BASELINE ASSESSMENT

FOR

RIPARIAN RESTORATION

AT THE

JENSEN RESTORATION AREA

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SECTION ONE

JENSEN

RESTORATION PLANTING RECOMMENDATIONS

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Introduction

The Jensen tract is located about two miles south of Princeton, in Colusa County on the east side of the Sacramento River at river mile 161 and is owned by The Nature Conservancy. The entire tract is 105 acres in area. The Jensen Restoration Area (hereafter "Restoration Area") comprises 83 acres of the tract inside the levees and is currently an active walnut orchard. The remainder of the tract to the west consists of riparian habitat.

Mixed riparian forest on the adjacent property (Womble tract) forms the Restoration Area's northern boundary and wraps around the top third of the eastern boundary (Figures 1 and 5). The middle portion of the eastern boundary is valley wildrye grassland/valley oak woodland, and mixed riparian forest composes the bottom third. The southern border of the Restoration Area is a mature walnut orchard on the adjacent property. A narrow band of mixed riparian forest approximately 90-130 m wide within the Jensen tract, separates the Restoration Area's western boundary from the Sacramento River. There was no obvious colonization by native riparian species in the Restoration Area.

Field surveys of nearby remnant riparian vegetation, site soils and birds were conducted during May, June and July 2005, at the Restoration Area. Information on special status animals and non-native mammals for the site was also compiled during that time.

Vegetation sampling was done in the eight natural plant communities to the north, east and west of the Restoration Area, two of which are adjacent to the Restoration Area. The adjacent natural communities are: Great Valley mixed riparian forest and valley wildrye grassland/valley oak woodland. The six natural communities nearby the Restoration Area occur to the north: buttonbush scrub, Great Valley valley oak riparian forest, Great Valley willow scrub, Great Valley cottonwood riparian forest, elderberry blackberry scrub, and herbland (Figure 1). Qualitative community descriptions follow Holland (1986). With the exception of herbland, all of these communities in some form (i.e. nomenclature may differ) are on the list of California Terrestrial Natural Communities recognized by the California Natural Diversity Database (CA DFG 2003). Great Valley mixed riparian forest comprises the estimated 22 acres of native riparian vegetation within the Jensen tract. A detailed discussion of nearby remnant riparian vegetation is in Section Two.

The restoration planting recommendations are presented below with supporting vegetation and soil surveys in Sections Two and Three. The special status animal, bird counts and non-native mammal information is in Section Four.

Adjacent Landcover

The Jensen tract is adjacent to three properties. To the north and east adjacent to the Restoration Area, is the 307 acre Womble tract owned by the Wildlife Conservation Board and managed by the California Department of Fish and Game as part of their Sacramento River Wildlife Area. The remaining eastern boundary of the Restoration Area is with the Propfe property consisting of 23 acres of remnant riparian forest. To the south, adjacent to the Restoration Area is 145 acres of mature walnut orchard and riparian vegetation owned by Gaines Ranch Partnership. A dirt road separates this property from the Restoration Area along the orchard portion of the boundary. For the western 60 m of the southern boundary the mixed riparian forest on the Jensen tract continues south into the Gaines Ranch Property. The Sacramento River is the western border.

Methods

The 83-acre Restoration Area was stratified into sections based on soils, topography and geomorphology. The sections were determined from aerial photographs and soil maps, and

refined as needed upon site review. Potential plant communities were chosen for the Restoration Area utilizing the remnant riparian vegetation community descriptions and Restoration Area soil descriptions and estimated elevations (not shown), including the influence of historic channels and estimated flood frequency (Figures 1-4; Sections Two and Three). In the figures, the information on flood frequency comes from Department of Water Resources (DWR) 1997 data whereas most of the aerial photographs are from 1999 and a few are from 2005 as noted in the figure captions. Thus on occasion the two do not coincide due to changes in landform and river location between the two time periods. Furthermore the DWR estimated flood frequencies do not account for local topography and thus the estimated flood frequencies may not represent actual flooding patterns (CA DWR 2002, US ACE 1997).

Although only the flood frequencies are shown here, restoration recommendations take into account the topography data from the U.S. Army Corps of Engineers 1997 digital elevation model (DEM) with 2 foot contours. Since the error on these data is +/- 2 feet, only differences greater than 4 feet are considered real. The potential plant communities are based on Holland's riparian communities (1986). Since biodiversity enhancement is an important restoration goal, species composition of the Holland community is adjusted to reflect nearby remnant riparian plant communities and local differences in that plant community (Hubbell and Efseaff 1998).

Recommended frequencies for woody species are based on species frequency in the remnant riparian vegetation, visual dominance and biodiversity concerns (Tables 1 and 2; Peterson et al. 2003, Wood 2003). For communities where no nearby remnant vegetation data exist, data from other baseline assessments with that community were used (e.g. Hubbell et al. 1998, 1999a-d, 2003a-d) or estimates were made based on expected frequency of a species for that community. Remnant riparian woody species frequency was calculated in two ways to provide information on both species composition and distribution for recommended woody species. (1) Calculating remnant riparian woody species frequency across quadrants provides data on species composition and thus is referred to as composition frequency in this document. Within a remnant riparian community type composition frequency was calculated as: number of quadrants a species occurred in divided by total number of quadrants sampled times 100 (Table 4). Since remnant riparian vegetation composition frequencies for woody species are by one of three physiognomic classes, and recommended composition frequencies are for all woody species lumped together, then recommended composition frequencies will be 1/3 of those found in the remnant vegetation and then possibly adjusted as noted above (Table 1). For species that occurred in multiple physiognomic classes the composition frequency was totaled and then divided by three. (2) Calculating remnant riparian woody species frequency across sampling points provides data on species distribution within the community (e.g. is it clumped or ubiquitous) and thus is called distribution frequency in this document (Table 2). These data can be utilized in the details of the planting design. Within a remnant riparian community type distribution frequency was calculated as: number of points a species occurred at divided by total number of points sampled times 100 (Table 4). For recommendations of species that occurred in multiple physiognomic classes, distribution frequency was calculated across these physiognomic classes. Thus remnant vegetation distribution frequencies are more similar to recommendations.

The species composition and abundance recommendations for herbaceous species are predominantly based on local visual dominance in remnant riparian areas, ecologically-based substitutions of natives for those non-natives common in remnant areas, and biodiversity enhancement (Table 3; Peterson et al. 2003, Wood 2003). Recommendations for herbaceous species are not as precise as are those for woody species due to low occurrence of native herbs in remnant riparian vegetation as well as to the paucity of information regarding composition and abundance of the natural herbaceous layer of riparian communities. Holl and Crone's (2004)

study of herbaceous communities along a 150 km reach of the middle Sacramento River found no relationship between understory herbaceous communities and overstory dominance. Still, we were able to use Holl and Crone's data as a basis for some of the recommended herbaceous species. If there were data from both remnant riparian vegetation surveys and from Holl and Crone (2004) we used a mean of the two for the basis of our recommendations. Abundance of remnant riparian herbaceous species within a community type was calculated as mean percent cover: percent cover for a species summed over all points divided by the total number of sampling points (Table 5). Direct seeded grass species are listed without abundances. Only abundance for recommended herbaceous species composition is included here due to the limited data for distribution frequency of remnant riparian herbaceous species (Table 3).

For communities with *Salix* species (cottonwood riparian forest, mixed riparian forest, willow scrub, mule fat scrub, buttonbush scrub, blackberry scrub, rose/*Baccharis* scrub) the total recommended herbaceous species coverage is less than 100 % because this value was calculated as 100% minus the sum of mean percent cover for all the *Salix* species in that community.

Restoration Type Recommendations

Active horticultural restoration is recommended to derive the greatest habitat benefit for this Restoration Area. Direct loss of habitat is one of the primary reasons that many native species and communities of the Sacramento River ecosystem are in such critical condition. To improve the situation more habitat must be created in the short term. While restoration by natural processes provides one means of creating new terrestrial habitats, the approach has its limitations. Natural process restoration only works in a timely manner on the lowest lying areas of the floodplain where appropriate hydrogeomorphologic conditions exist. Sites where natural process restoration is appropriate are limited on the Sacramento River, as most areas are not subject to the erosional and depositional forces that foster natural recruitment events.

Active restoration is recommended even though the Restoration Area is near the main channel of the Sacramento River, is in the estimated 1-2-year floodplain, and has generally similar elevations (U.S. ACE 1997) as the adjacent remnant riparian vegetation. The northern patches of existing mixed riparian forest occurring at 70-74 feet, particularly the central patch, required over 50 years to reach their current size (patches were significantly smaller in the 1952 aerial photo (1968 Glenn County soil survey used for Womble tract) than in the 1999 aerial photo). This suggests that any natural process restoration that might occur will be too slow to develop into quality habitat in a timely manner. In addition, the higher elevation of the Restoration Area, 82-76 feet, (going west to east, away from the river) will likely preclude it from flooding to the degree required for natural process restoration to be successful. Higher floodplain lands such as found at this site will likely become infested with non-native invasive species (e.g., yellow-starthistle, Johnson grass, Bermuda grass) that will inhibit the colonization and proliferation of desirable native vegetation for the foreseeable future. Previous research along the Sacramento River has shown that even when sites are artificially flooded coincident with the dispersal of native propagules, exotic species will come to dominate (Peterson 2002). Thus active restoration of this Restoration Area would be the most efficient method to create natural habitat relatively quickly.

