

PROPOSAL
Central Valley Regional Water Quality Control Board
Supplemental Environmental Projects

Project Title: Riparian Woodland and Riparian Brush Rabbit Flood Refugia Habitat Restoration

Geographic Area of Interest: Central Valley Region (5)

Name of Responsible Entity: River Partners

Estimated Cost for Project Completion: Scalable from \$119,072 - \$1,155,992

Contact Information:

Julie Rentner, Regional Director

River Partners

1301 L street #4

Modesto, California 95354

Office: (209) 521-1700 x 23

Cellular: (209) 639-2012

Project Description:

River Partners, with the assistance of major partners the US Fish and Wildlife Service (USFWS) and CSU/Stanslaus-Endangered Species Recovery Program (ESRP), has restored 2,200 acres of riparian woodland and wetlands on the San Joaquin River National Wildlife Refuge (Refuge) since 2002. This is the second-largest overall, and largest contiguous, riparian woodland restoration effort in California. The design of the restoration specifically targets habitat for the critically endangered riparian brush rabbit, which has been reintroduced onto the Refuge through a captive propagation and reintroduction program as well as other riparian-obligate species such as neo-tropical migratory songbirds, riparian woodrat, owls and other birds of prey. A critical element of this habitat design is the provision of high-ground refugia so that the rabbits -- and other terrestrial wildlife -- can survive flood events, which have proved to be the greatest threat to survival. So far, 5 linear miles have been restored with dense shrub cover to provide cover from predation on the only remaining flood refugia in the area -- the levee slopes. Three miles of this levee restoration were funded through previous Supplemental Environmental Projects. Riparian brush rabbit monitoring in 2010 has shown high levels of rabbit usage on restored levees indicating their habitat value extends beyond flood refugia to provide movement corridors across the floodplain even in dry years. All restoration thus far has taken place on the west side of the San Joaquin River; the proposed project will fund restoration across the River on the east side, including up to 35,100 linear feet of levee slope (6.6 miles, see Figure 1), 30 acres of adjacent riparian field, and provide support for the on-going monitoring of riparian brush rabbit response to restoration.

Work Plan:

The project will consist of the following six tasks.

Task 1 – Planting Plan: River Partners will assess the condition of the site, anticipated weed management challenges, and the suitability of the site to support target plant species. We will then prepare a detailed planting plan to describe the species and density to be planted on the levee slopes and field as well as the vegetative performance standards expected for the project. This document is used to communicate restoration designs to partners to ensure proper design and implementation.

Task 2 – Field Preparation: Up to 6 miles of levee will be supplied with a water source, drip irrigation system, and the soil surface prepared for planting. Thirty acres of adjacent field will be weeded and prepared for flood irrigation.

Task 3 – Planting: Native plants from local collections will be installed on the levees and in the field during the spring and fall. Levee plantings require drip irrigation lines 10 feet apart, and field plantings are flood irrigated. Field plantings are usually established at 227 woody plants per acre, comprised of at least 12 different appropriate species. Levee plantings are established at 870 woody plants per acre, and consist largely of California rose and California blackberry, both shown to provide little resistance to flood flows and significant soil erosion control under high velocity flows¹.

Task 4 – Maintenance: All necessary irrigation, irrigation system maintenance, weeding, and replacement of dead or dying plants will continue in Year 2 and Year 3; resulting in minimum 70% survival and near 100% coverage by native plants by the end of Year 3.

Task 5 – Performance Monitoring: River Partners biologists will monitor the plantings in Years 1 through 3 to determine if they are providing the target benefit, and to promote the adaptive management process. Following the first growing season, a complete census of planted individuals will be performed to determine survival of planted species. Years 2 and 3 will be monitored for species diversity and total vegetative cover as described in the planting plan.

Task 6 -- Wildlife Monitoring: Riparian brush rabbit habitat requirements and use will be monitored and documented by ESRP staff.

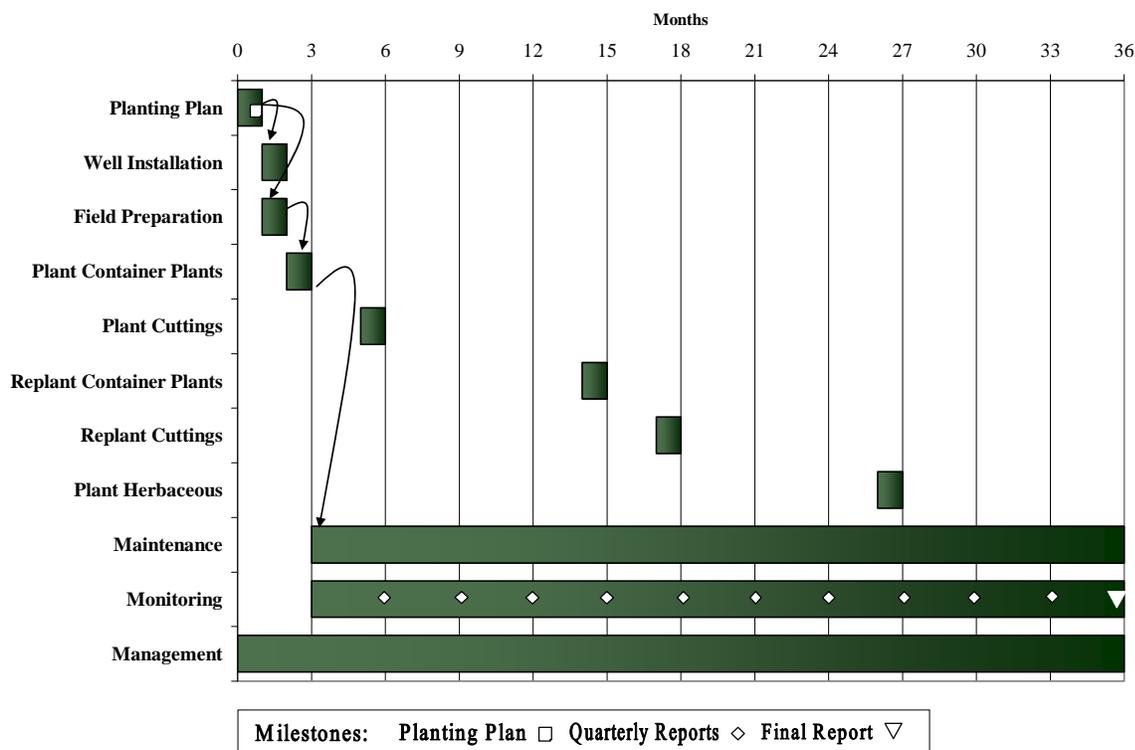
Schedule:

Upon approval and funding River Partners, USFWS and ESRP will begin development of the planting and monitoring plan. Field preparation and well installation will commence after completion of the planting plan or immediately before the spring or fall planting season, whichever comes first. Initial restoration planting will take place the following planting season. Additional planting will be added the following spring/fall (certain species are typically planted only in the spring or only in the fall). Finally, within one year of initial planting any plants that have died will be replaced.

¹ M. Levent Kavvas, Z.Q. Richard Chen, H. Bandeh1, Elcin Tan, N.Ohara1, Stefan Lorenzato and John Carlon and Thomas Griggs. 2009. Study of the Roughness Characteristics of Native Plant Species in California Floodplain Wetlands Final Report to USEPA: WETLANDS PROGRAM DEVELOPMENT GRANT Agreement #: 96975001

Work in project years 2 and 3 consists of irrigation, maintenance, weed control, and replanting of any plants that have died to assure a minimum of 70% survival of all species. Just prior to the final irrigation, understory vegetation consisting of native grasses and forbs (such as creeping wild rye, mugwort, gumplant, evening primrose, etc.) will be seeded between planted shrubs and trees. The final irrigation will jump-start that understory, with the target of near-100% coverage by native vegetation to out-compete non-native invasive weeds. This method has been developed by the project team adaptively over the last 4 years on over 5 miles of levees in this region, and has demonstrated success both in covering levees with weed-resistant native vegetation that will endure flooding and drought, and in hosting populations of endangered riparian brush rabbit and other terrestrial target wildlife. Final project reports for similar completed SEP projects are included in Appendix A.

Table 1. Proposed Project Timeline



Cost:

Estimated costs presented here are subject to change depending on the source of funds provided by the discharger (i.e. public works or other public funding sources may have additional wage rate requirements not accounted for in this estimate). The estimated total cost of the project, if completed in its entirety, is \$1,155,992. Up to \$666,900 will be dedicated to the restoration of over six miles of levee slope. A total of \$278,292 will be dedicated to the restoration of 30 acres of fields to riparian habitat (including provision of a water source), and \$210,000 will provide wildlife monitoring.

Drill low-flow well		\$ 24,072
Restoration of 30 acres	@\$8,474/ac.	\$ 254,220
Plant 35,100 linear feet of 40' -width levee slope	@\$19/ft.	\$ 666,900
Wildlife Monitoring (3 years)	@\$70,000/yr	\$ 210,000
TOTAL		\$1,155,992

A detailed budget can be provided at the Board's request.

Scalability:

This project can easily be broken down into several smaller projects of smaller size, as long as the water source (\$24,072) is provided for any smaller project. The 30-acre field restoration needs to be a single project, and wildlife monitoring must be funded by year.

The highest priority would be to restore the 30-acre field (\$254,220 + \$24,072) plus the immediately-adjacent 3,400 linear feet of levee slopes (both sides of 1,700 feet of levee) that separate this field from the San Joaquin River floodplain (\$64,600); to provide flood refugia for endangered riparian brush rabbits and other terrestrial species. Wildlife monitoring (\$210,000) is a critical component of this work as well. **(total = \$552,892).**

A second priority would be to restore the 9,400 feet of river levee slope (both sides), totaling 18,800 linear feet of levee slope **(total = \$357,200).**

A third priority would be to restore the 6,450-foot double-width Floodplain Bench Slope **(total = \$245,100).**

Should smaller funding amounts become available, the minimum project size as proposed would include the water source (\$24,072) plus 5,000 linear feet of levee slopes (both sides of 2,500 feet of levee) **(total = \$119,072).**

Permitting:

All NEPA documentation has been completed for this sort of riparian restoration work on the Refuge, and no further planning or documentation is required. The Comprehensive Conservation Plan for the Refuge (with Environmental Assessment, Section 7 ESA evaluation, and Compatibility Determination) was completed in 2006. Identical restoration efforts, the benefits of which this project would contribute greatly to, have been successfully completed on the Refuge since 2002 (Appendix A). Work will not be conducted on the slopes of the incised San Joaquin River channel; rather, on the levees set back some distance from the River.

Deliverable:

Within 30 days of issuance of the funding, River Partners will provide copies of the Scopes of Work to the Central Valley Water Quality Control Board (Board). Quarterly reports will be provided upon commencement of work, describing the status of the project. A final report will be delivered to the Board no later than December 31 of the third year of the project.

