Brizzolara Creek Revegetation & Restoration Plan

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Abstract

In 2009, a portion of the Cal Poly Farm Shop was removed to create a stream bank supported by rip-rap facing for Brizzolara Creek. However, weed eradication and revegetation measures were necessary to fully restore the riparian corridor. The Brizzolara Creek Revegetation and Restoration plan was implemented in winter 2011. The plant palette was composed of early successional native species including *Salix lasiolepis, Salix laevigata, Populus balsamifera* spp. *trichocarpa, Rubus ursinus, Rhamnus californica, Baccharis pilularis, Sambucus mexicana,* and *Artemisia douglasiana.* A monitoring plan will evaluate the relative success of this project in Spring 2014. The final success criteria for this project are 70% survivorship. However, adaptive management techniques may be used to accomplish the long-term objectives of this project, which are to establish native plant cover, provide wildlife habitat, improve water quality, and encourage the natural recruitment of native species.

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Chapter 1

Introduction

Historically, the foundation of the Cal Poly Farm Shop formed the south bank of a portion of Brizzolara Creek (Figure 1). After an earthquake damaged the foundation of the building in 2003, the Cal Poly Farm Shop Removal and Stream Bank Repair Project was designed to repair the Farm Shop and stream bank. Implemented in 2009, a portion of the farm shop was removed and the bank slope was re-shaped. Rip-rap facing was installed to stabilize the stream bank and prevent erosion. The rocks used were approximately 12 inches in diameter and 75 pounds in weight (Busby, 2009). The plan for the project included a revegetation plan that was never implemented. This resulted in the establishment and predominance of non-native weed species at the site and required further restoration in 2011.

The goal of this project was to establish a riparian buffer using native vegetation at the project site. First, invasive species were eradicated using hand-weeding techniques in December 2010. *Baccharis pilularis* (coyote brush), *Rubus ursinus* (blackberry), *Rhamnus californica* (coffeeberry), and *Sambucus mexicana* (blue elderberry) were planted from containers in December 2010. *Populus balsamifera* ssp. *trichocarpa* (black cottonwood), *Salix laevigata* (red willow), and *Salix lasiolepis* (arroyo willow) were planted using live stakes in January 2011. *Artemisia douglasiana* (mugwort) was also planted in January 2011 from seed and vegetative propagules. A monitoring program was developed before project completion and will evaluate the relative success or failure of the restoration plan in June 2014.

Figure 1. The Cal Poly Farm Shop forms the south bank of Brizzolara Creek prior to the implementation of the Cal Poly Farm Shop Removal and Stream Bank Repair Project.

Chapter 2

Literature Review

Riparian restoration has various facets to be considered prior to implementation including species composition, ecological succession, and habitat function. This literature review discusses these aspects by evaluating the context of the project, the species to be used, and the implications of other restoration projects.

Project Context

Brizzolara Creek is a perennial stream that forms in the Santa Lucia Mountain Range and flows southwesterly through the California Polytechnic State University, San Luis Obispo campus. It runs for 3.3 miles before merging with Stenner Creek in the City of San Luis Obispo behind Mustang Village, a student housing complex. Stenner Creek is a tributary to San Luis Obispo Creek, which enters the Pacific Ocean at Avila Beach (Dingus, 2002).

The goal of the project was to establish a riparian community using native vegetation at the project site. The term riparian refers to land located adjacent to and influenced by a river, stream, drainage channel, or other body of water. Riparian vegetation consists of plants that are adapted to the fluctuating hydroperiod of the water source and rely on the availability of moisture for survival. Characteristics of riparian vegetation often include anemophilous pollination, flood tolerance, and winter deciduousness. Riparian vegetation is often stratified into different canopies. The uppermost canopy is often composed of winter-deciduous trees including *Platanus*, *Populus*, *Salix*, and *Quercus* species. The intermediate canopy consists of woody vines, shrubs, and immature trees including *Toxicodendron diversilobum*, *Rubus ursinus*, and

Baccharis pilularis. The understory consists of perennial herbs such as *Artemisia douglasiana*. However, species composition and structure varies with climate, altitude, topography, soil, and hydrology (Griggs, 2008).