Restoration Planting Recommendations

The potential plant communities are shown in Figure 3 with 1999 aerial photography, whereas Figure 4 depicts the potential plant communities with 2005 aerial photography, estimated flood frequency and soil sampling locations. Composition and distribution frequencies for the recommended species within a potential plant community are in Tables 1-3. Communities

are placed in arcuate bands as much as possible to simulate the natural vegetation pattern. Along the northwest border of the Restoration Area there is a large patch of giant reed (*Arundo donax*) which should be removed to prevent its spread into either the remnant riparian vegetation or the Restoration Area.

Rose/*Baccharis* scrub and valley wildrye grassland are recommended for sections A, C, D and F due to sandy loam soils, habitat diversity, similar elevation as remnant vegetation, and occurrence in the1-2-year floodplain. Rose/*Baccharis* scrub (Keeler-Wolf and Vaghti 2000), co-dominated by California rose (*Rosa californica*) and coyote brush (*Baccharis pilularis*), is combined with valley wildrye grassland to both reflect the composition of the valley wildrye grassland /valley oak woodland found in the remnant vegetation as well as the physical factors of the Restoration Area. Rose/*Baccharis* scrub is suggested instead of valley oak woodland due to the Restoration Area being in the 1-2-year floodplain, the valley oak woodland being predominantly in the 4-year floodplain portion of the remnant vegetation, the poor tree growth as shown in the 1999 aerial photo, and to expand coyote brush habitat. Sections C and D have sandy loam soils as shown by soil sampling (e.g. sample point 5, Table 11). Sandy loam soils are coarser-textured and thus are drier soils; this is evidenced by poor vegetative cover on the 1999 aerial photo in general in these sections. Sections A and F have similar poor vegetative cover on the 1999 aerial photo indicative of equivalent soils to Sections C and D. The Rose/*Baccharis* scrub and valley wildrye grassland communities would provide structural diversity for the site and thus create different types of habitat. Sections A, C, D and F have an elevation range from 81-76 feet going west to east (away from the river; US ACE 1997). Coyote brush and blue wildrye (*Elymus glaucus* ssp. *glaucus*) are found at 78-80 feet in the valley wildrye grassland /valley oak woodland. Also, coyote brush occurs at 64-91 feet in the sampled remnant valley oak riparian forest. Although California rose was only found in the remnant mixed riparian forest (64-82 feet) the Restoration Area elevation is still appropriate for this species.

Mixed riparian forest is recommended for section B to further connect and expand the existing mixed riparian forest north and west of the Restoration Area. This section has clay loam soils, similar elevation as remnant vegetation, and is mainly within the estimated 1-2-year floodplain. The soils are generally finer-textured clay loams which overlay sandy loams in some places. These finer textured soils will be wetter and thus more likely to support a forest. This is evidenced by the better orchard growth in this section on the 1999 aerial photo. Section B has an elevation of 80 feet sloping down to 77 feet going away from the river (west to east). Mixed riparian forest generally occurs in the 1-4-year floodplains from 70 to 74 feet and 64 to 82 feet in the sampled remnant riparian vegetation to the north of the Restoration Area (US ACE 1997).

Cottonwood riparian forest is recommended for section E to expand the cottonwoods near the oxbow lake and increase habitat diversity. This community is recommended due to a higher water table, similar elevation as remnant vegetation, and occurrence in the 2-year floodplain. Cottonwood riparian forest has a different structure than mixed riparian forest and thus provides habitat diversity. The water table at the north end of the Restoration Area ranged from about 19 feet in the west to 4 feet near section E in the end of June 2005 (Table 11). Although this may be higher than typical due to the late spring early summer rains of 2005, it still suggests a higher water table near the oxbow lake, likely due to the old channel. Section E is at 76 feet, which is similar to the sampled remnant cottonwood riparian forest found from 66-76 feet in the 1-year floodplain. Although section E is in the 2-year floodplain it is adjacent to the old channel and current oxbow lake where the water table is likely higher, mitigating the less frequent flooding.

Jensen Restoration Area:
Remnant Riparian Plant Communities

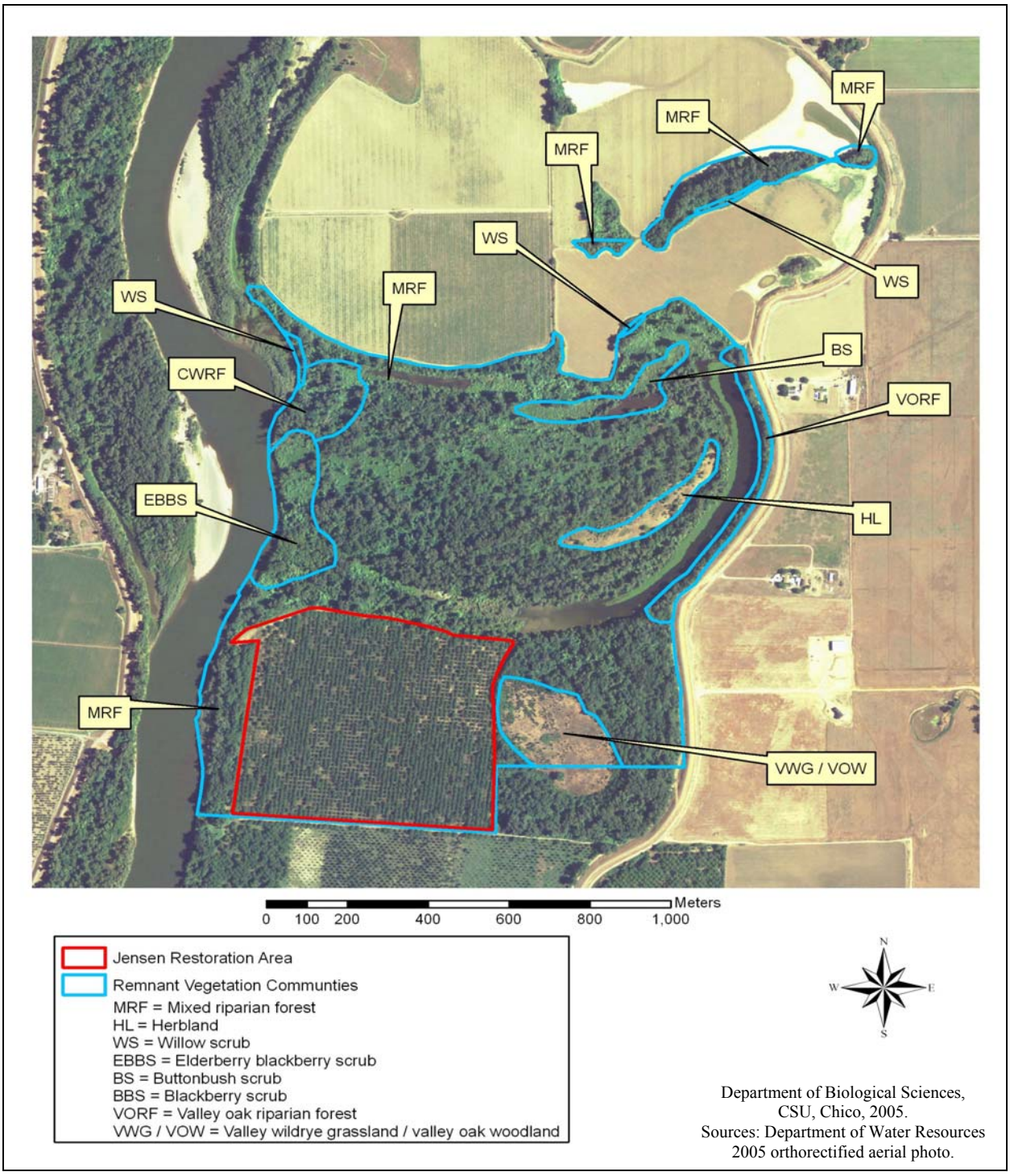

Figure 1. Remnant riparian plant communities nearby the Jensen Restoration Area, Glenn and Colusa Counties, California.

Jensen Restoration Area: Estimated Flood Frequency, Soil Sampling Locations, and Historic River Channels