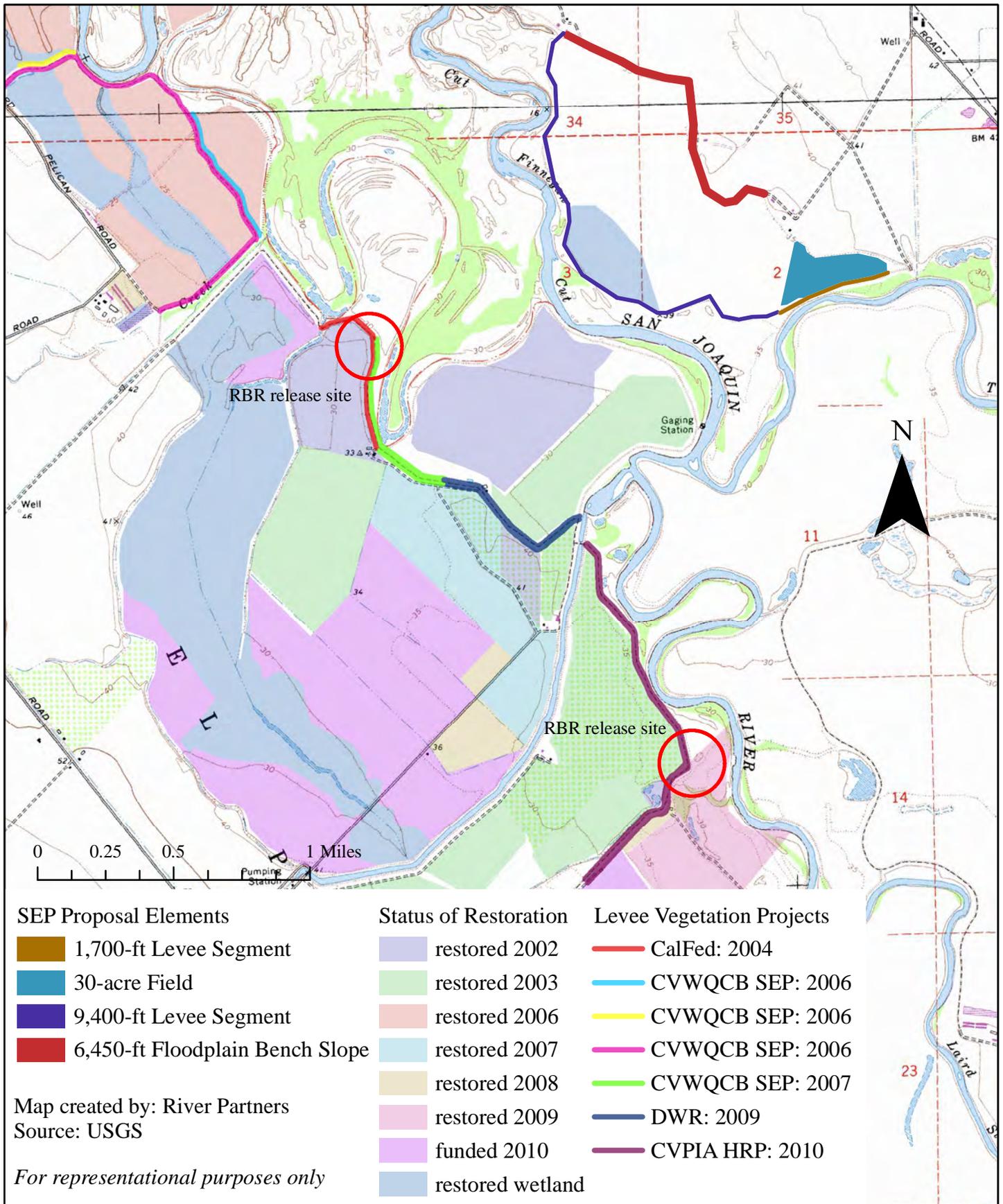


Figure 1. Proposal elements and relationship to other habitat restoration projects including 4 prior Supplemental Environmental Projects (see Appendix A)

Water Body, beneficial use and/or pollutant addressed by this project:

Per the General SEP/RWQIP Qualification Criteria, this project will provide "(iv) habitat restoration or enhancement; and, (vi) wetland, stream, or other waterbody protection, restoration or creation"; as well as some degree of water quality improvement.

It is rare in California to have the opportunity to enhance levee slopes for erosion control and sediment reduction. General levee maintenance standards require slopes to be mowed short at least once per year and vegetation to be kept at a maximum height of 12 inches. This prescription not only provides little benefit for our endangered riparian-obligate terrestrial species, but induces substantial water quality impacts throughout our major river systems during large storm events and floods which cause soil movement. The Refuge provides a unique opportunity to enhance the capacity of existing levees to provide much needed flood refuge for endangered wildlife, and to reduce the bare levee slopes' impact on water quality. Planting woody shrubs and vines in the floodway has a demonstrated positive impact on sedimentation as stems and leaves that are rooted in the levee can protect the soil surface from erosion. Planting woody trees and shrubs in the floodplain of the San Joaquin River further helps to improve water quality by enhancing groundwater percolation and filtration through subsurface soil layers, contributing cleaner water to the base flow of the river.

In this project, those benefits will be magnified by the juxtaposition and configuration of these levee slopes immediately adjacent to the San Joaquin River, and separating the River from adjacent agricultural lands. A major source of sediment and water quality impairment in this part of California is agricultural runoff. By establishing dense native vegetative cover on slopes immediately adjacent to agricultural fields and roads, this impact is ameliorated. This will contribute to improving the quality of the River, and thus the beneficial uses of waters of the State.

- (a) This project is not a part of nor proposed as mitigation to offset impacts of any discharger's project(s).
- (b) This project will directly benefit both groundwater and surface water quality by enhancing well-documented filtration benefit provided by riparian habitat, and by providing surface vegetative cover to reduce soil erosion and sedimentation from bare levee slopes into the adjacent river.
- (c) This proposed project will not directly benefit the State Water Board or Regional Water Board functions or staff.
- (d) See project description above for detailed schedule and timeline.
- (e) Oversight of the completion of the project will be provided by River Partners and a final project completion report will be submitted to the Board upon completion of the project.
- (f) This proposed project has not been submitted for any other funding. If, in the future, it is submitted and approved for alternative funding and is also accepted on the SEP/RWQIP List, River Partners will notify Board staff of the receipt of any other funding from any voter approved Propositions, section 319 of the Clean Water Act, Grant Programs, or other source. River Partners will provide documentation to the Board illustrating that the monies received through other sources will not fund projects that are already funded or plan to be funded with SEP/RWQIP monies. This notification and clarification will accompany the workplan, and will be updated in the event of any funding source changes.

Appendix A
Similar Supplemental Environmental Projects
Completed by River Partners in this Region

2008 Final Report

City of Manteca Levee Planting: Vierra Unit

*San Joaquin River National Wildlife Refuge
San Joaquin River Mile 78—88
Stanislaus County, California*

November 2008



Prepared for:

The City of Manteca



1301 L St #4 Street
Modesto, CA 95354
info@riverpartners.org

Phone: (209) 521-1700
Fax: (209) 521-7327
www.riverpartners.org

TABLE OF CONTENTS

I.	INTRODUCTION.....	2
A.	Project Overview	2
B.	Purpose of Report	2
II.	PROJECT ACCOMPLISHMENTS	4
A.	City of Manteca Levee Planting Overview.....	4
B.	Monitoring Results.....	5
C.	Photo Point Monitoring.....	6
III.	DISCUSSION	6
A.	Analysis of Activities.....	6
B.	Management Recommendations	6

List of Tables

Table 1.	Summary of project goals, objectives, and special considerations for riparian restoration on the City of Manteca Levee Planting, Vierra Unit, SJRNWR.	2
Table 2.	Species planted in the City of Manteca Levee planting.....	4
Table 3.	Management activities performed by River Partners for the City of Manteca Levee	5
Table 4.	End of Contract Planting Summary from the 2007 and 2008 permanent sample plots...	5

List of Figures

Figure 1:	Location of the City of Manteca Levee Planting.....	3
Figure 2:	Average Height of Surveyed Plants 2007 and 2008.....	5

Appendices

Appendix A: Photo Points 2006-2008: City of Manteca Levee Planting.

Suggested citation:

River Partners. 2008. 2008 Annual Report for the City of Manteca Levee Planting: Vierra Unit, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Chris Stevenson. Modesto, California.

**2008 Final Report for the City of Manteca Levee Planting: Vierra Unit
San Joaquin River National Wildlife Refuge
Stanislaus County, California**

I. INTRODUCTION

A. Project Overview

On October 17, 2005, River Partners entered into a contract with the City of Manteca to plant approximately 11,000 linear feet of abandoned Army Corps of Engineers (ACOE) levees on the San Joaquin River National Wildlife Refuge (Refuge) (Figure 1). The goal of this project was to restore dense, shrubby habitat for the state and federally endangered riparian brush rabbit and provide suitable long, linear refugia during times of flooding.

This levee planting is located within the boundary of the Vierra Unit, a large riparian and wetland habitat restoration project funded by the Department of Water Resources Flood Protection Corridor Program. In 2006, widespread flooding throughout the refuge inundated the Vierra Unit for up to 4 months. Post-flood surveys of riparian brush rabbits conducted by the Endangered Species Recovery Program (ESRP) recorded high mortality of brush rabbits, highlighting the need for high water refugia such as the Manteca levee planting (River Partners, 2007a).

B. Purpose of Report

This final report evaluates project success in terms of stated goals, objectives, and special considerations (Table 1).

Table 1. Summary of project goals, objectives, and special considerations for riparian restoration on the City of Manteca Levee Planting, Vierra Unit, SJRNWR.

Project Goals and Objectives
<ul style="list-style-type: none"> • Provide long, linear refugia for the riparian brush rabbit during times of flooding
Site Specific Considerations
<ul style="list-style-type: none"> • Maintain any existing native plants • Use local seed sources • Establish native shrubs for maximum ground coverage • Establish native understory for forage and ground cover

This report is an important part of the adaptive management model that River Partners uses to assess projects and programs. This report documents project implementation from initiation throughout the course of the project. Key functions of the final report are to:

- Communicate implementation activities to our partners
- Document the completion of project milestones
- Present monitoring results
- Evaluate the effectiveness of field activities
- Recommend specific actions for future management