The species composition in a community also changes over time in a process called ecological succession. In ecological succession, dominance changes from seral species to climax species. Seral species are also known as pioneer species because they colonize disturbed sites and form the first community in ecological succession. Pioneer species grow best on bare or disturbed soils and are intolerant of shade. They also facilitate the natural recruitment of less tolerant plant species by providing protection from harsh weather and predators. Climax species form the final plant community in ecological succession. These plants are intolerant of full sun and will grow under the shade of the seral species. As they become established and canopy cover produces shade, they will outcompete the seral species and form the climax community.

Riparian habitats are ecologically important because they provide wildlife habitat, improve water quality, and provide flood control. Canopy cover provides shade and cover from predators for fish and other aquatic organisms. Also, the shade limits algal growth by maintaining lower temperatures in the stream, which in turn allows for higher dissolved oxygen levels necessary for fish and aquatic insects. Vegetation also improves water quality by stabilizing stream banks and reducing erosion and sedimentation. This is particularly important for the federally threatened *Oncorhynchus mykiss* that reside in Brizzolara Creek. *Oncorhynchus mykiss* require tributaries that are free of heavy sedimentation, provide cover from predators, and maintain optimum temperature, dissolved oxygen, and turbidity levels (Griggs, 2008).

Invasive plant species impact the biological diversity, hydrology, and soils of riparian communities and other habitats. Invasive species can alter the vegetation structure of the communities they invade. They also impact biological diversity by outcompeting or hybridizing with native species. In some areas, invasive species completely eliminate entire species and communities. Some invasive species impact hydrology by altering the shape, carrying capacity, and flooding cycle of streams by trapping sediment, lowering water tables, or increasing erosion rates. At some sites, invasive species may reduce or completely eliminate surface waters that are necessary for the survival of native plants and animals. Invasive species may also alter soil chemistry through allelopathy or changing the soil fertility. These situations make it difficult or impossible for native species of plants and animals to survive (Bossard, 2000).

Plant Palette

Common pioneer species found in San Luis Obispo County include *Salix lasiolepis, Salix laevigata, Populus balsamifera* ssp. *trichocarpa, Rubus ursinus, Baccharis pilularis, Sambucus mexicana,* and *Rhamnus californica* (Circuit Rider Productions, NOAA, 2004). They are used for riparian restoration projects because they are establish easily on disturbed sites and tolerate a variety of conditions.

Salix species

Salix lasiolepis, commonly known as arroyo willow, and *Salix laevigata,* commonly known as red willow, are deciduous trees that occur in riparian habitats along streams and stream bottoms in California. *Salix lasiolepis* can be distinguished from *Salix laevigata* by its silver-backed leaves. In addition, *Salix laevigata* also has unique red stems that can be used to differentiate the species. Their common associates are *Platanus* *racemosa*, *Alnus rhombifolia*, and *Umbellularia californica*. Both species have flexible stems that are adapted to periodic flooding. Also, both reproduce through wind dissemination as well as root and branch cuttings. They are intolerant of shade and need full sunlight to establish. They are relatively short-lived, on average, 12 to 22 years. In addition to being seral species in riparian habitats, they provide stream habitat and erosion control (USFS, 2011).

Populus balsamifera ssp. *trichocarpa*

Populus balsamifera ssp. *trichocarpa,* commonly known as black cottonwood, occurs in riparian habitats less than 5,000 feet. Its common associates are *Acer macrophyllum*, *Pseudotsuga menziesii*, *Alnus*, *Betula*, and *Salix* species. It is an annual seeder and has a very high rate of germination, but also reproduces from stump sprouts and cuttings. It is a fast-grower and lives up to 175 years. Although it is tolerant of shade, it is intolerant of late frost, snow, drought, and canker. It has a deep root system that anchors it in place during flooding and is also able to reach the water table (USFS, 2011).

Baccharis pilularis

There are over 400 species of *Baccharis* with 8 species in California. *Baccharis pilularis* var consanguinea, commonly known as coyote brush, is a shrub that occurs in oak woodland, soft chaparral, and coastal scrub habitats. It grows throughout California's coast ranges, the Sierra Nevada foothills, and northern Mexico below 5,000 feet. It often occurs in recently disturbed areas within forests and is tolerant of disturbances such as fire and drought. It also provides browse for deer and seeds for birds (Stuart, et al 2001).