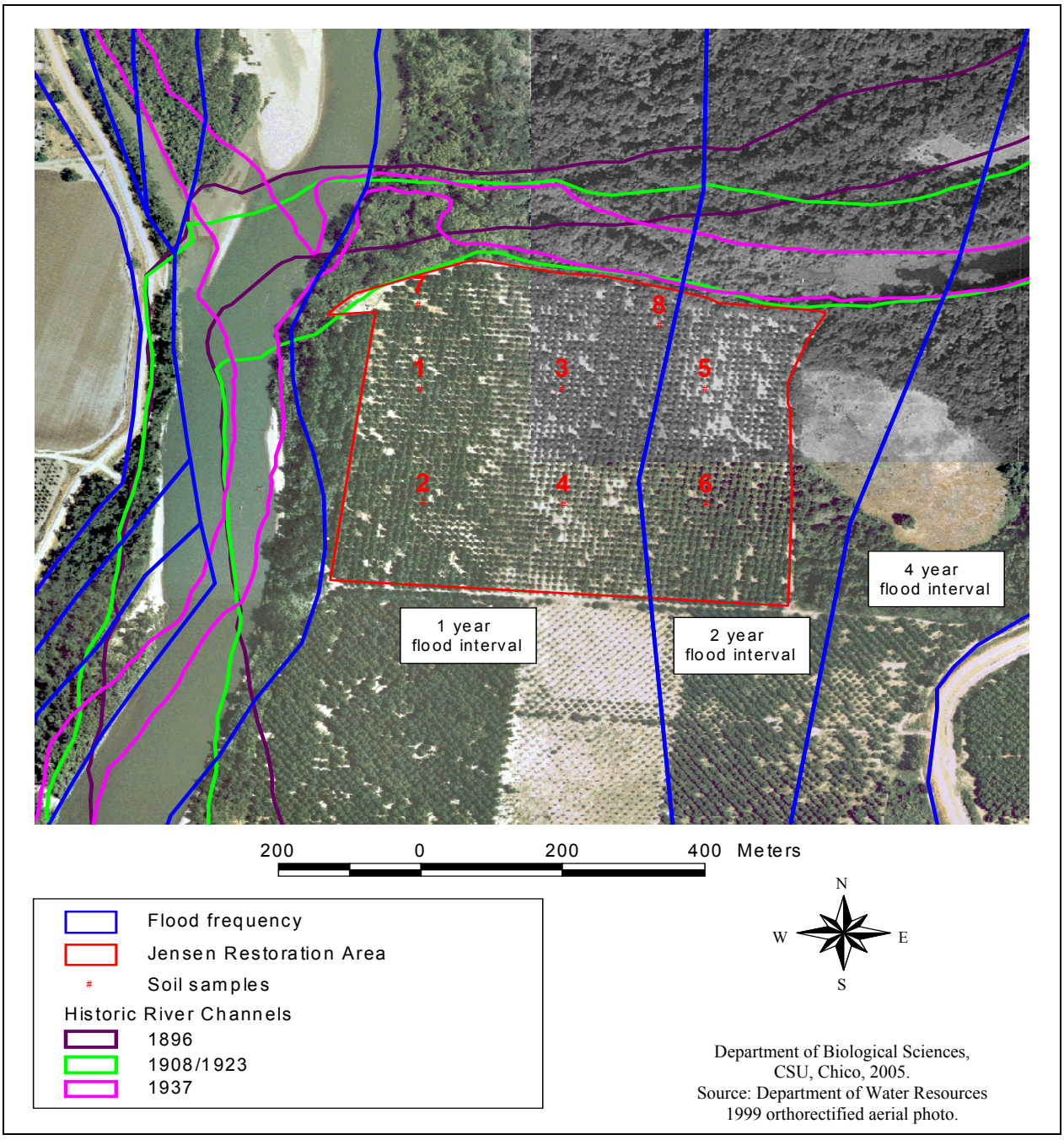

Figure 2. Estimated flood frequency, soil sampling locations, and historic river channels from 1896, 1908, 1923 and 1937 at the Jensen Restoration Area, Colusa County, California. The 1923 river channel is the same as the 1908 river channel for this stretch of the river.

Jensen Restoration Area: Potential Plant Communities

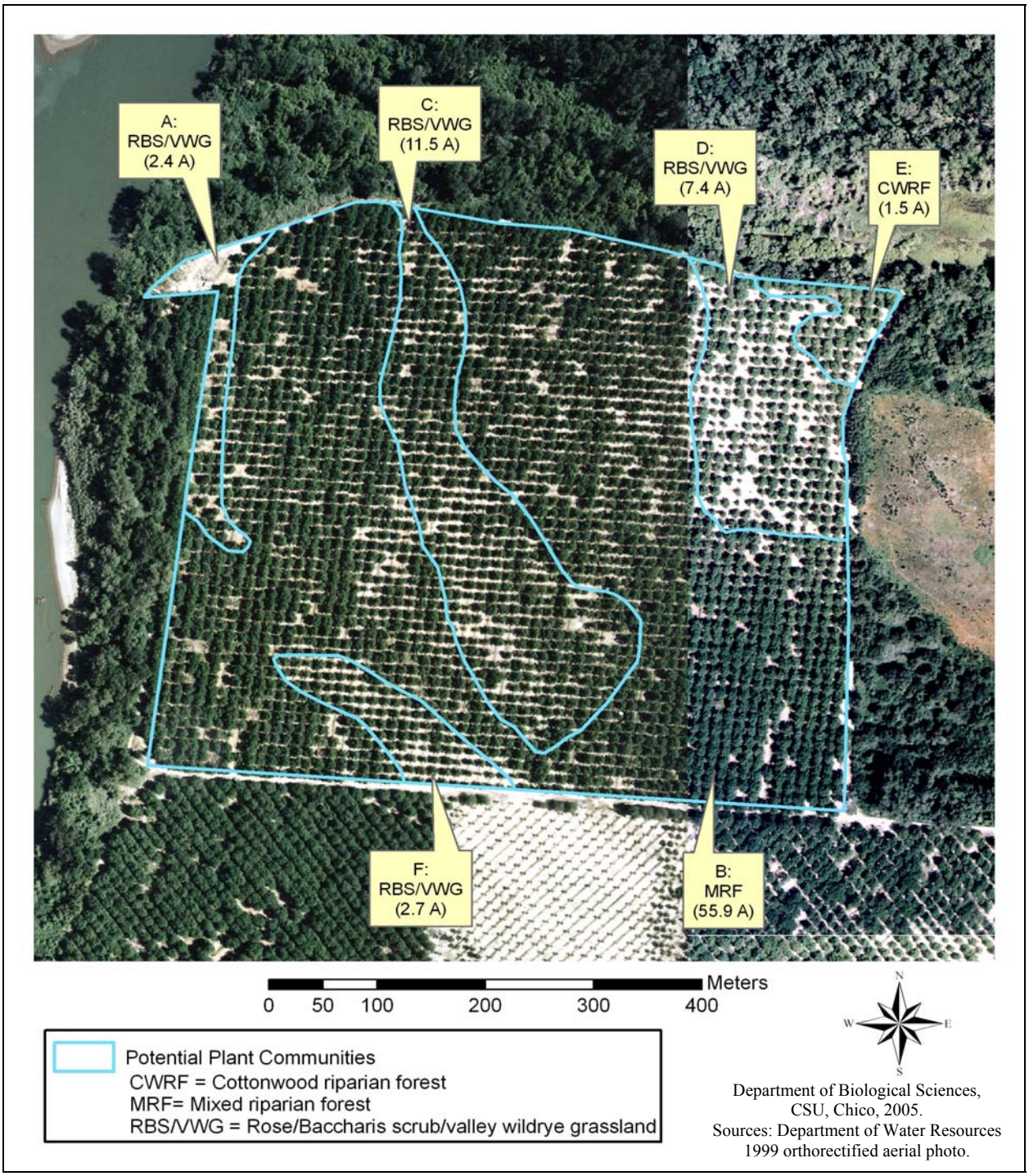

Figure 3. Potential plant communities for the Jensen Restoration Area, Colusa County, California.

Jensen Restoration Area: Estimated Flood Frequency, Soil Sampling Locations and Potential Plant Communities