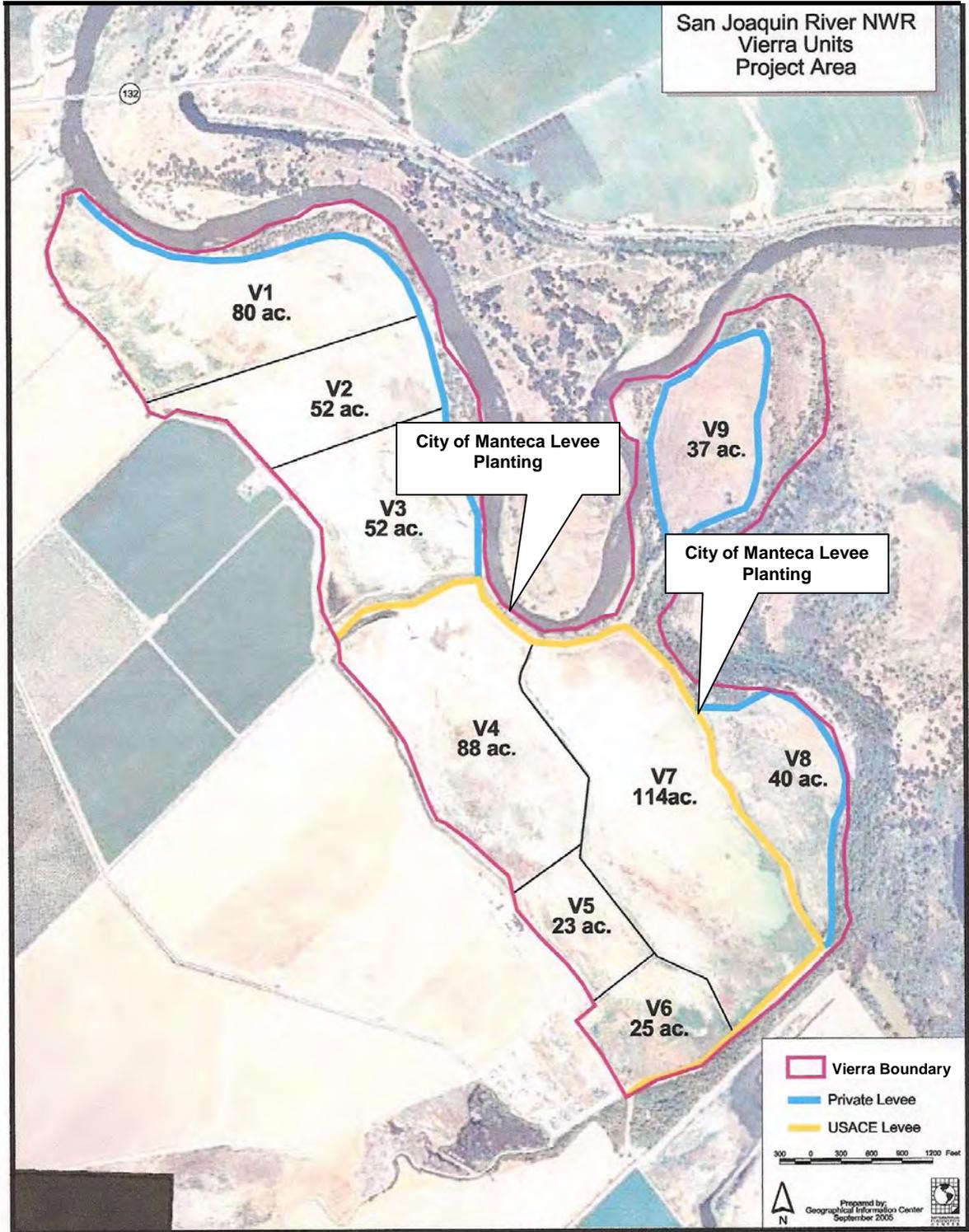


Figure 1: Location of the City of Manteca Levee planting. The City of Manteca Levee planting covers the inside slope of the USACE levee shown in yellow.

II. PROJECT ACCOMPLISHMENTS

A. City of Manteca Levee Planting Overview

In 2005, River Partners meet with the US Fish and Wildlife Service (USFWS) and the Endangered Species Recovery Program (ESRP) to develop plant design requirements for suitable riparian brush rabbit refugia. Key characteristics of the planting design included planting of species along the slope of the levee which would provide dense cover for the riparian brush rabbit and selection of shrubby species which would not provide perching for predatory raptors. Three rows of plants were installed on the levee 5 ft apart. The plant composition is detailed in Table 2. The levee was planted in February, 2006.

Table 2. Species planted in the City of Manteca Levee planting.

Common Name	Scientific Name	Number Planted
California rose	<i>Rosa californica</i>	1295
Sandbar willow	<i>Salix exigua</i>	549
California blackberry	<i>Rubus ursinus</i>	1663
Coyote brush	<i>Baccharis pilularis</i>	927
Blue elderberry	<i>Sambucus mexicana</i>	554
	Total	4968

Following the initial planting in February 2006, the area surrounding the levee was flooded for up to 4 months (River Partners, 2007a). As a result of this infrequent occurrence, there was a high mortality in the lowest row of planting. This row was replanted with sandbar willow, a flood tolerant species. The sandbar willow plantings at the base of the levees are expected to help buffer the levee from flood-induced erosion (Griggs, 2008).

River Partners conducted maintenance throughout the course of the contract period consisting of weed control, regular irrigation during the dry summer months and replanting. Replanting occurred due to plant mortality or lack of planting material during the initial planting. Maintenance details for 2006 and 2007 can be found in the annual reports for those periods (River Partners, 2006 and 2007b). Table 3 summarizes activities performed during 2008.

Table 3. Management activities performed by River Partners for the City of Manteca Levee planting, December 2007 to November 2008.

Activity	Date
Replanting	
No replanting occurred during this period	
Weed Control	
Spray herbicide as needed	Dec 2007 – Nov 2008
Removal of weeds with hand tools as needed	Dec 2007 – Nov 2008
Irrigation	
Water with drip-line irrigation on a regular basis	Feb – Nov 2008
Drip line repairs	April 2008
Monitoring	
Monthly Field Inspection	Dec 2007 – Nov 2008
Permanent sample plot monitoring and data entry	July 2008
Photo point monitoring	November 2008

B. Monitoring Results

A complete census of the levee planting was conducted in 2006. In 2007, a permanent sample plot was established. The purpose of the permanent sample plot is to record detailed information on a select group of plants over time. Within the permanent sample plot, River Partners assessed plant survivorship, the height of each plant within the plot and coverage by the planted species. The survivorship goal of this project was 50% over the course of three years. The monitoring data shows that this success criterion was met for all species. Relative coverage is calculated by dividing the absolute coverage by one species by the total cover of all species. California rose (*Rosa californica*) had the highest relative coverage of all species planted.

Table 4. End of Contract Planting Summary from the 2007 and 2008 permanent sample plot surveys. The numbers in the table represent an average for both years.

Common Name	Scientific Name	Total Average Density (plants/acre)	Average Survivorship	Relative Coverage
California blackberry	<i>Rubus ursinus</i>	53	100 %	41.4 %
California rose	<i>Rosa californica</i>	36	94 %	13.4 %
Coyote brush	<i>Baccharis pilularis</i>	41	100 %	13.9 %
Blue elderberry	<i>Sambucus mexicana</i>	18	100 %	18.8 %
Sandbar willow	<i>Salix exigua</i>	22	83 %	12.5 %

Figure 2 shows the average height of all planted species in 2007 and 2008. Although variation occurs throughout the levee planting, it appears that coyote brush and sandbar willow achieved their maximum height by 2007.

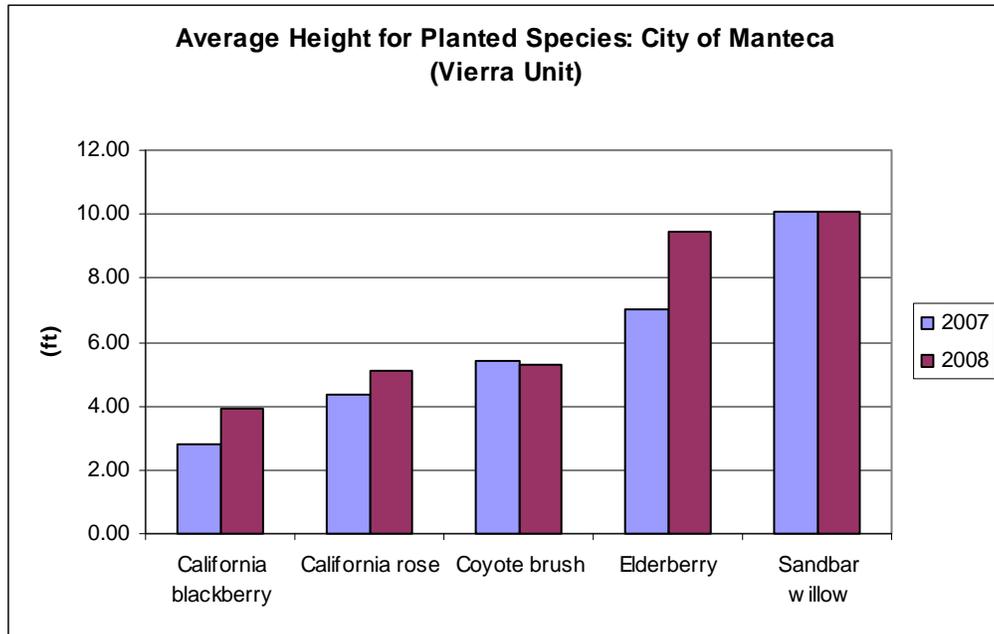


Figure 2: Average height of surveyed plants on the City of Manteca levee planting, 2007 and 2008.

C. Photo Point Monitoring

To track project development over time, five permanent photo points were established in 2006 on the City of Manteca Levee planting. All photos were shot with a 38-50-mm lens. Sample photos from all years of the project are provided in Appendix A.

III. DISCUSSION

A. Analysis of Activities

Data from the 2007 and 2008 permanent plot surveys showed that survivorship exceeded 50 % for all plant species. Although the permanent sample plots only represent a portion of the total planting, comparison of survivorship between the permanent sample plot surveys and census data indicates that survival estimates from plots are within 5% of whole field census data (Sacramento River Partners, 2003)). The levee plantings have developed into a dense network of vegetation. It is anticipated that this vegetation will function as natural flood refugia for the riparian brush rabbit in its current condition.

B. Management Recommendations

1. Maintenance

a) Weed and Pest Control

The restoration plantings on the City of Manteca Levee were designed to be resistant to invasive species. It is expected that the canopy cover provided by the plantings should provide sufficient weed control by limiting the areas available for invasion.

Managing for insect pests within the restored areas is not recommended. Aphids are ubiquitous but will not increase mortality in established vegetation. Borers, which mostly effect willows, primarily result in limb damage. In addition, the widespread use of insecticides may actually result secondary pest explosions as a consequence of non-target effects on predatory arthropods (Fisher et al. 1999).

b) Irrigation

All species are well-established on the City of Manteca Levee. Future irrigation is not required to promote establishment or survivorship of the planted species.

2. Fire

Prescribed burning as a management tool is not recommended within the restored areas. Currently, the restored areas possess a high degree of both structural and species diversity with little weed pressure within the fields. Prescribed fires may reduce structural and species diversity within the restoration and open areas to invasive weeds. In an effort to reduce fire hazards, roads should be kept clear of vegetation and maintained as fire breaks to reduce both the intensity and spread of wildfires.

3. Flooding

The City of Manteca levee plantings were designed to be resistant to flooding. However, River Partners anticipates evaluating the levee plantings following any flood events as part of a routine post-flood monitoring program.

References:

Fisher, T.W., T.S. Bellows, L.E. Caltagirone, D.L. Dahlsten, C.B. Huffaker, eds. 1999. Handbook of Biological Control: Principles and Applications of Biological Control. Academic Press.

Griggs, T. 2008. California Riparian Habitat Restoration Handbook.

River Partners. 2006. 2006 Annual Report for the City of Manteca: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Tom Griggs and Sara Taylor. Modesto, California.

River Partners. 2007a. Effects of Long Duration Flooding on Riparian Plant Species in Restoration Plantings. San Joaquin River National Wildlife Refuge, Stanislaus County, California. L. Singleton, S. Small and T. Griggs. Modesto, CA.

River Partners. 2007b. 2007 Annual Report for the City of Manteca: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Lauren Singleton and Stacy Small. Modesto, California.

