Name: Sonoma Ecology Center

Project Title: Nathanson Creek Preserve Parkway

Agreement Number: R81754-0

Project Scope:

Restore approximately two and one-half acres of habitat, create 400 feet of trail and provide interpretive facilities at the Nathanson Creek Preserve Parkway located in Sonoma, California. Nathanson Creek provides an ecological transition between the San Francisco estuary bay lands and the montane tributaries of Sonoma Valley's Coast Range.

Project components include (details provided in the *Nathanson Creek Preserve and Parkway Restoration Site Plan*-sections cited as appropriate):

- Project Management including site plans, finalizing construction specifications, project coordination and public outreach (two meetings – one community orientation workshop and one public hearing regarding final construction details).

- Recreation Enhancements
  - Picnic facilities consisting of an approximately 1,000 square foot footprint with three (3) 8' wheelchair accessible picnic tables, anchored to the site
  - Demonstration Garden with native plantings
  - Eight benches located throughout the site including the Northern end at the McArthur Street staging area and along the length of the trail at the bridge crossings and interpretive elements
  - Approximately 400 lineal-foot ADA pedestrian path approximately 5' wide of Terra Pave or a comparable material
  - Two (2) bicycle racks located at the juncture of Reach 2 and Reach 3 (the boundary between the City and School District parcels in the Northern end of the preserve presently occupied by chain link fence slated for removal) adjacent to the existing bike path
  - Six waste receptacles *(permanent)*
  - Construction Safety and Funding Acknowledgement Signage

- Habitat Restoration
  - Site preparation/debris removal
  - Invasive weed eradication using a combination of control methodologies including manual control (hand pulling, tarping, and cutting), and herbicide treatments (cut stump and foliar spray), as appropriate
  - Riparian re-vegetation of approximately 2.4 acres with native trees, shrubs and grasses. (see detailed plant list: Site Plan, Section 2.2, p. 18, Section 2.2 Habitat Restoration of the Nathanson Creek Preserve and Parkway Restoration Site Plan)
  - Native shade trees along bike path to be selected from native *Acer* and *Quercus* families.
  - Removal and replacement of existing fence (40 feet) due to hazardous conditions
  - Parking Control (bollards spaced at roughly 5' on center)
  - Irrigation main hook-up consisting of a distribution system from the City and School District sources and a link to the irrigation system for re-vegetated areas

EXHIBIT A

Conservation and Interpretive Enhancements

- Three (3) interpretive kiosks discussing watershed connectivity, riparian forest values, and - attributes/uses of native plants; kiosks located on the Northern most city parcel and parkway entrance (one), and on school district sites adjacent to the creek (two)
- Designated Fish and Wildlife Viewing area (need for platform to be determined); to be located adjacent to an interpretive kiosk on school district property
- Watershed Exhibit demonstrating linkages between the Parkway and the Nathanson Creek sub-watershed

The Preserve provides public access year-around with various entry points including a public facility on the east side, unregulated parking on the west side and a bike/pedestrian path running along the east side of the creek linking access point from MacArthur Street and Napa Road.

Project Schedule:

Activity Description	Timeline
Work Plan Development in Coordination with partners	July 2007 – January 2008
Finalize Construction Plans With Community	September 2007 – April 2008
Vegetation Management-including Re-vegetation	October 2007 – March 2010
Site Preparation	May – August 2008
Interpretive and Recreational Enhancements Installation	May 2008 – November 2009
Final Reporting, Follow up, Contingency measures	December 2009 – -June 2010
Project close-out including any plant establishment period required to obtain Notice of Completion, as applicable	July 2010

Figure 2

Plant Survivorship Data Table

	Planted	Alive'	Dormant'	% survival
Elymus Glaucus	138	**70**		50.724638
Festuca Rubra	434	320		73.732719
Fraxinus Latifolia	119	**33**		27.731092
Mimulus aurantiacus	57	27		47.368421
Festuca californica	211	143		67.772512
Carex barbarae	687	429		62.445415
Baccharis pilularis	53	105		198.11321
Artemisia douglasiana	238	112		47.058824
Scrophularia californica	330	213		64.545455
Oak	96	66		68.75
Potentilla glandulosa	82	44		53.658537
Rosa Californica	179	65		36.312849
Carex praegracilis	396	220		55.555556
Lonicera Hispidula	48	18		37.5
Umbellularia californica	11	9		81.818182
Symphoricarpos albus	170	95	1	56.470588
Juncus	99	55		55.555556
Rubus ursinus	0	1		
Acer negundo	0	7		
Calycanthus occidentalis	60	26		43.333333
Acer macrophyllum	102	46	5	50
Aesculus californica	119	16	67	69.747899
Melica torreyana	19	4		21.052632