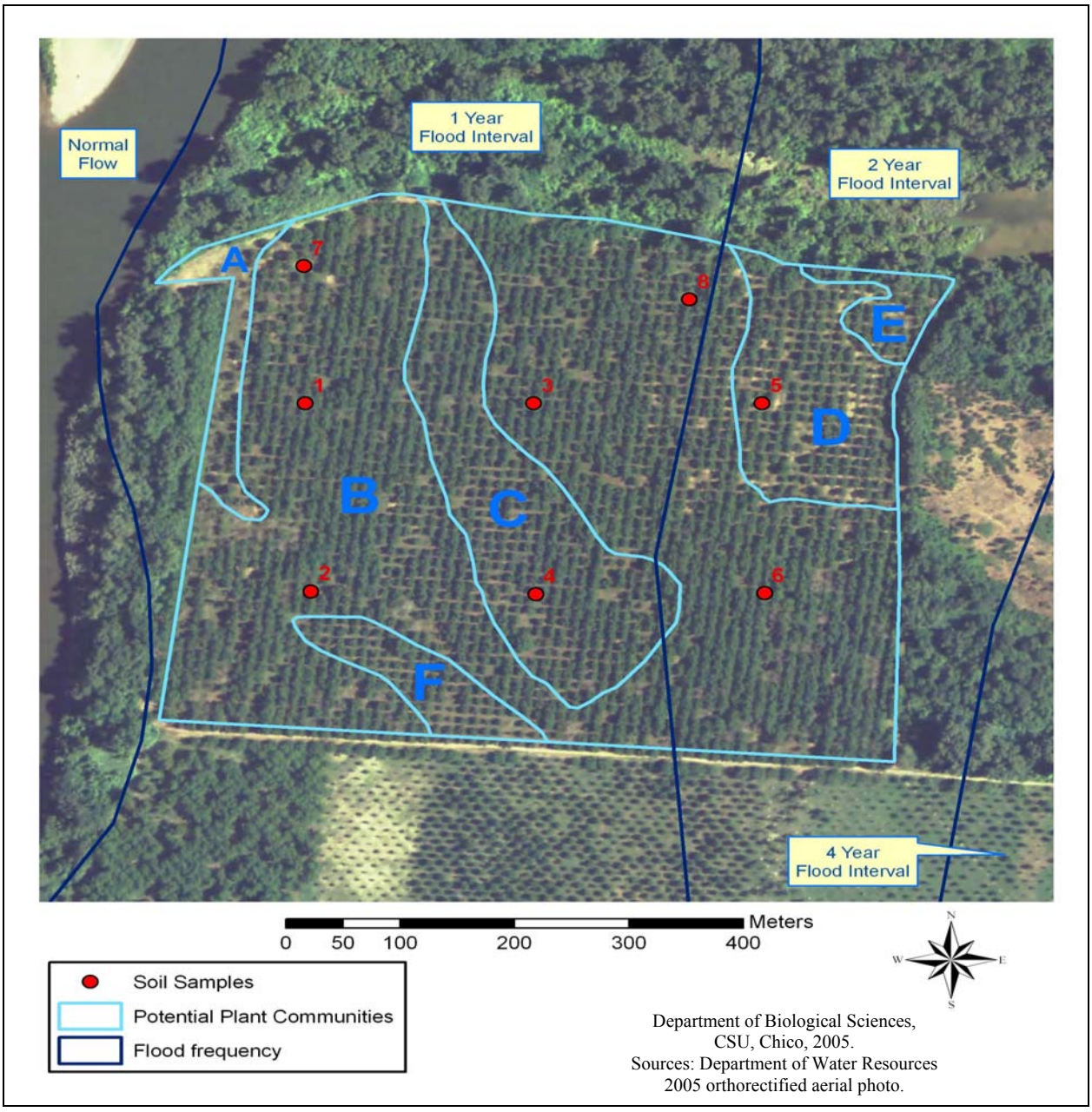

Figure 4. Estimated flood frequency, soil sampling locations, and potential plant communities at the Jensen Restoration Area, Colusa County, California. A, C, D and F are rose/*Baccharis* scrub/valley wildrye grassland (2.4, 11.5, 7.4 and 2.7 acres, respectively); B is mixed riparian forest (55.9 acres); E is cottonwood riparian forest (1.5 acres). Flood frequencies are from Department of Water Resources 1997 data; air photo is from 2005. See text for discussion of discrepancy.

Table 1. Composition frequency by community type for potential woody overstory restoration species for the Jensen Restoration Area, Colusa County, California. Remnant vegetation frequency is given by community type for those species recorded during quantitative sampling. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; VWG/VOW= Valley Wildrye Grassland/Valley Oak Woodland; RBS/VWG=Rose/*Baccharis* Scrub/Valley Wildrye Grassland. A "+" indicates observed but not sampled for that community; a blank indicates not observed. An "H" indicates a species added since listed by Holland. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Composition Frequency (%)					
		Remnant Vegetation Jensen/Womble			Jensen Recommendations		
Woody species		**MRF (n=84)**	**CWRF (n=4)**	**VWG/VOW (n=12)**	**MRF**	**CWRF**	**RBS/VWG**
box elder	*Acer negundo*	60	100		15	22	
western sycamore	*Platanus racemosa*	+			5		
Fremont cottonwood	*Populus fremontii*	20	75		11	30	
valley oak	*Quercus lobata*	7		50	7		
narrow-leaved willow	*Salix exigua*		H			4	
Goodding's black willow	*Salix gooddingii*	7	H		7	4	
arroyo willow	*Salix lasiolepis*	12	+		6	5	5
Oregon ash	*Fraxinus latifolia*	H	H		4	4	
coyote brush	*Baccharis pilularis*			92			31
California button willow	*Cephalanthus occidentalis var. californicus*	5	H		3	4	
California rose	*Rosa californica*	5			3		30
California blackberry	*Rubus ursinus*	43	25		17	9	10
blue elderberry	*Sambucus mexicana*	4			2		9
western poison oak	*Toxicodendron diversilobum*	8		H	3		5
red willow	*Salix laevigata*	H	H		2	4	
shining willow	*Salix lucida ssp. lasiandra*	H	H		2	4	
California pipevine	*Aristolochia californica*	4			2		5
virgin's bower	*Clematis ligusticifolia*	6			3		
California wild grape	*Vitis californica*	23	75		8	10	5
Total Coverage					100	100	100

Table 2. Distribution frequency by community type for potential woody overstory restoration species for the Jensen Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; RBS/VWG=Rose/*Baccharis* Scrub/Valley Wildrye Grassland. A blank indicates not observed. An "*" indicates estimated frequency for species that were recommended but not sampled within a remnant community. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Jensen Recommendations		
		Distribution Frequency (%)		
Woody Species		MRF	CWRF	RBS/VWG
box elder	*Acer negundo*	86	100	
western sycamore	*Platanus racemosa*	10*		
Fremont cottonwood	*Populus fremontii*	52	100	
valley oak	*Quercus lobata*	19		
narrow-leaved willow	*Salix exigua*		10*	
Goodding's black willow	*Salix gooddingii*	29	10*	
arroyo willow	*Salix lasiolepis*	24	10*	10*
Oregon ash	*Fraxinus latifolia*	10*	10*	
coyote brush	*Baccharis pilularis*			100
California button willow	*Cephalanthus occidentalis* var. *californicus*	10	10*	
California rose	*Rosa californica*	5		100*
California blackberry	*Rubus ursinus*	67	100	50*
blue elderberry	*Sambucus mexicana*	14		50*
western poison oak	*Toxicodendron diversilobum*	19		10*
red willow	*Salix laevigata*	10*	10*	
shining willow	*Salix lucida* ssp. *lasiandra*	10*	10*	
California pipevine	*Aristolochia californica*	10		10*
virgin's bower	*Clematis ligusticifolia*	14		
California wild grape	*Vitis californica*	62	100	10*

Table 3. Mean percent cover by community type for potential herbaceous understory restoration species at the Jensen Restoration Area, Colusa County, California. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; VWG/VOW= Valley Wildrye Grassland/Valley Oak Woodland; RBS/VWG=Rose/*Baccharis* Scrub/Valley Wildrye Grassland. Abundances in italics are from Holl and Crone (2004). A blank indicates not observed. "E" indicates species to be planted on the edge. "DS" indicates that these species will be direct seeded and thus not planted as plugs. Note that the herbaceous component is less than 100 % in communities with *Salix* species (see Methods). Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Mean Percent Cover					
		Remnant Vegetation			Jensen Recommendations		
		Jensen/Womble					
Herbaceous Species		**MRF (n=21)**	**CWRF (n=1)**	**VWG/VOW (n=3)**	**MRF**	**CWRF**	**RBS/VWG**
mugwort	*Artemisia douglasiana*	1.00	*44.60*	H	20	35	10
horseweed	*Conyza canadensis*	*0.05*			3		
fireweed	*Epilobium ciliatum*	*0.05*			3		9
goose grass	*Galium aparine*	8.00	5.00	1	8	5	1
lotus	*Lotus purshianus*	*0.05*			3		
bugleweed	*Lycopus americanus*	*0.09*	*0.10*		3	2	
nettle	*Urtica dioica*	*1.76*		H	5	5	15
western goldenrod	*Euthamia occidentalis*				10	5	15
California goldenrod	*Solidago californica*				10	5	10
hairy evening-primrose (E)	*Oenothera elata*				5	5	5
Santa Barbara sedge	*Carex barbarae*	*1.56*	*2.60*		10	13	15
clustered field sedge	*Carex praegracilis*				5	5	15
blue wildrye	*Elymus glaucus* ssp. *glaucus*	*3.49*	*0.40*	33	DS	DS	DS
creeping wildrye	*Leymus triticoides*		H	H	DS	DS	DS
meadow barley	*Hordeum brachyantherum*				DS	DS	DS
Total Coverage					85	79	95

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SECTION TWO

JENSEN

REMNANT RIPARIAN VEGETATION SURVEY

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Introduction

Remnant riparian vegetation surveys of nearby stands are used as a reference for potential vegetation communities and for determining planting recommendations in the Restoration Area.

Mixed riparian forest on the adjacent property forms the Restoration Area's northern boundary and wraps around the top third of the eastern boundary (Figure 5). The middle portion of the eastern boundary is valley wildrye grassland/valley oak woodland, and mixed riparian forest composes the bottom third. The southern border of the Restoration Area is a mature walnut orchard. A narrow band of mixed riparian forest within the Jensen tract separates the Restoration Area's western boundary from the Sacramento River.

Remnant riparian vegetation surveyed occurs on land owned by the Wildlife Conservation Board and managed by California Department of Fish and Game as part of their Sacramento River Wildlife Area (Womble tract) and on The Nature Conservancy's (TNC) Jensen tract. This remnant riparian vegetation bounds the Restoration Area to the north, east and west and extends north to the Womble Restoration Area (Figure 5). The remnant riparian vegetation on TNC's Jensen tract lies between the Sacramento River and the Restoration Area. Details of adjacent landcover can be found in Section One. The same remnant riparian vegetation was surveyed for both the Jensen and Womble Restoration Area Baseline Assessments.

Eight natural communities were found to occur nearby the Restoration Area: buttonbush scrub, Great Valley cottonwood riparian forest, elderberry blackberry scrub, valley wildrye grassland/valley oak woodland, Great Valley mixed riparian forest, Great Valley valley oak riparian forest, Great Valley willow scrub, and herbland (Figure 5). Qualitative community descriptions follow Holland (1986). With the exception of herbland, all of these communities in some form (i.e. nomenclature may differ) are on the list of California Terrestrial Natural Communities recognized by the California Natural Diversity Database (CA DFG 2003). Mixed riparian forest comprises the estimated 22 acres of native riparian vegetation within the Jensen tract.

Methods

The vegetation survey maps community types and lists the most obvious plant species for nearby remnant riparian vegetation. Community typing here is qualitative and is based on visually dominant species, overall species list and frequency data rather than complete quantified sampling for community composition. Intergradations occur for most community types in the riparian vegetation. Listing of the visually common plant species was performed during point-quarter sampling and site reconnaissance. Nomenclature follows *The Jepson Manual* (Hickman 1993). If no common name is listed in *The Jepson Manual* then Oswald and Ahart's (1994) common name was used.