Sacramento River Partners. 2003. 2001 & 2002 End of Season Report for the Ord Bend Unit, Sacramento River National Wildlife Refuge, Glenn County, California. Helen Swagerty. Chico, California

Appendix A

Photo Points 2006-2008

City of Manteca Levee Planting: Vierra Unit

Figure A-1: Pre-construction of the City of Manteca Levee Planting: Vierra Unit



Appendix A-2: City of Manteca Levee Planting looking northwest on the Vierra Unit



2006



2007



2008

Appendix A-3: City of Manteca Levee slope: Vierra Unit



2006



2007



2008

Final Report

Hagemann Unit Levee Planting

*San Joaquin River National Wildlife Refuge
San Joaquin River Mile 78—88
Stanislaus County, California*

October 2009



Prepared for:
The City of Manteca

Table of Contents

I.	INTRODUCTION	1
A.	Project Overview	1
B.	Purpose of Report	1
II.	PROJECT ACCOMPLISHMENTS	3
A.	Project Overview	3
B.	Implementation Overview	4
C.	Outreach	4
D.	Conditions That Influenced Project Implementation	5
III.	MONITORING	5
A.	Growth and Survivorship	5
B.	Photo Point Monitoring	6
C.	Wildlife Monitoring and Observations	6
IV.	DISCUSSION	7
A.	Project Goal Review	7
B.	Management Recommendations	7
V.	PROJECT SUMMATION	7

List of Tables

Table 1.	Summary of project goals and objectives	1
Table 3.	Implementation summary: December 2008 to October 2009	4
Table 3.	Plant species composition and survivorship monitoring results.....	5
Table 4.	Plant height and canopy width monitoring results	6

List of Figures

Figure 1.	Location Map.....	2
Figure 2.	Plant design for the Hagemann Unit Levee Planting (M. Gilbert, 2009)	3

Appendices

Appendix A. Photo Points 2007-2009: Hagemann Unit Levee Planting

Suggested Citation:

River Partners. 2009. Final Report for the Hagemann Unit Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. C. Stevenson and J. Rentner. Modesto, California.

**2009 Final Report for the Hagemann Unit Levee Planting Project
San Joaquin River National Wildlife Refuge
Stanislaus County, California**

I. INTRODUCTION

A. Project Overview

The goal of this project is to restore dense, shrubby habitat for the state and federally - endangered riparian brush rabbit (*Sylvilagus bachmani riparius*) on 5,300 linear feet of levee side on an Army Corps of Engineers (Corps) levee on the San Joaquin River National Wildlife Refuge (Refuge, SJRNWR). This project fits into a mosaic of other riparian restoration efforts at the Refuge covering over 1,700 acres of flood-prone former agricultural fields and over 5 miles of vegetated San Joaquin River levees to date (Figure 1). This levee planting is located on US Fish and Wildlife Service (USFWS) fee title lands west of the San Joaquin River, approximately 5 miles south of Highway 132 in Stanislaus County, California.

The USFWS, in partnership with the Endangered Species Recovery Program (ESRP) began releasing captive-bred riparian brush rabbit to remnant and restored riparian habitat on the Refuge in 2003. In spring 2006, widespread flooding throughout the Refuge inundated floodplain riparian habitat for up to 4 months in some locations. Elevated areas on the Refuge that remained above water almost exclusively consisted of levees that were devoid of riparian vegetation. Post-flood surveys of riparian brush rabbits conducted by ESRP recorded high mortality due to drowning and predation of rabbits on these exposed high-ground areas. This result highlighted the need for development of more high-elevation refugia covered with dense riparian vegetation such as the Hagemann Unit Levee Planting (River Partners, 2007a). In January 2007, River Partners entered into a contract with the City of Manteca to plant approximately 5,300 linear feet of San Joaquin River levees on the Refuge to promote riparian brush rabbit dispersal and survival.

B. Purpose of Report

The purpose of this report is to document the progress of the restoration plantings over the 3-year contract period and to discuss how the goals and objectives outlined in the restoration plan have been met. Table 1 summarizes the project goals, objectives and specific considerations.

Table 1. Summary of project goals and objectives

Project Goals and Objectives
<ul style="list-style-type: none"> • Provide long, linear refugia for the riparian brush rabbit during times of flooding • Create a dense network of native vegetation to provide cover during flood events
Site Specific Considerations
<ul style="list-style-type: none"> • Integrate existing native plants into the planting composition • Use local seed sources • Establish native shrubs and native herbaceous understory for forage and ground cover

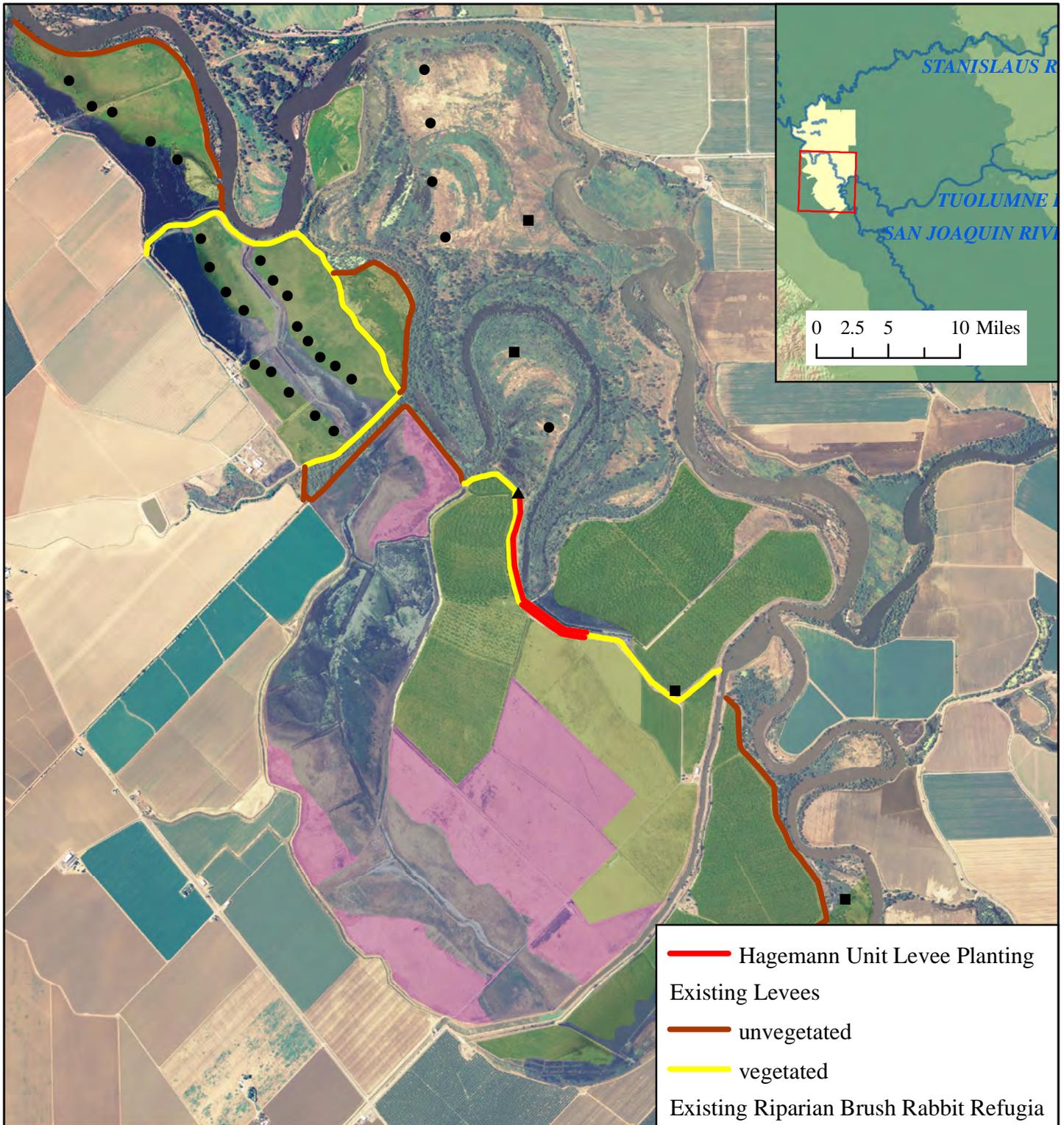
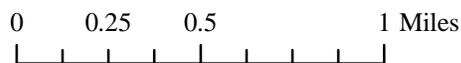


Figure 1. Location Map

San Joaquin River National Wildlife Refuge
Stanislaus County, California



Date: October 2, 2009
Source: NAIP 2005
Created by: J Rentner



- Hagemann Unit Levee Planting
- Existing Levees
- unvegetated
- vegetated
- Existing Riparian Brush Rabbit Refugia
- planted 2006
- planted 2008
- ▲ RBR release pen
- Riparian Habitat Restoration
- Restored Riparian Forest
- Restored Wetland
- Funded Restoration

This report is an important part of River Partners' active management strategy which is used to assess projects throughout the contract period. This report documents project implementation from December 2008 to September 30, 2009. Key functions of the final report are to:

- communicate implementation activities to our partners,
- document the completion of project milestones,
- present monitoring results, and
- evaluate the effectiveness of field activities.

II. PROJECT ACCOMPLISHMENTS

A. Project Overview

In 2006, River Partners met with the USFWS and the ESRP to develop plant design requirements for riparian brush rabbit refugia. Primary design considerations included:

- 1) create protected habitat quickly by planting species with dense foliage that are known to spread rapidly,
- 2) minimize plantings of tall trees which act as perches for predatory raptors,
- 3) plant shrub species that grow vertically to provide trellises for climbing species, and
- 4) protect the base of the levee from erosion by planting a band of sandbar willow as "green rip-rap" (Figure 2).

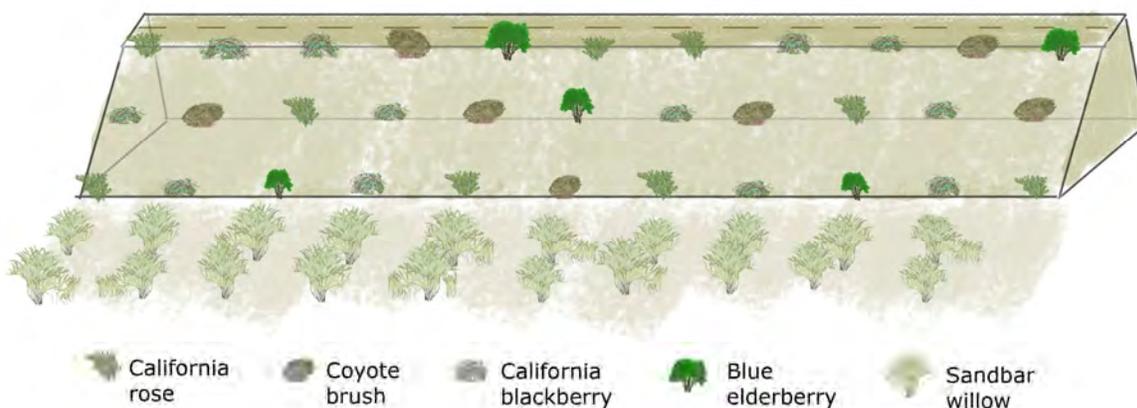


Figure 2. Plant design for the Hagemann Unit Levee Planting (M. Gilbert, 2009)

B. Implementation Overview

Woody species were planted from container stock and cuttings in the spring of 2007. Table 2 summarizes plant composition and survivorship for the project. Mugwort (*Artemisia douglasiana*) and gumplant (*Grindelia camporum*) were broadcast in the area between plantings from seed collected on-site in fall 2007 to promote weed control and understory native herbaceous community establishment. Significant stands of native herbaceous species that existed in the area were preserved where possible.

Monitoring in 2008 and 2009 recorded low survival of sandbar willow (15% and 0% respectively) on the levee slope, although overall survivorship of the planting exceeded the goal of 240 plants per 1000 feet of levee. Sandbar willow planted at the base of the levee as a green rip rap was not included in this monitoring effort and was generally very successful.

River Partners conducted maintenance (irrigation and weed control) throughout the course of the contract period. In 2009, maintenance activities focused on regular irrigation during the dry summer months and repairs to the irrigation system when necessary. Weed control was very limited during this period due to dense, native understory growth which prevented weed establishment. Maintenance details for 2007 and 2008 can be found in the annual report for those periods (River Partners, 2007b, and 2008). Table 3 summarizes activities performed during 2009.