Rubus ursinus

Rubus ursinus, commonly known as California blackberry, is a trailing or climbing shrub that occurs in a variety of habitats in California at elevations below 5,000 feet. It occurs in many riparian communities in California dominated by *Salix* and *Populus* species as a codominant with *Baccharis* and *Rubus* species. Although it occurs in mature forest communities, it reaches its greatest abundance in early seral communities. It tolerates seasonal flooding, infertile soils, and fire disturbance, making it a valuable plant for restoration. However, it requires adequate soil moisture to establish. It reproduces by seed and vegetative propagules and can grow up to 20 feet long. *Rubus ursinus* also prevents soil erosion on some sites and food and cover for birds and mammals (USFS, 2011).

Rhamnus californica

Rhamnus californica, commonly known as California coffeeberry, is a shrub that occurs in chaparral, woodland, sage-scrub, mixed conifer, and riparian communities in California. It occurs on a variety of sites within these communities, including hillsides, ravines, dry flats, and rocky ridges. It is moderately shade-tolerant and can grow up to 12 feet tall. It is useful in restoration because it provides erosion control on hillsides, browse for wildlife, and produces large numbers of volunteers from young plants (USFS, 2011).

Sambucus mexicana

Sambucus mexicana, commonly known as blue elderberry, is a dominant understory species in riparian woodlands. It occurs in early seral communities on moist, well-drained sites. Common associates include *Platanus racemosa, Juglans hindsii, Alnus rhombifolia, Toxicodendron diversilobum, Sali*x, and *Rubus* species. Relatively short-lived, plants may flower two to three years after planting and reach full size in three to four years. However, competition from invasive weed species is a key factor in mortality at restoration sites. The fruit, foliage, and stems provide browse for birds and mammals Bornstein, et al. 2005).

Artemisia douglasiana

Artemisia douglasiana, commonly known as mugwort, is a perennial herb that occurs in hills, valleys, and foothills up to 6,000 feet from Baja California north to Washington. It tolerates seasonal flooding, summer drought, heavy soils, and full sun to partial shade. It can grow up to three feet tall and spreads through rhizomes, forming dense mats. It is also deer resistant (Bornstein, et al. 2005).

Implications From Other Projects

The Sacramento River Project, a riparian forest restoration, utilized various test plots to determine the impacts of soil types on various plant species. The plant palette used was similar to the palette described above. Among the plants used were *Salix lasiolepis, Sambucus mexicana,* and appropriate *Rosa, Populus,* and *Quercus* species for the area. Plants were also irrigated for the first three growing seasons. However, in contrast to this project, weeds were controlled using a combination of hand removal, mowing, and herbicides. The results of the project show that *Salix* and *Populus* species planted as cuttings had the greatest success at the project sites. It was also determined that restoration plantings should avoid areas within sites that have shallowly buried layers of sand or gravel (Alpert, et al. 1999).

Another study measured successional changes over time on 35 restoration sites along the Sacramento River. The aim of this study was to determine the efficacy of passive natural succession as opposed to introducing later successional species during or after the initial restoration planting. The results suggest that using a passive approach to succession may be sufficient for hardy species such as *Rubus ursinus, Artemisia douglasiana, Galium aparine,* and *Epilobium* species. Other species common to the remnant forests were able to naturally recruit, but less common species in the understory did not.

At sites where shade-adapted, later successional species were planted during the initial planting, plant species experienced low survivorship. In addition, over the time period the sites were studied (11-18 years), the entire native understory communities were not fully restored. This was determined because the remnant forests studied had greater cover from native understory species than at the restoration sites. This suggests that to restore natural understory vegetation completely, later successional species should be planted after adequate overstory cover is accomplished (Holl, et al. 2010).

A study of riparian restoration projects in the Spring Creek watershed in Central Pennsylvania assessed the impacts of restoration on water quality. Restoration projects were monitored after installation to assess channel morphology, substrate composition, and suspended sediments. After restoration, high flow events rarely impacted the structure of the restored stream banks. Suspended sediments also decreased 47-87% in the restored streams during base flow and storm events. In addition, the proportion of sediments in stream substrates decreased at one of the restoration sites. Ultimately, restoration goals to minimize erosion and sedimentation in the Spring Creek Watershed were met (Carline, 2007).