Vegetation sampling was conducted during May and June 2005 in the remnant riparian vegetation located along the northern, eastern and western borders of the Restoration Area, and extending north to the Womble Restoration Area, including patches adjacent to its northern border (Figure 5). Point-quarter sampling was used to quantify frequency of woody species and abundance of herbaceous species (Barbour et al. 1999). Remnant vegetation was stratified into approximate community types using aerial photograph interpretation and GIS vegetation coverage (CA DWR 2002; not shown). Each community type was then sampled to provide enough data to confirm the community type, adjust boundaries, and describe species composition. The amount of sampling for each community is proportional to its area. In each community type within the remnant riparian vegetation at least two sampling points were established (if possible). Thirty-five sampling points, each with four quadrants, were established along several transects running roughly perpendicular to the bands of vegetation. The dense

vegetation at this site resulted in a few points being sampled very close together. For frequency of woody species, each quadrant was sampled for three types of woody species: trees, shrubs and vines. For each type of woody species, the first species encountered within each quadrant of a sampling point was recorded. Since a number of riparian woody species occur as both trees and shrubs, physiognomic criteria were used (e.g. multiple stems for shrub and diameter at breast height greater than 8 cm for trees). Thus some woody species can be listed in two categories. For abundance of herbaceous species, the percent cover of the three most visually abundant species within a 3 m radius of each sampling point was recorded.

Within each remnant riparian community type and woody species category, frequency was calculated in two ways to provide information on both woody species composition and distribution. (1) Calculating woody species frequency across quadrants provides data on species composition and thus is referred to as composition frequency in this document. Within a community type composition frequency was calculated as: number of quadrants a species occurred in divided by total number of quadrants sampled times 100 (Tables 4 and 6). These data are the basis for determining frequency of recommended species for restoration. (2) Calculating woody species frequency across sampling points provides data on species distribution within the community (e.g. is it clumped or ubiquitous) and thus is called distribution frequency in this document. These data can be utilized in the details of the planting design. Within a community type distribution frequency was calculated as: number of points a species occurred at divided by total number of points sampled times 100 (Tables 4 and 6). Abundance of herbaceous species within a community type was calculated as mean percent cover: percent cover for a species summed over all points divided by the total number of sampling points (Tables 5 and 7). Total percent herbaceous cover for a given point may sum to above or below 100% as a result of overlapping herb layers or patches of bare ground, respectively.

Species observed in the remnant riparian vegetation were divided into potential woody and herbaceous restoration species (Tables 4 and 5) and species not recommended for restoration (Tables 6 and 7). Composition and distribution frequency by community type are given for species that occurred at the sampling points. Species observed, but not quantitatively sampled, in a community type are noted by a "+" in the tables.

A search of the literature and the California Natural Diversity Database (CNDDB; CA DFG 2005) records was performed to determine potential and known occurrences of threatened and endangered plant species occurring within 1.0 mile of the Restoration Area. A separate CNDDB search was done by USGS quadrangles (7.5'series) to determine additional species with potential to occur on site. Four quadrangles were searched: Princeton, Butte City, Moulton Weir, and Sanborn Slough. An electronic copy of the CNDDB records is included on the Baseline Assessment CD.

River Channel History

The main channel of the Sacramento River scrolled across the majority of the remnant vegetation area from at least 1896 through 1946 (DWR 2002, Figures 10-12). By 1946 the main channel had moved to the western edge of the present day forests, making these forests between 59 to >109 years old. It appears the main channel did not occupy the remnant forests west and east of the Restoration Area or the patches north of the Womble Restoration Area since before 1896 (Figure 10). Therefore, these forests are potentially over 109 years old. However the northern patches of existing mixed riparian forest adjacent to the Womble Restoration Area, particularly the central patch, were significantly smaller in the 1952 aerial photo (1968 Glenn County soil survey) than in the 1999 aerial photo. Thus a portion of these stands developed over the last 50 years.

Remnant Riparian Vegetation Community Descriptions

Qualitative community descriptions follow those of Holland (1986) with approximate acreage in parentheses. Remnant riparian plant communities sampled are mapped in Figure 5. The remnant riparian vegetation that borders the Womble Restoration Area to the north consists of three patches of mixed riparian forest (10, 1, and 1 acres) primarily dominated by Fremont cottonwood (*Populus fremontii*) covered in California wild grape (*Vitis californica*) vines. There is a tree subcanopy of California black walnut (*Juglans californica*) and edible fig (*Ficus carica*) with an understory dominated by California blackberry (*Rubus ursinus*). The western patch of the three also has blue elderberry (*Sambucus mexicanus*) shrubs lining the forest edge. There is a narrow corridor of willow scrub (<1 acre) between the Womble Restoration Area and the mixed riparian forest that is composed predominantly of arroyo willow (*Salix lasiolepis*) in the eastern half and narrow-leaved willow (*Salix exigua*) in the western half. The other two patches of willow scrub are dominated by narrow-leaved willow. These small patches (<1 acre and 1 acre) are located in the remnant riparian vegetation between the Womble and Jensen Restoration Areas: one along the southern edge of the Womble Restoration Area and the other one along the Sacramento River.

The majority of the remnant riparian vegetation between the Womble and Jensen Restoration Areas consists of a mixed riparian forest (215 acres) almost surrounded by remnant oxbow and slough areas. The forest is a mosaic dominated by Fremont cottonwood and Goodding's black willow trees (*Salix gooddingii*) in some sections, and valley oak (*Quercus lobata*) and western sycamore (*Platanus racemosa*) in other sections, with an underlying subcanopy of trees in both. The subcanopy consists of a mix of box elder (*Acer negundo*), California black walnut, edible fig, and arroyo willow, with an abundance of Himalayan blackberry (*Rubus discolor*) occurring under the trees. There is a buttonbush scrub (6 acres) community in one of the seasonal slough areas composed of California button willow (*Cephalanthus occidentalis* var. *californicus*) with scattered California blackberry and California wild grape. This area was completely flooded during the initial survey but limited access for sampling occurred later as floodwaters receded. Closer to the river, there is a small stand of cottonwood riparian forest (8 acres) visually dominated by Fremont cottonwood. South of the cottonwood riparian forest, adjacent to the river, there is an elderberry blackberry scrub community (12 acres) composed primarily of large blue elderberry, sometimes single stemmed, and tall, dense Himalayan blackberry. Along the northwest border of the Restoration Area there is a large patch of giant reed (*Arundo donax*).

East of the Restoration Area there is an abandoned field that has been colonized by native grasses such as blue wildrye (*Elymus glaucus* ssp. *glaucus*), by coyote brush (*Baccharis pilularis*) shrubs, by young valley oak trees, and by some non-native forbs. In between the levee and the larger oxbow area there is a stand of valley oak riparian forest (7 acres) dominated by large valley oak trees, western poison oak (*Toxicodendron diversilobum*), and native vines. On the other side of the oxbow, within the mixed riparian forest, there is an herbland community (6 acres) that was not sampled due to access issues.