Table 2. Implementation summary: December 2008 to October 2009

Activity	Date
Weed Control	
Minimal herbicide spot treatment of problem weeds	Dec 2008 – Oct 2009
Irrigation	
Watered with drip-line irrigation on a regular basis	April – Oct 2009
Drip line repairs	Jan-June 2009
Monitoring	
Monthly Field Inspection	Dec 2008 – Oct 2009
Permanent plot monitoring and data entry	July 2009
Photo point monitoring	Sept 2009

C. Outreach

One of River Partners goals is to build cooperative relationships with local communities, neighboring landowners, the agricultural community, educational institutions and government agencies. All work contracted by this project was performed by River Partners staff or local contractors. During 2009, this project was included in educational and fundraising tours for numerous organizations including the National Marine

Fisheries Service, the Central Valley Joint Venture, the California Native Plant Society, the San Joaquin River Partnership, and the Bureau of Reclamation.

D. Conditions That Influenced Project Implementation

No major maintenance problems occurred during 2009. Drip line hose is often chewed by wildlife and repairs are generally minimal. The herbaceous understory seeded in this project was highly successful, with great diversity in native flowering plants and few invasive weeds currently present. Maintenance activities in 2009 included very limited spot treatment of problem weeds, and it is expected that this planting will be resistant to weed invasion without future management.

Monitoring of plant survival was hindered in Year 3 by the density of plantings and the inability of project biologists to decipher the edge of the canopy of individual plants. In general, the planting has developed into a dense thicket of native riparian shrubs which provide high quality habitat for wildlife. Observed mortality was the result of shading and competition by dominant individuals, and does not indicate a performance problem.

III. MONITORING

Monitoring provides critical information that can be used to judge project performance and to determine future implementation actions. It is a key component in River Partners adaptive management strategy (River Partners, 2008). Results from seasonal monitoring are used throughout the project period to actively assess the success of the planting and to react to observed issues such as poor survivorship in a timely fashion. Monitoring protocols are designed to measure the diversity of species within the sampled population and are specific to the type of vegetative community sampled. Detailed monitoring protocols can be found in the 2008 Monitoring Program Plan for River Partners (River Partners, 2008).

A. Growth and Survivorship

A complete plant census of the Hagemann Unit Levee Planting was conducted in July 2007. In July 2008, two permanent sample plots were established. Each sample plot was 75 ft long and covered the levee slope from the road to the toe. These plots were revisited in 2009. Within each permanent sample plot, River Partners assessed plant survivorship, and the height and canopy width of each plant within the plot. Table 3 summarizes survivorship monitoring data for the entire project period. Table 4 summarizes the height and canopy width measurements from 2008 and 2009 sampling.

Table 3. Plant species composition and survivorship monitoring results

Common Name	Scientific Name	# planted	2007 census	2008 Survivorship	2009 Survivorship
California rose	<i>Rosa californica</i>	763	694	90%	83%

Common Name	Scientific Name	# planted	2007 census	2008 Survivorship	2009 Survivorship
California blackberry	<i>Rubus ursinus</i>	977	588	79%	78%
Coyote brush	<i>Baccharis pilularis</i>	544	507	100%	68%
Blue elderberry	<i>Sambucus mexicana</i>	330	275	88%	43%
Sandbar willow	<i>Salix exigua</i>	639	484	15%	0%
Total		3253	2548	78%	67%
Plants/1000 linear feet		614	481	375	322

Plants were spaced 5 feet apart along planting rows that were spaced 10 feet apart. The average canopy width for each species in 2009 was greater than 3.5 ft indicating a high degree of overlap between plants within row, and at least 70% coverage of the areas between rows on average. Coyote brush and elderberry on average are taller than rose and blackberry indicating that they are providing potential trellising opportunities as planned. Observations of plant growth on the levee show that the plant community has developed a nearly closed canopy and complex vertical structure that is important for wildlife. Representative photographs are provided in Appendix A.

Table 4. Plant height and canopy width monitoring results

Species	Average height (ft)		Average canopy width (ft)	
	2008	2009	2008	2009
California blackberry	1.8	2.5	2.8	3.9
California rose	3.3	4.3	4.0	4.1
Coyote brush	5.0	5.4	2.9	3.5
Blue elderberry	4.4	7.2	2.2	3.8
Sandbar willow	2.5	-	0.3	-

B. Photo Point Monitoring

Seven permanent photo points were established in 2007 to record changes over time on the Hagemann Unit Levee Planting. Photo points were revisited annually during the project period. All photos were shot with a 38-50-mm lens at approximately 1.5 meters above the ground. A selection of photos from all years of the project is provided in Appendix A.

C. Wildlife Monitoring and Observations

Because the planting is located immediately adjacent to other restoration plantings and along a roadside, incidental observation of wildlife by biology staff at River Partners and

partner organizations (USFWS, PRBO Conservation Science, ESRP) are numerous despite the lack of a formal wildlife monitoring program. Wildlife observed near the Hagemann Unit Levee Planting includes riparian brush rabbit, desert cottontail (*Sylvilagus audubonii*), black-tailed hare (*Lepus californicus*), California quail (*Callipepla californica*), riparian songbirds, coyote (*Canis latrans*) and a nesting turtle (species unknown).

IV. DISCUSSION

The purpose of this section is to describe how the restoration has met the project goals and to discuss any future management recommendations.

A. Project Goal Review

- 2009 plant sampling recorded an estimated 322 live plants/1000 linear feet of levee which exceeds the project goal of 240 plants/1000 feet
- Survivorship of planted species was 67%, however the coverage provided by those plants is nearly 100%
- Coverage of planted species is sufficient to provide quality habitat for the target wildlife species
- A dense and diverse native herbaceous understory was established

B. Management Recommendations

The project area has developed a dense network of native vegetation and no weeds are present on the levee slope. Irrigation was tapered off in 2009 and this project is currently self-sustaining. River Partners recommends that USFWS continue to monitor for problematic weed infestations near the planting to ensure its success in the long term.

V. PROJECT SUMMATION

The goal of this project was to develop densely vegetated high ground refuge for the endangered riparian brush rabbit and other terrestrial species. After 3 years, the plantings have created a dense network that will provide suitable long-term habitat and high ground refuge during flood events.

Wildlife is in abundance in the project area and there have been anecdotal reports that the levees are being used by the riparian brush rabbit. The project has increased connectivity between the large-scale riparian restoration efforts located on either side of the levee and added an additional mile of protected habitat which will contribute significantly to the resiliency of this population of riparian brush rabbit to flooding.

References:

- Griggs, T. 2008. California Riparian Habitat Restoration Handbook. Riparian Habitat Joint Venture and River Partners, Chico, California
- River Partners. 2007a. Effects of Long Duration Flooding on Riparian Plant Species in Restoration Plantings. San Joaquin River National Wildlife Refuge, Stanislaus County, California. L. Singleton, S. Small and T. Griggs. Modesto, California.
- River Partners. 2007b. 2007 Annual Report for the City of Manteca: Hagemann Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Lauren Singleton and Stacy Small. Modesto, California.
- River Partners. 2008. 2008 Monitoring Program for River Partners. Chico, California.
- Sacramento River Partners. 2003. 2001 & 2002 End of Season Report for the Ord Bend Unit, Sacramento River National Wildlife Refuge, Glenn County, California. Helen Swagerty. Chico, California.

Appendix A

Photo Points 2007-2009

Hagemann Unit Levee Planting: San Joaquin River National Wildlife Refuge

2007



2008



2009



2007



2008



2009



2007



2008



2009



2006



2007



2008



2009



2008 Final Report for the City of Tracy Levee Planting: Vierra Unit

*San Joaquin River National Wildlife Refuge
San Joaquin River Mile 78—88
Stanislaus County, California*

November 2008



Prepared for:
City of Tracy



1301 L St #4 Street
Modesto, CA 95354
info@riverpartners.org

Phone: (209) 521-1700
Fax: (209) 521-7327
www.riverpartners.org

TABLE OF CONTENTS

I.	INTRODUCTION.....	2
A.	Project Overview	2
B.	Purpose of Report	2
II.	PROJECT ACCOMPLISHMENTS	4
A.	City of Tracy Levee Planting Overview	4
B.	Monitoring Results.....	5
C.	Photo Point Monitoring.....	6
III.	DISCUSSION	6
A.	Analysis of Activities.....	6
B.	Management Recommendations	7

List of Tables

Table 1.	Summary of project goals, objectives, and special considerations for riparian restoration on the City of Tracy Levee Planting, Vierra Unit, SJRNWR.....	2
Table 2.	Plant species planted on the City of Tracy Levee planting.....	4
Table 3.	Activities performed for the City of Tracy Levee during the period of December 2007	5
Table 4.	End of Contract Planting Summary from the 2007 and 2008 permanent sample plot	5

List of Figures

Figure 1:	Location of the City of Tracy Levee Planting.....	3
Figure 2:	Average Height of Surveyed Plants 2007 and 2008.....	5

Appendices

Appendix 1: City of Tracy Levee Planting Photo Points: 2006-2008

Suggested citation:

River Partners. 2008. 2008 Annual Report for the City of Tracy: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Chris Stevenson. Modesto, California.

**2008 Final Report for the City of Tracy Levee Planting: Vierra Unit
San Joaquin River National Wildlife Refuge
Stanislaus County, California**

I. INTRODUCTION

A. Project Overview

In April 2006, River Partners entered into a contract with the City of Tracy to plant approximately 2,000 linear feet of abandoned Army Corps of Engineers (ACOE) levees on the San Joaquin River National Wildlife Refuge (Refuge) (Figure 1). The goal of this project was to restore dense, shrubby habitat for the state and federally endangered riparian brush rabbit and provide suitable long, linear refugia during times of flooding.

This levee planting is located within the boundary of the Vierra Unit, a large riparian and wetland habitat restoration project funded by the Department of Water Resources Flood Protection Corridor Program. In 2006, widespread flooding throughout the refuge inundated the Vierra Unit for up to 4 months. Post-flood surveys of riparian brush rabbits conducted by the Endangered Species Recovery Program (ESRP) recorded high mortality of brush rabbits, highlighting the need for high water refugia such as the City of Tracy levee planting (River Partners, 2007a).

B. Purpose of Report

This final report evaluates project progress in terms of goals, objectives, and special considerations (Table 1).

Table 1. Summary of project goals, objectives, and special considerations for riparian restoration on the City of Tracy Levee Planting, Vierra Unit, SJRNWR.