The City of San Luis Obispo restored 0.96 acres of riparian habitat on Orcutt Creek after it was realigned to accommodate for the Damon Garcia sports field. The site had a variety of invasive species present, including *Cynodon dactylon* and *Foeniculum vulgare.* The project also used all of the plants described above in the plant palette in addition to 24 other native plant species. However, the plans differed in weed control measures and success criteria. The success criteria for the project included 80-90% survivorship, 75% areal native cover, no presence of invasive species, and the completion of a successful wetland delineation at the project site (Rincon Consultants, Inc., 2003).

The City of San Luis Obispo was not able to fulfill the success criteria by the expected project completion date even though the stream bank appeared to be fully restored. Zero tolerance of invasive species was unrealistic for the project site as it is surrounded by rangeland dominated by Eurasian weeds. Also, because of the soil type, some of the species listed on the plant palette were not able to establish successfully. The success criteria did not allow for adaptive management and, therefore, modifications to the plant palette were not able to be made.

Chapter 3

Materials & Methods

This section describes the location, climate, hydrology, soils, and vegetation of the site, as well as the weed eradication and revegetation methods implemented to complete this project.

Site Description

Location

Brizzolara Creek is located in San Luis Obispo, CA and stretches from Cuesta Ridge, in Los Padres National Forest, to the southeastern corner of the Cal Poly campus. Its watershed comprises approximately 1,883 acres and predominantly contains ranchland and the main campus of Cal Poly, which encompasses various roads, parking lots, buildings, sports fields, agricultural fields, and rangeland (Figure 2). Historically, improperly placed culverts, mining, and ranching operations caused erosion and other negative impacts to Brizzolara Creek upstream from the project site (Engels, 2005). The project location is behind the Cal Poly Farm Shop (Building 9) and comprises approximately 5,200 square feet. Rip-rap covers approximately 70% of the project site leaving 1,560 square feet available for planting.

Climate

San Luis Obispo has a Mediterranean climate, with hot summers and cool winters. The average high temperature is 82ºF with the average warmest month being August. The average low temperature is 42ºF with the average coldest month being December. On average, total precipitation is 24.36 inches per year with a majority of rainfall occurring between the months of October and April (Dingus, 2002).

Figure 2. A map of the watershed of Brizzolara Creek. The project site location is indicated by the arrow (Cal Poly, 2005).

Hydrology

Brizzolara Creek is considered to be a perennial stream, although there are no flows in the summer months during dry years (Dingus, 2002). Average streamflow data were not available, but streamflow was estimated to be 1.21 cfs by the Cal Poly Watershed Management and Restoration class in January 2010. Brizzolara Creek was also observed to have no flows during the summer months leading up to the project.

Soils

Along Brizzolara Creek, soils are developed from alluvium. Alluvium is composed of clay, silt, sand, or gravel deposited by streams. The soils found on the alluvium are classified as Salinas soil. The Salinas series consists of well drained, clay-loam soils that formed in alluvium weathered from predominantly sandstone and shale. Salinas soil has a Land Capability Class I when irrigated and is often used for agriculture (USDA, NRCS 2003).

Vegetation

Dominant plant species in the remnant forest surrounding the project site were *Platanus racemosa*, *Salix laevigata*, *Salix laevigata*, *Quercus agrifolia, Rhamnus californica*, and *Baccharis pilularis.* The predominant vegetation at the project site was non-native broadleaf and grass species, including *Dittrichia graveolens*, *Cynodon dactylon*, *Malva neglecta*, *Foeniculum vulgare,* and *Rumex crispus.* However, there were also several naturally occurring native species at the project site. The site contained three *Quercus agrifolia* and two *Rhamnus californica* seedlings. The site also contained established *Rhamnus californica*, *Salix lasiolepis*, and *Toxicodendron diversilobum* species. However, non-native species dominated the landscape, providing approximately 70% cover surrounding the rip-rap facing (Figure 3).

Methods

Weed Eradication & Control

All non-native plant species were eradicated by hand-removal techniques. Weed eradication activities occurred prior to planting in December 2010. In addition, weed eradication activities will be continued, during early summer in June 2011 prior to the development of mature seeds in the target weed species. In addition, leaf litter was used as mulch to discourage the growth of non-native and invasive species after weeding has occurred.

Figure 3. *Dittrichia graveolens* and *Cynodon dactylon* at the project site in October 2010.