Jensen Restoration Area:
Remnant Riparian Vegetation Sampling Locations

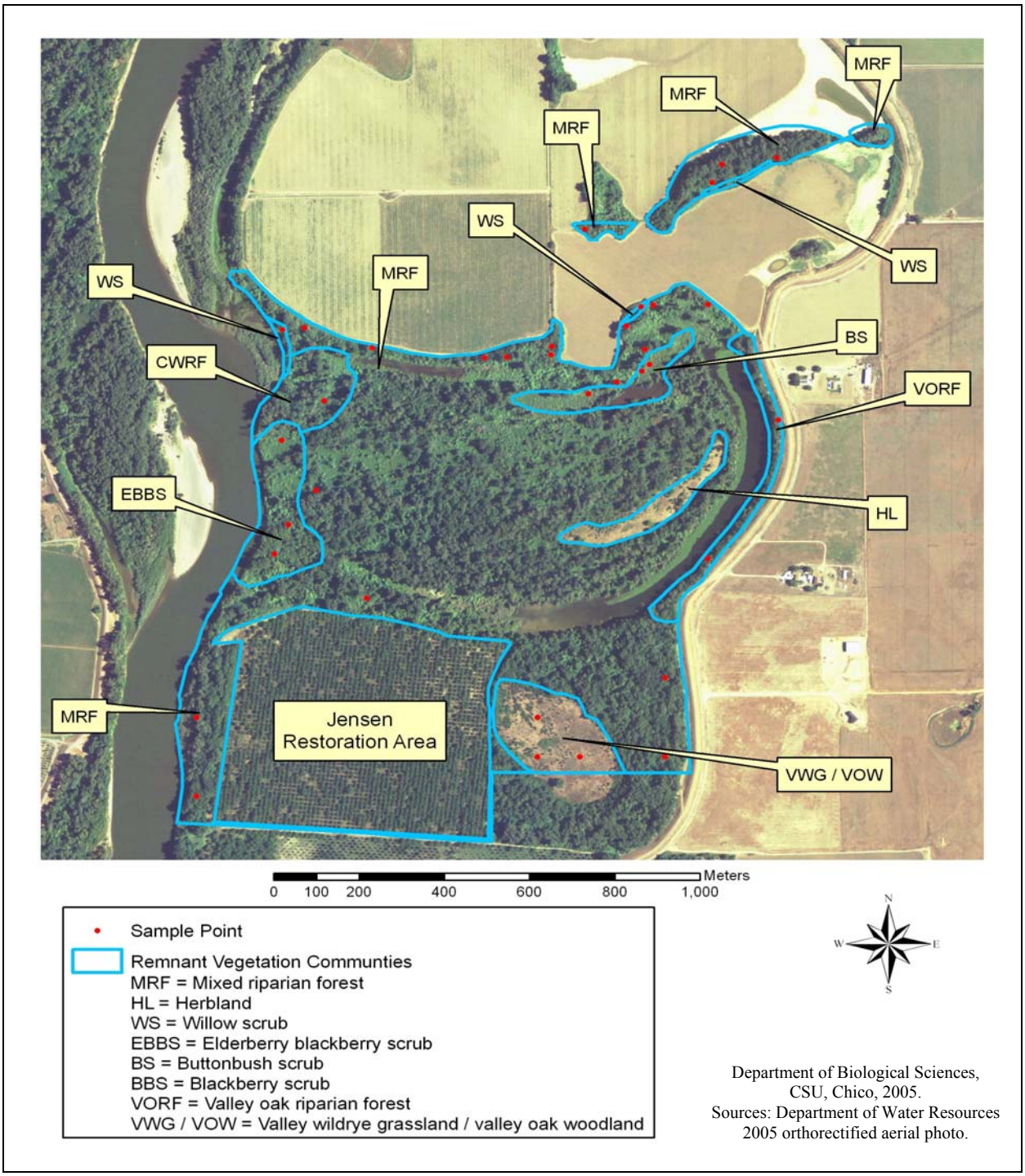

Figure 5. Remnant riparian plant communities and vegetation sampling locations within riparian plant communities close to the Jensen Restoration Area, Glenn and Colusa Counties, California.

Table 4. Composition and distribution frequencies by community type for potential native woody restoration species found in remnant riparian vegetation close to the Jensen Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (in parentheses) for composition frequency represents the number of quadrants sampled. The sample size (in parentheses) for distribution frequency represents the number of points sampled. Abbreviations are: BS=Buttonbush Scrub; CWRF=Cottonwood Riparian Forest; EBBS=Elderberry Blackberry Scrub; VWG/VOW=Valley Wildrye Grassland/Valley Oak Woodland; MRF=Mixed Riparian Forest; VORF=Valley Oak Riparian Forest**;** WS=Willow Scrub. A "+" indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	**Scientific Name**	**Composition Frequency (%)**							**Distribution Frequency (%)**						
Trees		**BS (12)**	**CWRF (4)**	**EBBS (12)**	**VWG/ VOW (12)**	**MRF (84)**	**VORF (8)**	**WS (8)**	**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**
box elder	*Acer negundo*			42		20					67		57		
western sycamore	*Platanus racemosa*					+									
Fremont cottonwood	*Populus fremontii*		75	8		20				100	33		52		
valley oak	*Quercus lobata*				50	7	75					100	19	100	
Goodding's black willow	*Salix gooddingii*					7							29		
arroyo willow	*Salix lasiolepis*		+			5							14		
blue elderberry	*Sambucus mexicanus*			33							67				
Shrubs															
box elder	*Acer negundo*		100	50		40		13		100	67		76		50
coyote brush	*Baccharis pilularis*				92		+					100			
California button willow	*Cephalanthus occidentalis* var. *californicus*	92				5			100				10		
California rose	*Rosa californica*					5							5		
narrow-leaved willow	*Salix exigua*							88							100
arroyo willow	*Salix lasiolepis*					7		+					19		
blue elderberry	*Sambucus mexicanus*					4							14		

Table 4 continued.

Common Name	Scientific Name	Composition Frequency (%)							Distribution Frequency (%)						
Shrubs continued		**BS (12)**	**CWRF (4)**	**EBBS (12)**	**VWG/ VOW (12)**	**MRF (84)**	**VORF (8)**	**WS (8)**	**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**
Western poison oak	*Toxicodendron diversilobum*					7	88						19	100	
Vines															
California pipevine	*Aristolochia californica*					4	+						10		
virgin's bower	*Clematis ligusticifolia*			8		6					33		14		
California man-root	*Marah fabaceus*			17			+				67				
California blackberry	*Rubus ursinus*	42	25	25		43	38		100	100	33		67	50	
western poison oak	*Toxicodendron diversilobum*					1	13						5	50	
California wild grape	*Vitis californica*	58	75			23	50		100	100			62	100	

Table 5. Mean percent cover and distribution frequency by community type of potential native herbaceous restoration species found in remnant riparian vegetation close to the Jensen Restoration Area, Colusa County, California. The sample size (in parentheses) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: BS=Buttonbush Scrub; CWRF=Cottonwood Riparian Forest; EBBS=Elderberry Blackberry Scrub; VWG/VOW=Valley Wildrye Grassland/Valley Oak Woodland; MRF=Mixed Riparian Forest; VORF=Valley Oak Riparian Forest**;** WS=Willow Scrub. A blank indicates not observed. Nomenclature follows *The Jepson Manua*l (Hickman 1993).

Common Name	**Scientific Name**	**Mean Cover (%)**							**Distribution Frequency (%)**						
Herbaceous		**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**	**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**
mugwort	*Artemisia douglasiana*					1		3					5		50
blue wildrye	*Elymus glaucus* ssp. *glaucus*				33							67			
goose grass	*Galium aparine*		5		1	8		15		100		33	19		50
nettle	*Urtica dioica*							1							50

Table 6. Composition and distribution frequencies by community type for woody plant species not recommended, but found in remnant riparian vegetation close to the Jensen Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (in parentheses) for composition frequency represents the number of quadrants sampled. The sample size (in parentheses) for distribution frequency represents the number of points sampled. Abbreviations are: BS=Buttonbush Scrub; CWRF=Cottonwood Riparian Forest; EBBS=Elderberry Blackberry Scrub; VWG/VOW=Valley Wildrye Grassland/Valley Oak Woodland; MRF=Mixed Riparian Forest; VORF=Valley Oak Riparian Forest**;** WS=Willow Scrub. A "+" indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manua*l (Hickman 1993).

Common Name	**Scientific Name**	**Composition Frequency (%)**							**Distribution Frequency (%)**						
Trees		**BS (12)**	**CWRF (4)**	**EBBS (12)**	**VWG/ VOW (12)**	**MRF (84)**	**VORF (8)**	**WS (8)**	**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**
tree of heaven	*Ailanthus altissima*						+								
edible fig	*Ficus carica*		+			2							10		
California black walnut	*Juglans californica*		25	17		33	25			100	33		81	100	
white mulberry	*Morus alba*					4							14		
black locust	*Robinia pseudoacacia*					+									
Shrubs															
edible fig	*Ficus carica*		+	17		5					33		19		
California black walnut	*Juglans californica*			33		24	13				33		48	50	
white mulberry	*Morus alba*	8				2			33				10		
Vines															
Himalayan blackberry	*Rubus discolor*			50	8	24	+				67	33	38		

Table 7. Mean percent cover and distribution frequency by community type for herbaceous plant species not recommended, but found in remnant riparian vegetation close to the Jensen Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (in parentheses) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: BS=Buttonbush Scrub; CWRF=Cottonwood Riparian Forest; EBBS=Elderberry Blackberry Scrub; VWG/VOW=Valley Wildrye Grassland/Valley Oak Woodland; MRF=Mixed Riparian Forest; VORF=Valley Oak Riparian Forest**;** WS=Willow Scrub. A "+" indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manua*l (Hickman 1993).

Common Name	**Scientific Name**	**Mean Cover (%)**							**Distribution Frequency (%)**						
Herbaceous		**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**	**BS (3)**	**CWRF (1)**	**EBBS (3)**	**VWG/ VOW (3)**	**MRF (21)**	**VORF (2)**	**WS (2)**
bur-chervil	*Anthriscus caucalis*					1							5		
giant reed	*Arundo donax*					+									
wild oat	*Avena fatua*						8							50	
ripgut grass	*Bromus diandrus*				2	3	13					33	10	50	
black mustard	*Brassica nigra*					2		5					5		50
soft chess	*Bromus hordeaceus*				20							33			
yelllow star-thistle	*Centaurea solstitialis*				17							33			
bull thistle	*Cirsium vulgare*				1							33			
grass	Grass sp.							1							50
jointed charlock	*Raphanus raphanistrum*				15							67			
cocklebur	*Xanthium strumarium*	+													

Special-status Plant Species

Information about known and potential occurrences of special-status plant species was obtained from the California Natural Diversity Database (CNDDB; CA DFG 2005). Based on the quadrangle search of the CNDDB, five species were initially identified to potentially occur within 1 mile of the Restoration Area (Table 8). Based on distribution, elevation, and habitat requirements, one of these species was determined to be unlikely to occur. Of the four species with potential to occur, no known occurrences were found within 1.0 mile of the Restoration Area.

Table 8. Special-status plant species potentially occurring within 1.0 mile of the Jensen Restoration Area, Colusa County, California. FE=federally listed as endangered; FT=federally listed as threatened; CE=California state listed as endangered; CNPS=California Native Plant Society, 1B=rare, threatened or endangered in California and elsewhere, 2=rare in California but more common elsewhere, 3=need more information, 4=plants of limited distribution; a watch list. Habitat descriptions were adapted from CNPS (2004).