Project Goals and Objectives
<ul style="list-style-type: none"> • Provide long, linear refugia for the riparian brush rabbit during times of flooding
Site Specific Considerations
<ul style="list-style-type: none"> • Maintain any existing native plants • Use local seed sources • Establish native shrubs for maximum ground coverage • Establish native understory for forage and ground cover

This report is an important part of the adaptive management model that River Partners uses to assess projects and programs. This report documents project implementation from initiation throughout the course of the project. Key functions of the final report are to:

- Communicate implementation activities to our partners
- Document the completion of project milestones
- Present monitoring results
- Evaluate the effectiveness of field activities
- Review future management recommendations

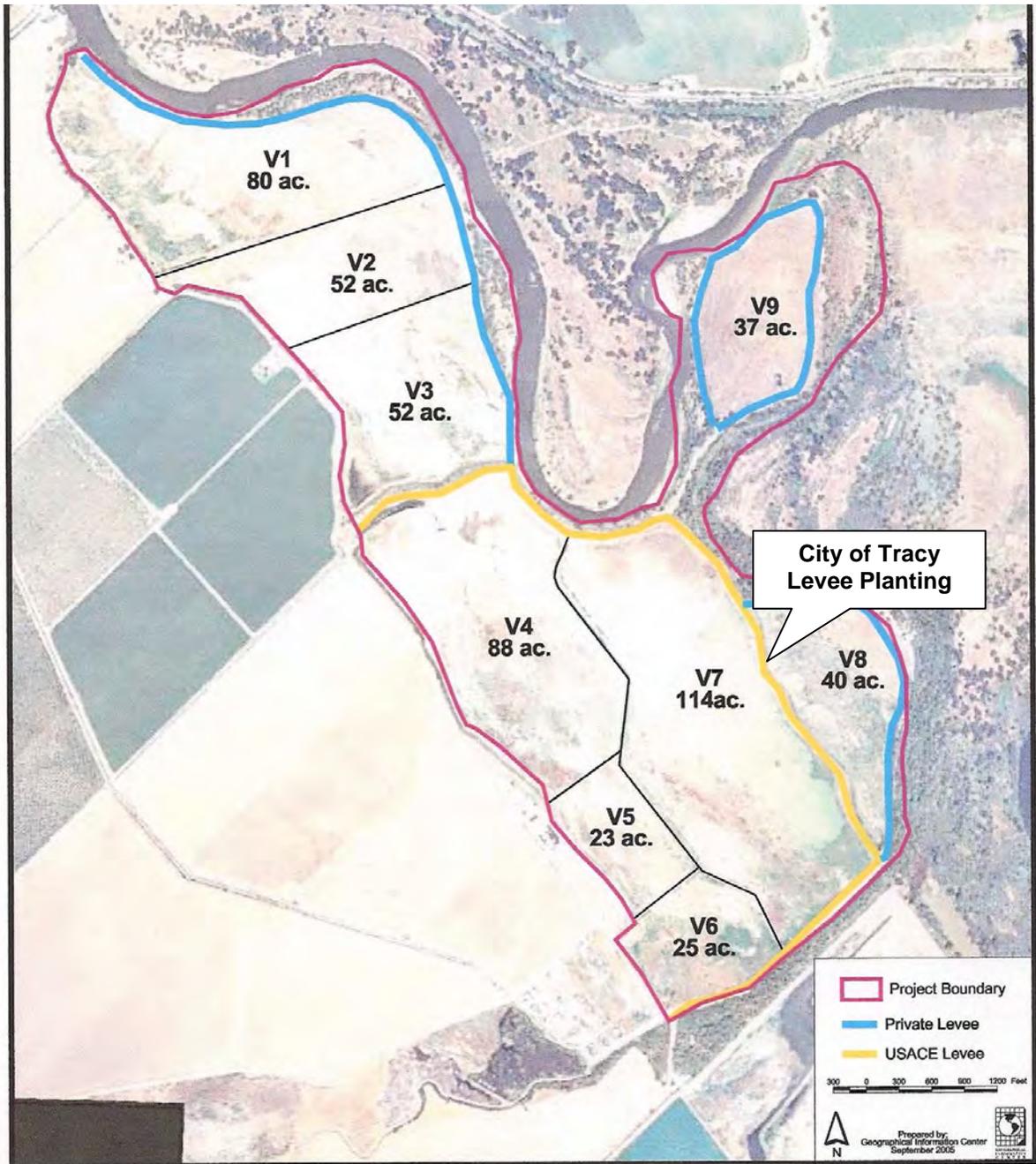


Figure 1: Location of the City of Tracy Levee Planting. The Tracy levee planting covers the outside slope of the USACE levee along Field 8 of the Vierra Unit

II. PROJECT ACCOMPLISHMENTS

A. City of Tracy Levee Planting Overview

In 2005, River Partners meet with the US Fish and Wildlife Service (USFWS) and the Endangered Species Recovery Plan (ESRP) to develop plant design requirements for suitable riparian brush rabbit refugia. Key characteristics of the planting design included planting of species along the slope of the levee which would provide dense cover for the riparian brush rabbit and selection of shrubby species which would not provide perching for predatory raptors. Three rows of plants were installed on the levee 5 ft apart. The plant composition is detailed in Table 2. The levee was planted in Spring, 2006.

Table 2. Plant species planted on the City of Tracy Levee planting.

Common Name	Scientific Name	Number Planted
California blackberry	<i>Rubus ursinus</i>	396
California rose	<i>Rosa californica</i>	308
Coyote brush	<i>Baccharis pilularis</i>	220
Blue elderberry	<i>Sambucus mexicana</i>	132
Sandbar willow	<i>Salix exigua</i>	132

Following the initial planting, the area surrounding the levee was flooded for up to 4 months (River Partners, 2007). As a result of this infrequent occurrence, there was a high mortality in the lower rows of planting. This row was replanted with sandbar willow, a flood tolerant species. The sandbar willow plantings at the base of the levees will also help buffer the levee from flood-induced erosion (Griggs, 2008).

River Partners conducted maintenance throughout the course of the contract period consisting of weed control, regular irrigation and replanting when necessary. Maintenance details for 2006 and 2007 can be found in the annual reports for those periods (River Partners, 2006 and 2007b). Table 3 outlines activities performed during 2008.

Table 3. Activities performed for the City of Tracy Levee during the period of December 2007 to November 2008.

Activity	Date
Replanting	
No replanting occurred during this period	
Weed Control	
Spray herbicide as needed	Dec 2007 – Nov 2008
Removal of weeds with hand tools as needed	Dec 2007 – Nov 2008
Irrigation	
Water with drip-line irrigation on a regular basis	Feb – Nov 2008
Drip line repairs	April 2008
Monitoring	
Monthly Field Inspection	Dec 2007 – Nov 2008
Permanent plot monitoring and data entry	July 2008
Photo point monitoring	November 2008

B. Monitoring Results

A complete survey of the levee planting was conducted in 2006. In 2007, a permanent sample plot was established. The purpose of the permanent sample plot is to record detailed information on a select group of plants over time. Within the permanent sample plot, River Partners assessed plant survivorship, the height of each plant within the plot and coverage by the planted species. The survivorship goal of this project was 50% over the course of three years. The monitoring data shows that this success criterion was met for all species. Relative coverage is calculated by dividing the absolute coverage by one species by the total cover of all species. California blackberry had the highest relative coverage of all the species planted. Relative coverage by blackberry exceeded 100 % because it covered a much larger area than the rest of the planting which skewed the calculations in favor of blackberry

Table 4. End of Contract Planting Summary from the 2007 and 2008 permanent sample plot surveys. The numbers in the table represent an average from both years.

Common Name	Scientific Name	Total Density (plants/acre)	Average Survivorship	Relative Coverage
California blackberry	<i>Rubus ursinus</i>	190	100 %	113.9 %
California rose	<i>Rosa californica</i>	85	95 %	21.9 %
Coyote brush	<i>Baccharis pilularis</i>	65	100 %	13.8 %
Blue elderberry	<i>Sambucus mexicana</i>	30	100 %	20.7 %

Figure 2 shows the average height of all planted species in 2007 and 2008. Although variation occurs throughout the levee planting, it appears that coyote brush reached its maximum height by 2007. Arroyo willow was observed in the permanent sample plot only in 2008. It is likely that these plants had recruited onto the levee the past spring.

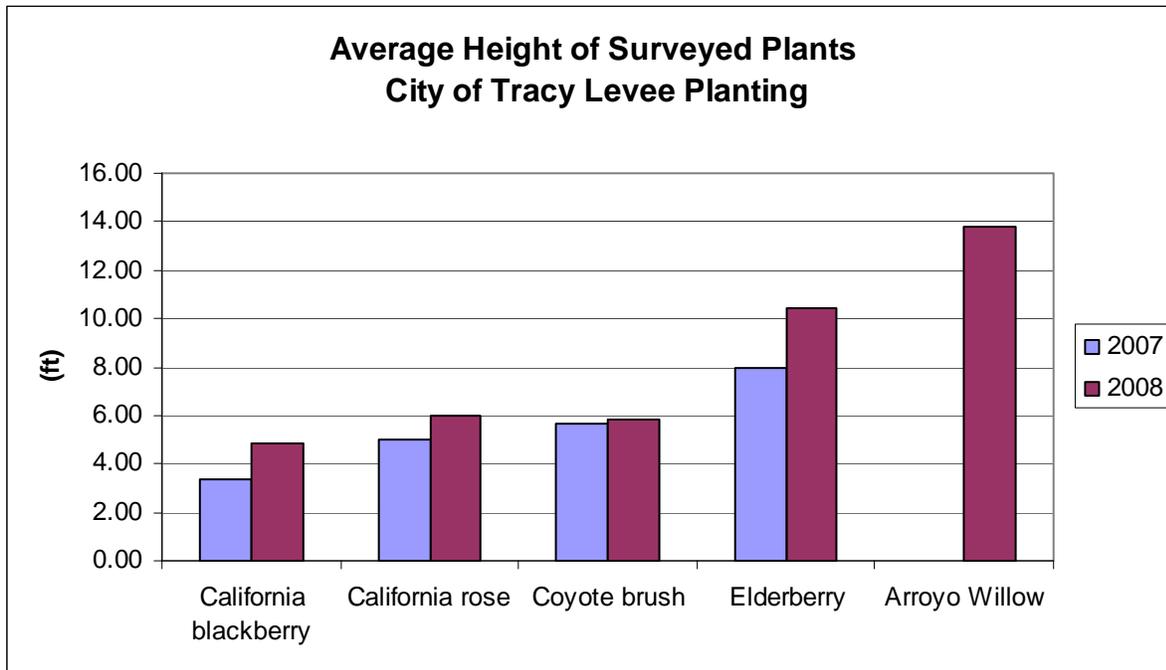


Figure 2: Average height of all surveyed plant species on the Tracy levee 2007 and 2008.

C. Photo Point Monitoring

To track project development over time, four permanent photo points were established in 2006 on the City of Tracy Levee. All photos were shot with a 38-50-mm lens. Sample photos from all years of the project are provided in Appendix A.1

III. DISCUSSION

A. Analysis of Activities

Data from the 2008 permanent plot surveys showed that survivorship exceeded 50 % for all plant species. Although the permanent sample plots only represent a portion of the total planting, comparison of survivorship between the permanent sample plot surveys and census data indicates that survival estimates from plots are within 5% of whole field census data (Sacramento River Partners, 2003). The levee plantings have developed into a dense network of vegetation. It is anticipated that this vegetation will function as natural flood refugia for the riparian brush rabbit in its current condition.

B. Management Recommendations

1. Maintenance

a) Weed and Pest Control

The restoration plantings on the City of Tracy Levee were designed to be resistant to invasive species. It is expected that the canopy cover provided by the tree and shrub plantings should provide sufficient weed control by limiting the areas available for invasion.

We do not recommend managing for insect pests within the restored areas. Aphids are ubiquitous but will not increase mortality in established vegetation. Borers, which mostly effect willows, primarily result in limb damage. In addition, the widespread use of insecticides may actually resulting secondary pest explosions as a consequence of non-target effects on predatory arthropods (Fisher et al. 1999).

b) Irrigation

Trees and shrubs are well-established on the City of Tracy Levee. Future irrigation is not required to promote establishment of the planted species.

2. Fire

Prescribed burning as a management tool is not recommended within the restored areas. Currently, the restored areas possess a high degree of both structural and species diversity with little weed pressure within the fields. Prescribed fires may reduce structural and species diversity within the restoration and open areas to invasive weeds. In an effort to reduce fire hazards, roads should be kept clear of vegetation and maintained as fire breaks to reduce both the intensity and spread of wildfires.