Revegetation

Planting occurred after rain saturated soils to a depth of 6 inches in December 2010. Initial weed eradication measures were completed in December 2010 and January

2011. All plants were installed around the existing rip-rap facing and no significant alterations to the streambed were made (Figure 3). The plant palette consisted of early successional species common to the remnant forest (Table 1). These species have proven to be successful at other sites and will be used to restore the ecological functions of the riparian corridor along Brizzolara Creek. However, remedial plantings and adaptive management techniques may be necessary due to limitations from the soils and rip-rap at the site to achieve adequate native cover and fully restore the site.

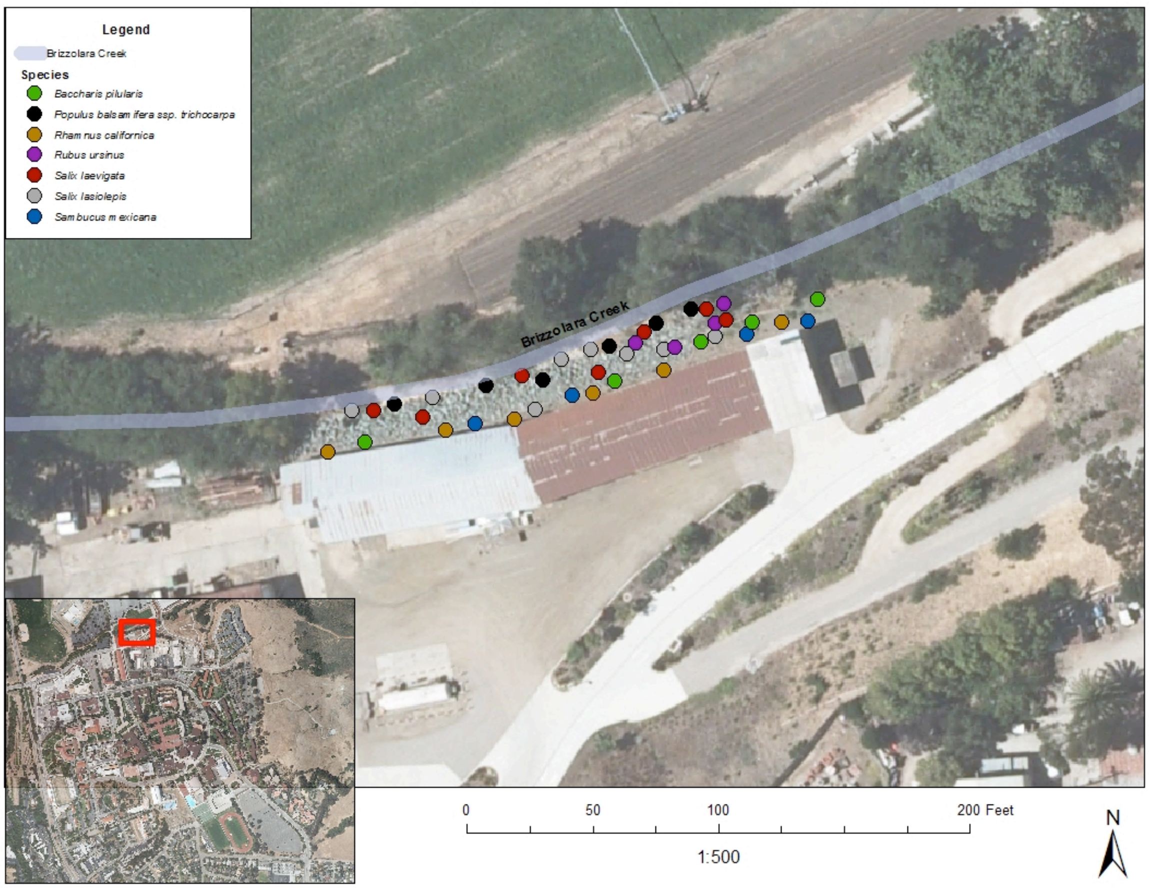

Figure 4. Planting map used for the Brizzolara Creek Revegetation & Restoration Plan.

Table 1: Plant palette used for restoration planting at the project site.