Scientific Name	Common Name	Habitat	Status	Potential to Occur
Astragalus tener var. *ferrisiae*	Ferris's milk-fetch	Meadows and seeps (vernally mesic), valley and foothill grassland (subalkaline flats); elevation 5-75 meters.	CNPS 1B	May occur. No known occurrences within 1 mile of the restoration area.
Atriplex depressa	brittlescale	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland, vernal pools/alkaline, clay; elevation 1-320 meters.	CNPS 1B	May occur. No known occurrences within 1 mile of the restoration area.
Cordylanthus palmatus	palmate-bracted bird's-beak	Chenopod scrub, valley and foothill grassland (alkaline); elevation 5-155 meters.	FE, CE, CNPS 1B	May occur. No known occurrences within 1 mile of the restoration area. Known from only nine occurrences.
Hibiscus lasiocarpus	rose-mallow	Marshes and swamps (freshwater); elevation 0-120 meters.	CNPS 2	May occur. No known occurrences within 1 mile of the restoration area.
Neostapfia colusana	Colusa grass	Vernal pools (adobe); elevation 5-200 meters.	FT, CE, CNPS 1B	Unlikely to occur due to the lack of suitable habitat. No known occurrences within 1.0 mile of the restoration area.

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SECTION THREE

JENSEN

SOIL SURVEY

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Introduction

A survey of Restoration Area soils is used to document existing conditions for plant growth and thus guide the restoration planting recommendations. Information on soil texture and depth to water table gathered from auger holes across the Restoration Area is used to match specific locations with appropriate plant community types.

The Jensen tract is located about 1.25 miles south of Princeton in Colusa County at river mile 161 and is owned by The Nature Conservancy. The Restoration Area is approximately 83 acres of the tract inside the levees on the east side of the Sacramento River. Currently the Restoration Area is a walnut orchard.

Methods

Soil data were gathered from augering 8 holes by hand across the Restoration Area during May and June 2005. These 8 holes were located on a grid at approximately 150-200 m intervals (Figures 2, 4 and 9). Initially a grid with holes 200 m apart was laid out on the Restoration Area, resulting in 6 holes. Two additional holes were added to meet the minimum of 5 holes per/Restoration Area, or 1 hole/10 acres in order to give an accurate representation of soils across the Restoration Area. Textural analysis was done following the Natural Resource Conservation Service's (NRCS) texture-by-feel method at one-foot increments (Table 9; Schoeneberger et al. 2002). In addition, depth to refusal (gravel, water table or unconsolidated sand) was noted for each sample location along with any unique characteristics. Soil locations were classified into deep and shallow based on NRCS soil survey standards (Table 10; Schoeneberger et al. 2002).

Table 9. Natural Resource Conservation Service's soil texture classification.

Texture	% Sand
Silt	0-20
Silt loam	20-35
Sandy silt loam	35-50
Sandy loam	50-70
Loamy sand	70-85
Sand	85-100

Table 10. Natural Resource Conservation Service's soil depth classification.

Depth class	Depth (inches)
Very Shallow	0-10
Shallow	10-20
Moderately Deep	20-40
Deep	40-60
Very Deep	>60

Soils Description

The Restoration Area is generally dominated by clay loams overlaying sandy loams. This generally differs from the historic soil surveys of Oroville Area (1926), Colusa County (1948 and 1967) and the current 1998 soil survey of Colusa County (Figures 6-9). In general the historic soil surveys map the Restoration Area as a type of Columbia loam. The 1926 Oroville Area historic soil survey, which included small portions of Glenn and Colusa Counties, delineates the Restoration Area as Columbia loam. In the 1948 and 1967 Colusa County historic surveys the Restoration Area soils are described as Columbia loam (USDA 1948) and Columbia association with fine sandy loam textures (USDA 1967). The 1998 Colusa County soil survey describes the soils as Vina loam (USDA 1998). The auger hole soil textures are generally finer textured clay loams over coarser textured sandy loams than the soils described in the surveys above. The soil auger data are most similar to the Columbia Association designation (USDA 1967) since some sandy loams are found at depth. Table 11 gives the auger hole data and Table 12 lists comments (if any) for each hole. Surface textures across the site are primarily clay loams with a few auger holes containing sandy clay loam. These courser-textured surface soils occur in a L-shaped polygon starting in the center of the Restoration Area that goes south and then east encompassing soil sample points 3, 4 and 6 (Figure 9; Table 11). Interestingly, neither this coarser-textured pattern is repeated in the subsurface profiles of these sampling points nor is there any obvious subsoil pattern across the Restoration Area. The profiles of sampling points 2 (southwest corner), 5 and 8 (northeast corner) are more homogeneous than the rest of the auger holes; perhaps indicative of being on the edge of old channels. Auger holes 1 and 7 (northwest corner) are loams of varying coarseness with a clay layer. The clay layer suggests that these may lie in an old channel. Auger holes 3 and 6 (center and southeast corner, respectively) are dominated by clay loams of varying coarseness and finally sample point 4 (center south) is dominated by clay loam over sandy loam. Most of the Restoration Area has very deep soils with refusal from 4 to 18.75 feet.

The Restoration Area soils are typical of active floodplain soils where stratification from various flooding events is still quite evident but a uniform fining upward sequence (where coarser material is found at depth and finer textures make up the upper layers of the profile) has yet to occur. A uniform fining upward sequence is more typical of alluvial soils further from the active channel (Andrew Conlin Pers. Comm., 2003). The soil auger holes tend to fall into three groups: one that has a uniform fining upward sequence (e.g. hole 5); one where there is a series of fining upward sequences (e.g. hole 1) and one with series of fining upward sequences but other layers above and below them (hole 6). The profiles of sampling points 2 (southwest corner), 5 and 8 (northeast corner) have the single fining upward sequence typical of floodplain deposits. The second group, composed of auger holes 1, 3, 4 and 7, has 2 or 3 fining upward sequences indicative of channel deposits. Also, auger holes 1 and 7 (northwest corner) are loams of varying coarseness with a clay layer. Finally auger hole 6 has coarser-textured layers (sandy and silty clay loam) over its fining upward sequences which overlay clay loam suggesting some sort of channel deposit. Despite the indication of channel deposits for two of the groups (5 sampling points) there has been no scrolling across the Restoration Area since before 1896 (Table 11; Figures 6, 10-12; DWR 2002, USDA 1926). However, the 1908, 1923 main channels and the 1937 side channel (Boggs Bend) of the Sacramento River were on the northern border of the Restoration Area. Sometime between 1923 and 1926 a new main channel had formed to the west through a channel avulsion making Boggs Bend a side channel that flowed along the northern edge of the Restoration Area. By 1935 Boggs Bend had shrunk such that it flowed north of the Restoration Area and by 1946 Boggs Bend no longer carried regular flow. Note that in

1937 the Boggs Bend channel was again flowing along the eastern portion of the Restoration Area's northern border.

The Restoration Area has deep to very deep soils with refusal at the water table at all sampling locations. Tree canopy reflects this well with good coverage across the site. The water table was reached between 12.5 and 15.5 feet during May 2005 sampling of points 1-6 and between 4 and 18.75 feet during June 2005 sampling of points 7 and 8. The water table tended to get higher as one goes from west to east across the Restoration Area reflecting the approximate 5 foot drop in elevation from west to east (US ACE 1997). The high water table in the north (hole 8) deviates from this pattern but is likely due to its proximity to the current oxbow lake and historic channel. A particularly wet spring and early summer occurred in 2005 and thus the water table may have been more elevated than in a typical year.

Four of the sampling locations had reduced oxygen characteristics (redox features) at depths ranging from 5 to 11 feet. Redox features represent soil horizons influenced by saturated conditions for extended periods of time throughout the year. These conditions would be expected in soils that are adjacent to present channels, overflow channels, or sloughs, or in the annual floodplain and in historic buried channels, which may then act as a channel for the underground flow of water. The occurrence of redox features in the 2 northwestern auger holes (1 and 7) is expected due to their proximity to the current and historic channels and due to the presence of a clay layer adjacent to or within which the redox features occurred (Tables 11 and 12). The clay layer has greater water retention capacity and thus more prone to redox features. The redox features for soil points 4 and 6 occur in the clay portions of their profiles as well.