3. Flooding

The City of Tracy levee plantings were designed to be resistance to flooding. However, River Partners anticipates evaluating the levee plantings following any flood events as part of a routine post-flood monitoring program.

References:

Fisher, T.W., T.S. Bellows, L.E. Caltagirone, D.L. Dahlsten, C.B. Huffaker, eds. 1999. Handbook of Biological Control: Principles and Applications of Biological Control. Academic Press.

Griggs, T. 2008. California Riparian Habitat Restoration Handbook.

River Partners. 2006. 2006 Annual Report for the City of Tracy: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Tom Griggs and Sara Taylor. Modesto, California.

River Partners. 2007a. Effects of Long Duration Flooding on Riparian Plant Species in Restoration Plantings. San Joaquin River National Wildlife Refuge, Stanislaus County, California. L. Singleton, S. Small and T. Griggs. Modesto, CA.

River Partners. 2007b. 2007 Annual Report for the City of Tracy: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Lauren Singleton and Stacy Small. Modesto, California.

Sacramento River Partners. 2003. 2001 & 2002 End of Season Report for the Ord Bend Unit, Sacramento River National Wildlife Refuge, Glenn County, California. Helen Swagerty. Chico, California

Appendix A

City of Tracy Levee Planting Photo Points 2006-2008

Figure A-1: City of Tracy Levee Planting looking northwest on the Vierra Unit



2006



2007



2008

Figure A-2: City of Tracy Levee slope on the Vierra Unit



2006



2007



2008

2008 Final Report

Monier Lifetile Levee Planting: Vierra Unit

*San Joaquin River National Wildlife Refuge
San Joaquin River Mile 78—88
Stanislaus County, California*

November 2008



Prepared for:
Monier Lifetile



1301 L St #4 Street
Modesto, CA 95354
info@riverpartners.org

Phone: (209) 521-1700
Fax: (209) 521-7327
www.riverpartners.org

TABLE OF CONTENTS

I.	INTRODUCTION.....	2
A.	Project Overview	2
B.	Purpose of Report	2
II.	PROJECT ACCOMPLISHMENTS	4
A.	Monier Lifetile Levee Planting Overview	4
B.	Monitoring Results	5
C.	Photo Point Monitoring.....	6
III.	DISCUSSION	6
A.	Analysis of Activities.....	6
B.	Management Recommendations	7

List of Tables

Table 1.	Summary of project goals, objectives, and special considerations for riparian restoration on the Monier Lifetile Levee Planting, Vierra Unit, SJRNWR.,	2
Table 2.	Plant species planted on the Monier Lifetile Levee.....	4
Table 3.	Activities performed for the Monier Lifetile Levee during the period of December 2007 to November 2008.....	4
Table 4.	End of Contract Planting Summary from the 2007 and 2008 permanent sample plot	5

List of Figures

Figure 1:	Location of the Monier Lifetile Levees.....	3
Figure 2:	Average Height of Surveyed Plants 2007 and 2008.....	5

Appendices

Appendix 1: Monier Lifetile Levee Planting Photo Points: 2006-2008

Suggested citation:

River Partners. 2008. 2008 Annual Report for the Monier Lifetile: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Chris Stevenson. Modesto, California.

**2008 Final Report for the Monier Lifetile Levee Planting: Vierra Unit Restoration
San Joaquin River National Wildlife Refuge
Stanislaus County, California**

I. INTRODUCTION

A. Project Overview

On March 15, 2006, River Partners entered into a contract with the Monier Lifetile to plant approximately 1,000 linear feet of abandoned Army Corps of Engineers (ACOE) levees on the San Joaquin River National Wildlife Refuge (Refuge) (Figure 1). The goal of this project was to restore dense, shrubby habitat for the state and federally endangered riparian brush rabbit and provide suitable long, linear refugia during times of flooding.

This levee planting is located within the boundary of the Vierra Unit, a large riparian and wetland habitat restoration project funded by the Department of Water Resources Flood Protection Corridor Program. In 2006, widespread flooding throughout the refuge inundated the Vierra Unit for up to 4 months. Post-flood surveys of riparian brush rabbits conducted by the Endangered Species Recovery Program (ESRP) recorded high mortality of brush rabbits, highlighting the need for high water refugia such as the Monier Lifetile levee planting (River Partners, 2007a).

B. Purpose of Report

This final report evaluates project success in terms of goals, objectives, and special considerations (Table 1).

Table 1. Summary of project goals, objectives, and special considerations for riparian restoration on the Monier Lifetile Levee Planting, Vierra Unit, SJRNWR., .

Project Goals and Objectives
<ul style="list-style-type: none"> • Provide long, linear refugia for the riparian brush rabbit during times of flooding
Site Specific Considerations
<ul style="list-style-type: none"> • Maintain any existing native plants • Use local seed sources • Establish native shrubs for maximum ground coverage • Establish native understory for forage and ground cover

This report is an important part of the adaptive management model that River Partners uses to assess projects and programs. This report documents project implementation from throughout the course of the project. Key functions of the final report are to:

- Communicate implementation activities to our partners
- Document the completion of project milestones
- Present monitoring results
- Evaluate the effectiveness of field activities
- Review future management recommendations

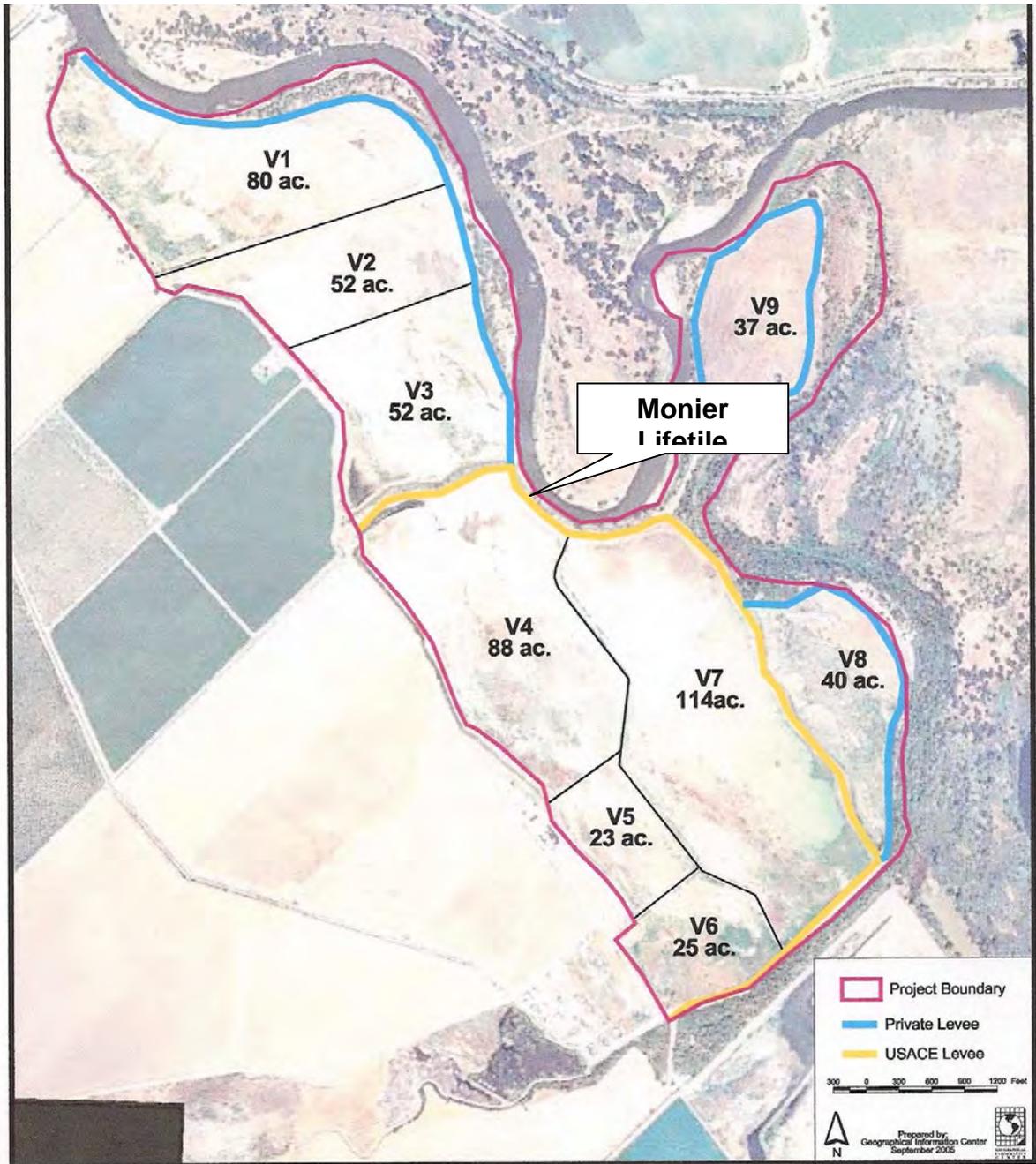


Figure 1: The Monier Lifetile planting covers the outside slope of the USACE levee just above Field 4 on the Vierra Unit

II. PROJECT ACCOMPLISHMENTS

A. Monier Lifetile Levee Planting Overview

In 2005, River Partners meet with the US Fish and Wildlife Service (USFWS) and the Endangered Species Recovery Plan (ESRP) to develop plant design requirements for proper riparian brush rabbit refugia. Key characteristics of the planting design included planting of species along the slope of the levee which would provide dense cover for the riparian brush rabbit. Three rows of plants were installed on the levee 5 ft apart. The plant composition is detailed in Table 2. The levee was planted in Spring 2006.

Table 2. Plant species planted on the Monier Lifetile Levee.

Common Name	Scientific Name	Number Planted
California blackberry	<i>Rubus ursinus</i>	207
California rose	<i>Rosa californica</i>	161
Coyote brush	<i>Baccharis pilularis</i>	115
Blue elderberry	<i>Sambucus mexicana</i>	69
Sandbar willow	<i>Salix exigua</i>	69

River Partners conducted maintenance throughout the course of the contract period consisting of weed control, regular irrigation and replanting when necessary. Maintenance details for 2006 and 2007 can be found in the annual reports for that period (River Partners 2006, 2007b). Table 3 outlines activities performed during 2008.

Table 3. Activities performed for the Monier Lifetile Levee during the period of December 2007 to November 2008.

Activity	Date
Replanting	
No replanting occurred during this period	
Weed Control	
Spray herbicide as needed	Dec 2007 – Nov 2008
Removal of weeds with hand tools as needed	Dec 2007 – Nov 2008
Irrigation	
Water with drip-line irrigation on a regular basis	Feb – Nov 2008
Drip line repairs	April 2008
Monitoring	
Monthly Field Inspection	Dec 2007 – Nov 2008
Permanent plot monitoring and data entry	July 2008
Photo point monitoring	November 2008

B. Monitoring Results

A complete survey of the levee planting was conducted in 2006. In 2007, a permanent sample plot was established. The purpose of the permanent sample plot is to record detailed information on a select group of plants over time. Within the permanent sample plot, River Partners assessed plant survivorship, the height of each plant within the plot and coverage by the planted species. The survivorship goal of this project was 50% over the course of three years. The monitoring data shows that this success criterion was met for all species with the exception of sandbar willow (Table 4). Sandbar willow survival was patchy on the levee planting. The willows at the base of the levee have done very well and have started to produce lots of recruits. Willows planted on the slope of the levee did not survive as well, likely due to the soil composition on the levee slope and water availability. Based on visual estimates of survivorship, it is anticipated that additional survey plots would record higher survival rates for sandbar willow.

Relative coverage is the average coverage of the planting area by each species. California blackberry had the highest relative coverage of the species planted (Table 4).