Scientific Name	Common Name
Salix laevigata	red willow
Salix lasiolepis	arroyo willow
Populus balsamifera spp. *trichocarpa*	black cottonwood
Baccharis pilularis	coyote brush
Rubus ursinus	blackberry
Rhamnus californica	coffeeberry
Sambucus mexicana	blue elderberry
Artemisia douglasiana	Mugwort

Twenty *Salix* and *Populus* species were propagated using live stakes taken from trees located along Brizzolara Creek (Figure 4). Cuttings were taken when trees were dormant during the month of January. Cuttings were approximately three quarters of an inch in diameter. Each stake was soaked in water for 48 hours prior to planting to stimulate root growth. Approximately two feet of the stake were planted below the soil line. This was done by using rebar to make properly sized holes in the soil into which the stakes were to be placed in. Species were planted interspersed between the rip-rap at a minimum of three feet on center to prevent competition between species. *Salix* and *Populus* stakes were planted at the toe slope of the stream bank and on the upstream side of the rip-rap because those locations receive the most impact from streamflow and both species are able to prevent erosion. Stakes were also planted at various locations below the ordinary highwater mark on the stream bank to provide shade and native cover. These species are suitable for these locations because they require saturated soils to establish and are tolerant of periodic flooding.

Figure 5. New growth on a live stake taken from a *Salix lasiolepis* cutting.

Twenty *Rhamnus californica, Rubus ursinus, Sambucus mexicana*, and *Baccharis pilularis* were transplanted from container plants grown by a local native plant retailer (Figure 5). *Artemisia douglasiana* was planted from seed and propagules collected downstream. *Rubus ursinus* was also planted on the upstream side of the rip-rap because it also prevents soil erosion. *Baccharis pilularis, Sambucus mexicana, Rhamnus californica,* and *Artemisia douglasiana* were planted at the top of the stream bank because they are tolerant of the drier conditions there.

Figure 6. New growth on *Rubus ursinus* planted from a container upstream from the rip-rap.

Chapter 4

Results

The long-term objectives of the restoration project are to establish native plant cover, provide wildlife habitat, improve water quality, and encourage the natural recruitment of native species. The natural recruitment of native species will be encouraged because seral species were used that provide shade and protection for later successional species. Also, climax species such as the *Quercus agrifolia* seedlings that were located at the project site prior to plant installation will be provided with the shade and protection necessary for their survival (Circuit Rider Productions, NOAA, 2004). Once established, the native vegetation should improve water quality by reducing erosion and sedimentation, as well as maintain optimum temperatures, dissolved oxygen, and turbidity levels (Griggs, 2008). The species used will also provide wildlife habitat by providing food and shelter for birds and mammals as well as shade habitat for fish.

The results of restoration projects on the Sacramento River may have some implications on this restoration project. The results of these projects indicated that gravel in the soil at project sites negatively impacted plant species. The top of the stream bank of Brizzolara Creek contained layers of gravel. Although much of the gravel was removed at planting, remedial planting may be necessary to achieve the success criteria should gravel negatively impact the species that were planted at the top of the stream bank.

Results from restoration projects on the Sacramento River also suggested that to fully restore understory vegetation, later successional species should be planted after adequate overstory cover is accomplished. This means that remedial planting of later successional species may be necessary in the future to fully restore Brizzolara Creek and achieve adequate native cover. However, there are definite limitations on native cover for the understory and limited locations for planting on the stream bank due to the rip-rap. To achieve the same amount of native cover as the remnant forest located adjacent to the Brizzolara Creek project site some of the rip-rap would need to be removed.

The success criteria for the Brizzolara Creek project is 70% survivorship and allows for adaptive management techniques including changing the plant palette should survivorship for any species be unsuccessful.

Monitoring & Management

The project site will be monitored and maintained by Cal Poly students for three years following the project installation starting immediately after installation in January 2011 and ending in June 2014. Supplemental watering may be done by hand during periods of infrequent rainfall during this time. Watering should only extend the natural rainy season from the months of September through June. Weeds will also be removed using hand removal methods or mechanical techniques prior to seed dispersal in the winter and summer months for the first three years. After the first three years, plants should be fully established and able to compete with non-native weed species and survive drought.

The final success criteria will be 70% survival for all species excluding *Artemisia douglasiana*. Success criteria will be evaluated in June 2014 to determine the relative success of the project. Should success criteria not be met at this time, remedial planting and additional weed eradication measures should be implemented. Success will also be indicated by reduced sedimentation, improved water quality, and improved wildlife habitat. However, there will be no success criteria to measure these indicators since baseline conditions were not measured prior to project implementation. Adaptive management techniques can be used should the methods outlined in this plan prove infeasible. This may include developing a new plant palette, weed eradication plan, and/or success criteria, as necessary.