Total	Total'
3648	2325

Figure 3

Surviving Plant Locations along Transects

TRANSECT 1

MEASURE	PLANT
0- (WATER'S EDGE)	Elymus glaucus
10'	Carex barbarae
WATER'S EDGE TO END	Rubus armeniacus

TRANSECT 2

MEASURE	PLANT
6	Raphanus sativus (radish)
8.3-9.5	Galium aparine
13-14.2	Cyperus rotundus
14-14.3	Polygonum punctatum
13-15.6	Bromus madritensis
17.7-18	Bromus madritensis
27-30	Polygonum punctatum
36.1-41	Fraxinus latifolia
45' +	RIP WRAP

TRANSECT 3

MEASURE	PLANT
0-10.3	BARE GROUND, WALNUT COVER
10.3-16.3	Rubus armeniacus
24-24.10	Salix lasiolepis (SAPLING)
14-50.2	Salix lasiolepis (COVER)

TRANSECT 4 (ALL UNDER A WILLOW)

MEASURE	PLANT
2.1-3.5	Baccharis pilularis
5-6.9	Potentilla glandulosa
35-42.6	STINGING NETTLE
42-43.4	Polygonum punctatum
44.7-45.2	Atropa belladonna
44.1-45.6	Carex barbarae
45.6-45.8	Melissa officinalis
46.9-47.2	Carex barbarae
51.2-54.2	JUNCUS

TRANSECT 5 (UNDER WILLOW, OAK, MAPLE, AND FRAXINUS)

MEASURE	PLANT
1-1.3	mimulus aurantiacus
3.4-3.4	Artemisia douglasiana
7.4-7.9	Artemisia douglasiana
7.9-8.2	Festuca Rubra
38.7-45.5	Polygonum punctatum
38.7-44	Rubus armeniacus
46.3-55.2	Salix lasiolepis (COVER)
51.6-51.8	Polygonum punctatum

Photo Documentation

Zone 1- Transect 1

15 ft overgrown Blackberry

condition of replantings transect 1 left bank

Graffiti under bridge

new tree planting transect 1 left bank

Replantings in transect 1
left bank levee

transect 1 left bank channel
and overgrown blackberry

transect 1 left bank channel at transect

transect 1 left bank detail of
grass planting condition good

transect 1 left bank first tripod position

transect 1 left bank from tripod set up

transect 1 left bank looking down stream at plantings

transect 1 left bank more trash present

transect 1 left bank trash present

transect 1 left bank water level at mid thigh

Trash and bubbles on top of water

Trash in water channel

Under MacArthur St overpass

Zone 2- Transect 2

15 ft overgrown
Blackberry

condition of replantings
transect 1 left bank

Graffiti under bridge

new tree planting transect
1 left bank

Replantings in transect 1
left bank levee

transect 1 left bank channel
and overgrown blackberry

transect 1 left bank channel at transect

transect 1 left bank detail of
grass planting condition good

transect 1 left bank first tripod position

transect 1 left bank from tripod set up

transect 1 left bank looking down stream at plantings

transect 1 left bank more trash present

transect 1 left bank trash present

transect 1 left bank water level at mid thigh

Trash and bubbles on top of water

Trash in water channel

Under MacArthur St overpass

Zone 3- Transect 3

transect 3 bank erosion and overgrown veg

transect 3 branch tied to right bank

transect 3 channel condtion low water level

transect 3 elevation of left bank higher then right bank

transect 3 right bank veg condition no new plantings done

transect 3 stream width very thin lots of sediment

transect 3 tripod position in trees left bank

Zone 4 – Transect 4

transect 4 backberry bush right bank overgrown over channel

Transect 4 canopy grapes growing on oak trees

transect 4 channel pool low flow wide channel

Transect 4 close up left bank root erosion

Transect 4 close up root erosion

transect 4 left bank overview root erosion tree hanging on side of bank

transect 4 left bank heavy root erosion

Transect 4 location of tie off sign

transect 4 position of tripod relative to sign by bridge

transect 4 position of tripod

transect 4 right bank blackberry and trash in channel

transect 4 right bank close-up blackberries

transect 4 set point back shot culvert drain location II

transect 4 set point back shot culvert drain location

Transect 4 shot of transect

Transect 4 tree and growth from moths

Transcect 4 veg overgrowing tarps close-up

Transect 4 veg overgrowing tarps right bank location of tarp around tree

Transect 4 veg overgrowing tarps

Zone 5- Transect 5

Transect 5 back shot position on electrical box relative to field

Transect 5 back shot position on electrical box

Transect 5 location of tripod relative to community garden

Transect 5 location of tripod relative to little tree

Transect 5 shot from tripod

Transect 5 stream condition and veg cover right bank II

Transect 5 stream condition and veg cover right bank

Transect 5 stream width