Table 4. End of Contract Planting Summary from the 2007 and 2008 permanent sample plot surveys. The numbers in the table represent an average from both years

Common Name	Scientific Name	Total Density (plants/acre)	Average Survivorship	Relative Coverage
California Blackberry	<i>Rubus ursinus</i>	48.6	100 %	32.2 %
California Rose	<i>Rosa californica</i>	40.5	95.5 %	18.7 %
Coyote Brush	<i>Baccharis pilularis</i>	32.4	100 %	23.5 %
Blue Elderberry	<i>Sambucus mexicana</i>	45	100 %	23.9 %
Sandbar Willow	<i>Salix exigua</i>	6	37.5 %	1.7 %

Figure 2 shows the average height for all plants recorded in the permanent sample plot in 2007 and 2008. This levee planting has started to develop structural diversity which will provide habitat for a variety of wildlife.

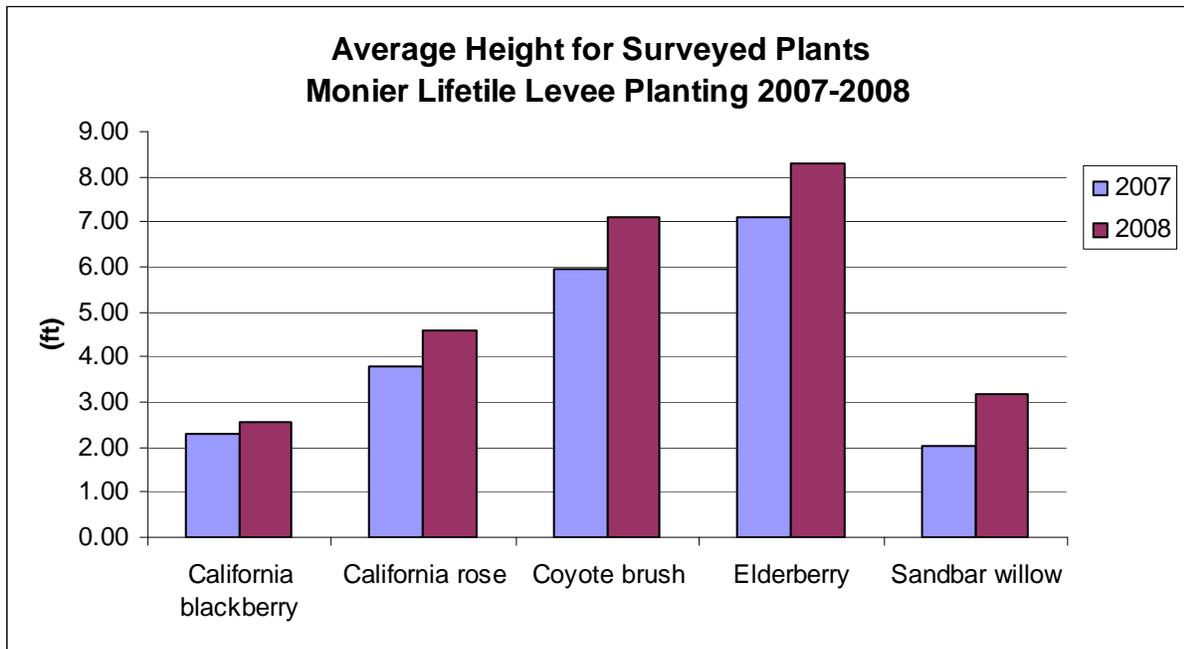


Figure 2: Average height for surveyed plants on the Monier Lifetile Levee Planting

C. Photo Point Monitoring

To track project development over time, two permanent photo points were established in 2006 on the Monier Lifetile Levee. All photos were shot with a 38-50-mm lens. Sample photos from all years of the project are provided in Appendix 1.1

III. DISCUSSION

A. Analysis of Activities

Data from the 2007 and 2008 permanent plot surveys showed that survivorship exceeded 50 % for all plant species with the exception of sandbar willow. Although the permanent sample plots only represent a portion of the total planting, comparison of survivorship between the permanent sample plot surveys and census data indicates that survival estimates from plots are within 5% of whole field census data (Sacramento River Partners, 2003)). However, permanent sample plots are randomly selected and on occasion, survivorship of plants with low densities may not be well represented by this method. The levee plantings have developed into a dense network of vegetation. It is anticipated that this vegetation will function as natural flood refugia for the riparian brush rabbit in its current condition.

B. Management Recommendations

1. Maintenance

a) Weed and Pest Control

The restoration plantings on the Monier Lifetile Levee were designed to be resistant to invasive species. It is expected that the canopy cover provided by the tree and shrub plantings should provide sufficient weed control by limiting the areas available for invasion.

Managing for insect pests within the restored areas is not recommended. Aphids are ubiquitous but will not increase mortality in established vegetation. Borers, which mostly effect willows, primarily result in limb damage. In addition, the widespread use of insecticides may actually resulting secondary pest explosions as a consequence of non-target effects on predatory arthropods (Fisher et al. 1999).

b) Irrigation

Trees and shrubs are well-established on the Monier Lifetile Levee planting. Future irrigation is not required to promote establishment of the planted species.

2. Fire

Prescribed burning as a management tool is not recommended within the restored areas. Currently, the restored areas possess a high degree of both structural and species diversity with little weed pressure within the fields. Prescribed fires may reduce structural and species diversity within the restoration and open areas to invasive weeds. In an effort to reduce fire hazards, roads should be kept clear of vegetation and maintained as fire breaks to reduce both the intensity and spread of wildfires.

3. Flooding

The Monier Lifetile levee plantings were designed to be resistant to flooding. However, River Partners anticipates evaluating the levee plantings following any flood events as part of a routine post-flood monitoring program.

References:

Fisher, T.W., T.S. Bellows, L.E. Caltagirone, D.L. Dahlsten, C.B. Huffaker, eds. 1999. Handbook of Biological Control: Principles and Applications of Biological Control. Academic Press.

Griggs, T. 2008. California Riparian Habitat Restoration Handbook.

River Partners. 2006. 2006 Annual Report for Monier Lifetile: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Tom Griggs and Sara Taylor. Modesto, California.

River Partners. 2007a. Effects of Long Duration Flooding on Riparian Plant Species in Restoration Plantings. San Joaquin River National Wildlife Refuge, Stanislaus County, California. L. Singleton, S. Small and T. Griggs. Modesto, CA.

River Partners. 2007b. 2007 Annual Report for Monier Lifetile: Vierra Unit Restoration Levee Planting, San Joaquin River National Wildlife Refuge, Stanislaus County, California. Lauren Singleton and Stacy Small. Modesto, California.

Sacramento River Partners. 2003. 2001 & 2002 End of Season Report for the Ord Bend Unit, Sacramento River National Wildlife Refuge, Glenn County, California. Helen Swagerty. Chico, California

Appendix A

Monier Lifetile Levee Planting Photo Points 2006-2008

Figure A-1: Monier Lifetile Levee Planting looking northwest



2006



2007



2008

Figure A-2: Monier Lifetile Levee slope



2006



2007



2008

Appendix B
Statement of Qualifications

River Partners

Since 1999, River Partners has restored over 6,200 acres of riparian habitat in the Sacramento and San Joaquin Valleys of California. To date, River Partners has planted over 1 million trees and worked with virtually every state and federal agency involved in riparian restoration. River Partners is a leader in the field of restoration and is continually developing new and innovative methods for large-scale floodplain restoration. We are currently engaged in restoration activities on six California rivers in eleven counties, including nine levee rehabilitation/riparian habitat restoration sites, and three mitigation sites. Our projects have brought together a wide variety of parties including private farmers, irrigation districts, drainage districts, federal and state wildlife agencies as well as NGO's under a shared vision of environmental stewardship and management.

River Partners is unique within the restoration industry in that our company provides a full service/vertically integrated product line. River Partners can provide site evaluation, restoration planning services, installation of plant materials, design and implementation of research and monitoring activities, as well as provision of long-term management. The firm owns its own agricultural equipment, and other hardware items required for habitat restoration and long-term land management. Additionally, River Partners holds a California state landscape contractor's license and is fully bonded and insured.

River Partners' adaptive management techniques incorporate an analysis of biological, anthropological and geomorphologic factors to create a management system that adapts to environmental changes over time. This adaptive management approach provides ecological and management flexibility and optimizes the end environmental result. Currently, River Partners manages approximately 2,200 acres of lands in various stages of habitat restoration. The long-term goal for all managed areas is to optimize their value in terms of habitat for native species, as well as complementing flood control management goals designed by relevant agencies.

John Carlon, President of River Partners, has worked protecting and restoring rivers in California since 1991. For six years he worked for the Nature Conservancy on their Sacramento River Project. In 1998 John and another local farmer started River Partners, which has grown to 28 full-time employees and a \$5.5 million dollar annual budget. Over the last 12 years, Mr. Carlon has overseen the implementation of over \$40 million of habitat protection and restoration in the central valley. Mr. Carlon is an advisory board member of the University of California's Biologically Integrated Farming Systems, Chair of the Riparian Habitat Joint Venture and serves as a water commissioner for Butte County.

Julie Rentner, Restoration Ecologist for River Partners, has worked on species recovery, restoration planning, and environmental permitting for over nine years. Since 2008, Ms. Rentner has worked at River Partners San Joaquin Valley office in Modesto, managing riparian restoration projects at the SJRNWR and advocating for ecologically-based riparian conservation. She has directly managed and supervised habitat restoration projects, contributed technical advice on river restoration plans and designs, participated in regional land-use planning efforts, and worked on land acquisition projects. Ms. Rentner received an M.S. in natural resources and environmental management from the University of Hawaii and a B.S. in forestry from UC Berkeley.

Stephen Sheppard, Director of Field Operations, has eight years experience restoring and managing riparian habitat in the San Joaquin Valley and Delta region for River Partners. This work includes restoration over 2,000 acres on the USFWS San Joaquin River National Wildlife Refuge. Mr. Sheppard brings to River Partners an in-depth knowledge of the local agriculture and environmental situation in the area in and around Dos Rios. Mr. Sheppard holds a B.S. in Agricultural Science from Fresno State University with a minor in Plant Science.

Endangered Species Recovery Program

California State University-Stanislaus (CalState Stanislaus) was established in 1950. CSU Stanislaus has been selected by the American Association of State Colleges & Universities selected as one of 12 universities nationwide for outstanding student retention and graduation rates. The Biological Sciences Department has 17 faculty members and both undergraduate and graduate degree programs including a Masters in Science, Ecology, and Sustainability. Scientists affiliated with this program include Dr. Matt Cover and Dr. Patrick Kelley of the Endangered Species Recovery Program (ESRP).

The ESRP was established at CSU Stanislaus in 1992, with the support of the USFWS and the Bureau of Reclamation to facilitate endangered species recovery and resolve conservation conflicts through scientifically-based recovery planning and implementation. ESRP integrates planning and implementation actions within a broadly inclusive public-private partnership to achieve an environmentally sound, economically feasible, and socially equitable product. ESRP continues to work very closely with USFWS and Reclamation, and has added additional projects partnering with other agencies and organizations. Since 2000, ESRP has maintained an active riparian mammals research group that focuses on captive breeding and reintroduction of riparian brush rabbits (RBR), and the recovery needs of riparian woodrats (RWR). Since 2002, in close cooperation with federal and state agencies, research has been conducted on a reintroduced RBR population at the Refuge (Williams et al. 2008). This collaborative effort is leading to the relatively rapid recovery of one of the most endangered mammals in the United States.