Chapter 5

Conclusion

The Cal Poly Farm Shop Removal & Stream Bank Repair Project left a deficit in native cover for a stretch of Brizzolara Creek on the California Polytechnic University, San Luis Obispo campus. The main goal of this project was to establish a riparian buffer using native vegetation at this site. The long-term benefits of establishing native vegetation at the project site are improved water quality and wildlife habitat.

Restoration efforts included removing non-native vegetation and planting seral species from containers, live stakes, seed, and vegetative propagules. The plant palette included *Salix laevigata, Salix lasiolepis, Populus balsamifera* ssp. *trichocarpa, Baccharis pilularis, Rubus ursinus, Rhamnus californica, Sambucus mexicana,* and *Artemisia douglasiana.* These species should encourage the natural recruitment of other native species by providing shade and cover. The site will be monitored for three years following plant installation and supplemental weeding, watering, and planting will be performed, if necessary. At the end of the monitoring program, the site will be evaluated for the final success criteria, which is a 70% survival rate for all species planted. Adaptive management techniques will be used at this time if the final success criteria are not met. Suggestions for further work to fully restore the stream bank include supplemental planting of seral species, removing rip-rap to allow for more vegetative cover, and the introduction of climax species when conditions permit.

References

Alpert, P., F.T. Griggs, and D.R. Peterson. 1999. Riparian forest restoration along large rivers: Initial results from the Sacramento River Project. Restoration Ecology. 7.4: 360-368.

Bornstein, C., D. Fross, and B. O'Brien. 2005. California native plants for the garden. Cachuma Press, Los Olivos, CA.

Bossard, C.C., M.C. Hoshovsky, and J.M. Randall. 2000. Invasive plants of California's wildlands. University of California Press, Berkeley, CA.

Busby, K. 2009. Cal Poly Farm Shop Removal and Stream Bank Repair Project. California Polytechnic State University, San Luis Obispo, Environmental Health & Safety, San Luis Obispo, CA.

Cal Poly. 2005. Brizzolara Creek base map. Available at http://polyland.calpoly.edu/overview/Archives/brizz_base_100dpi.jpg (verified 22 Feb. 2011)

Carline, R.F., Walsh, M.C. 2007. Responses to riparian restoration in the Spring Creek watershed, Central Pennsylvania. Restoration Ecology. 15.4: 731-742.

Circuit Rider Productions, Inc. and National Oceanic and Atmospheric Coastal Services Center. 2004. Salmonid habitat restoration planning resource. Available at http://www.cfses.org/salmonid/html/water/ecologic.htm (verified 22 Feb 2011)

Dingus, D. 2002. An introduction to Cal Poly Land's soil and water resources [Online]. Available at http://polyland.calpoly.edu/home.html (verified 22 Feb. 2011)

Engels, L. 2005. Brizzolara Creek: A snapshot in time. Available at http://polyland.calpoly.edu/overview/Archives/brizcreekstudy/index.htm (verified 22 Feb. 2011)

Griggs, T.F. 2008. California riparian habitat restoration handbook. Available at http://www.riverpartners.org/reports-and-articles/Restoration_Handbook_FINAL.pdf (verified 22 Feb 2011)

Rincon Consultants, Inc. 2003. Final amended riparian and wetland habitat mitigation and monitoring plan: Damon-Garcia Sports Complex Project. City of San Luis Obispo Parks and Recreation Department, San Luis Obispo, CA.

Stuart, J.D, and J.O. Sawyer. 2001. Trees and shrubs of California. University of California Press, Berkeley, CA.

USDA, NRCS. 2003. National Cooperative Soil Survey: Salinas Series. Available at http://www2.ftw.nrcs.usda.gov/osd/dat/S/SALINAS.html (verified 22 Feb. 2011)

USFS. 2011. Shrub index. Available at http://www.fs.fed.us/database/feis/plants/shrub/index.html (verified 22 Feb 2011)

Wilson, B. 2011. California native plants for your garden and wildlife. Available at http://www.laspilitas.com/plants/plants.htm (verified 22 Feb. 2011)