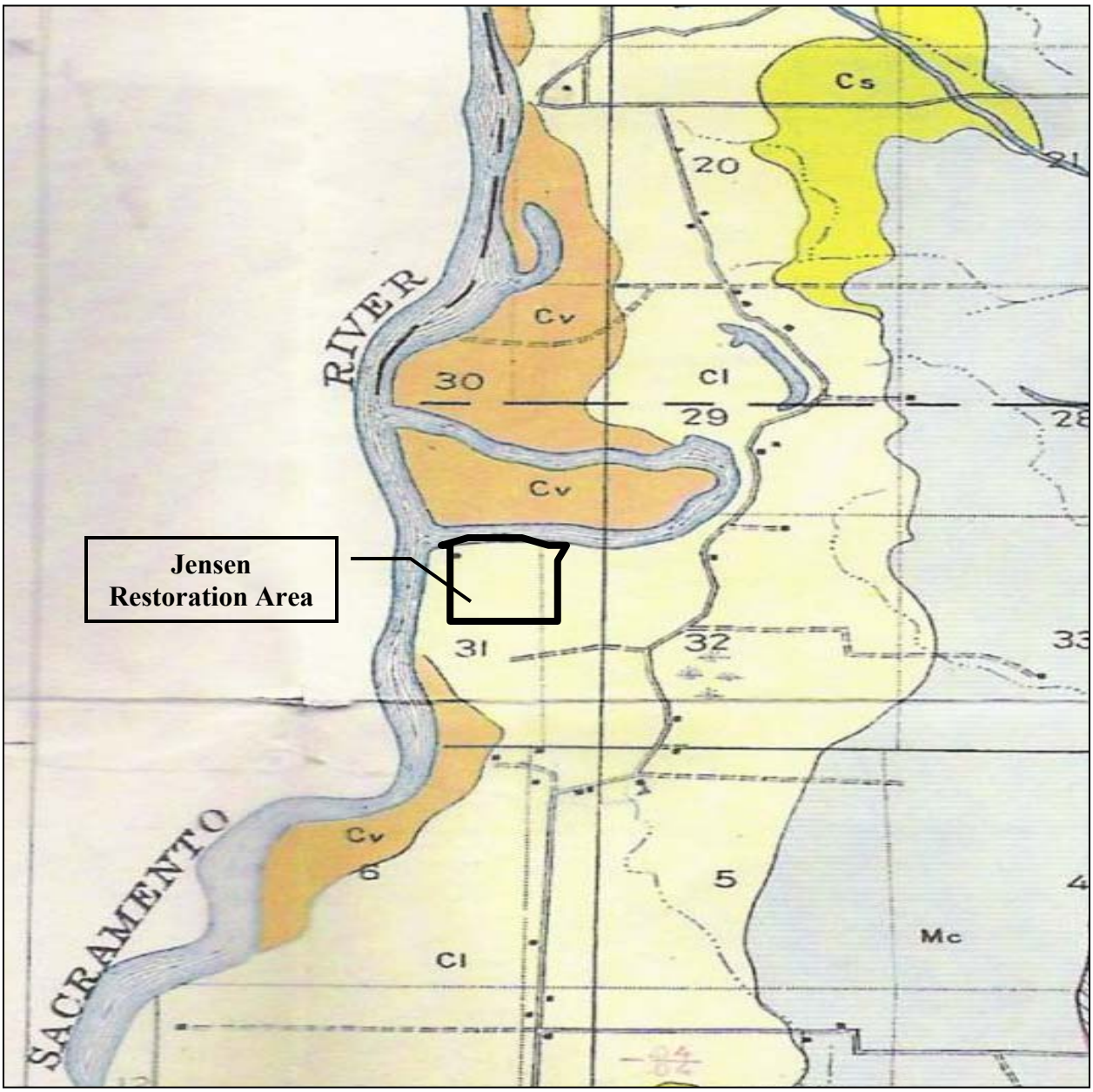
Table 11. Soil texture by depth from auger holes across the Jensen Restoration Area, Colusa County, California. For comments, see Table 12.

Date Sampled	5/31/2005	5/31/2005	5/31/2005	5/31/2005	5/31/2005	5/31/2005	6/22/2005	6/22/2005
Point	1	2	3	4	5	6	7	8
Surface	Clay Loam	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam
1 ft	Clay Loam	Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay Loam
2 ft	Clay Loam	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Silty Clay Loam	Clay Loam	Clay Loam
3 ft	Silty Clay	Clay Loam	Silty Clay Loam	Sandy Clay Loam	Clay Loam	Silty Clay Loam	Sandy Loam	Sandy Clay Loam
4 ft	Silty Clay	Loam/Clay Loam	Silty Clay Loam	Clay Loam	Loam	Clay Loam	Clay Loam	
5 ft	Silty Clay	Sandy Loam	Silty Clay Loam	Clay Loam	Sandy Loam	Clay Loam	Clay	
6 ft	Clay Loam	Sandy Loam	Silty Clay Loam	Clay Loam	Sandy Loam	Clay Loam	Clay	
7 ft	Loam	Sandy Loam	Silty Clay Loam	Clay Loam	Sandy Loam	Silty Clay Loam	Clay	
8 ft	Loam	Sandy Loam	Clay Loam	Sandy Clay Loam	Sandy Loam	Clay Loam	Clay	
9 ft	Loam	Sandy Loam	Sandy Clay Loam	Loamy Sand	Sandy Loam	Silty Clay Loam	Clay	
10 ft	Sandy Loam	Sandy Loam	Silty Loam	Loamy Sand	Sandy Loam	Clay Loam	Clay Loam	
11 ft	Sandy Loam	Sandy Loam	Sandy Clay Loam	Sandy Loam	Sandy Loam	Clay Loam	Sandy Clay Loam	
12 ft	Sandy Loam	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Clay Loam	Sandy Clay Loam	
13 ft	Sandy Loam	Sandy Loam	Loamy Sand	Loamy Sand	Loamy Sand		Sandy Clay Loam	
14 ft	Sandy Loam	Sandy Clay Loam					Sandy Loam	
15 ft		Sandy Loam					Loamy Sand	
16 ft							Sandy Loam	
17 ft							Sandy Loam	
18 ft							Loamy Sand	
Total	14 ft 6 in	15 ft 6 in	13 ft 6 in	13 ft 6 in	13 ft 6 in	12 ft 6 in	18 ft 9 in	4 ft
Refusal	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation

Table 12. Soil auger hole comments for the Jensen Restoration Area, Colusa County, California. Reduced oxygen conditions are noted as mottling. Extreme anaerobic conditions are noted as gleying or gleyed layers.

Hole #1- Mottling at 6 ft.
Hole #2- No comments.
Hole #3- No comments.
Hole #4- Mottling at 6 ft.
Hole #5- No comments.
Hole #6- Mottling at 5 ft, 7 ft, 10 ft, and 11 ft.
Hole #7- Red and black mottling at 7 ft.
Hole #8- No comments.

Jensen Restoration Area:
1926 Soil Series

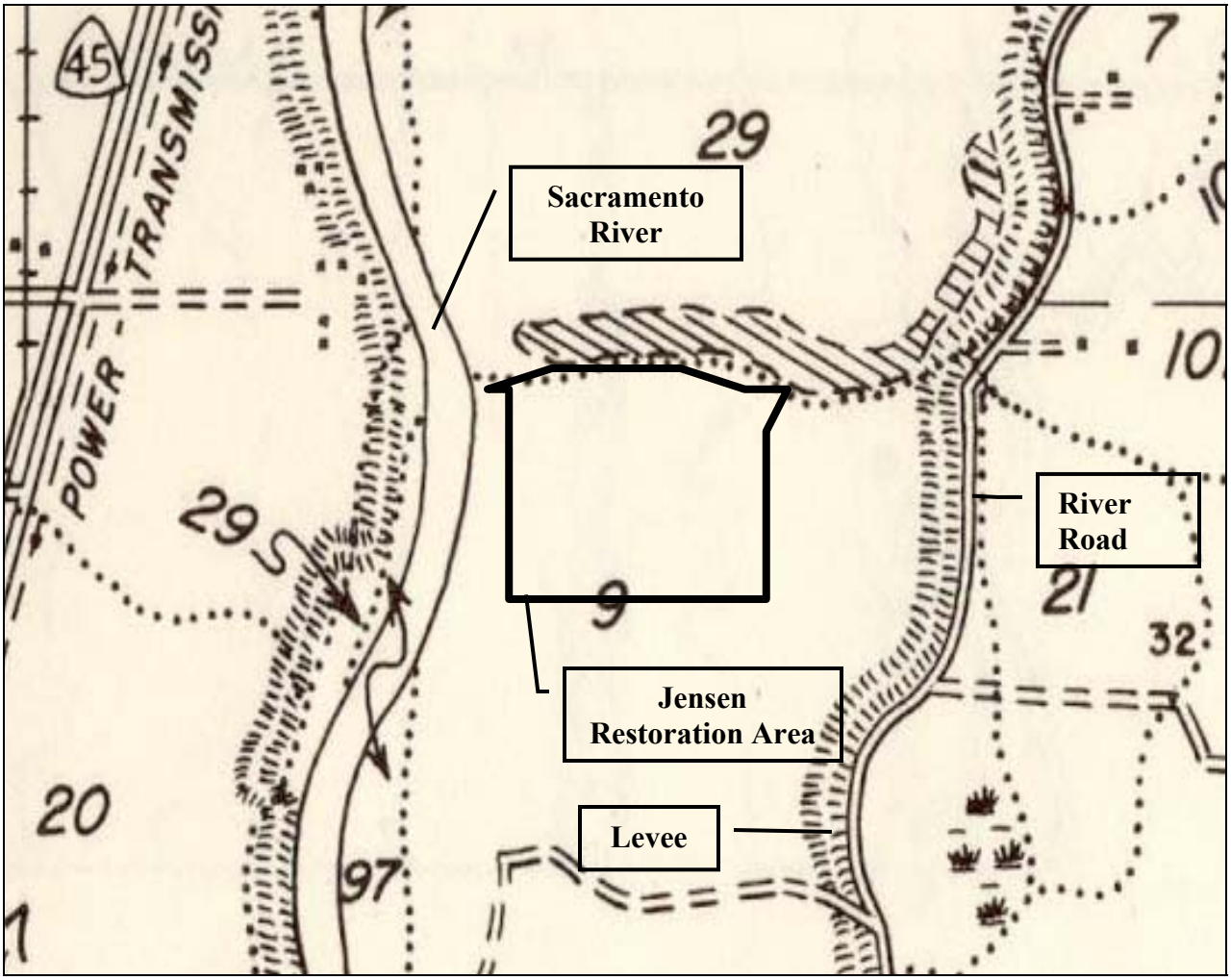


Cl= Columbia loam
Cv= Columbia very fine sandy loam

1 mile= approximately 2 inches

Figure 6. Approximate boundary and location of the Jensen Restoration Area on the 1926 Soil Survey map, Oroville Area, California (USDA Bureau of Soils), Colusa County, California.

Jensen Restoration Area:
1948 Soil Series

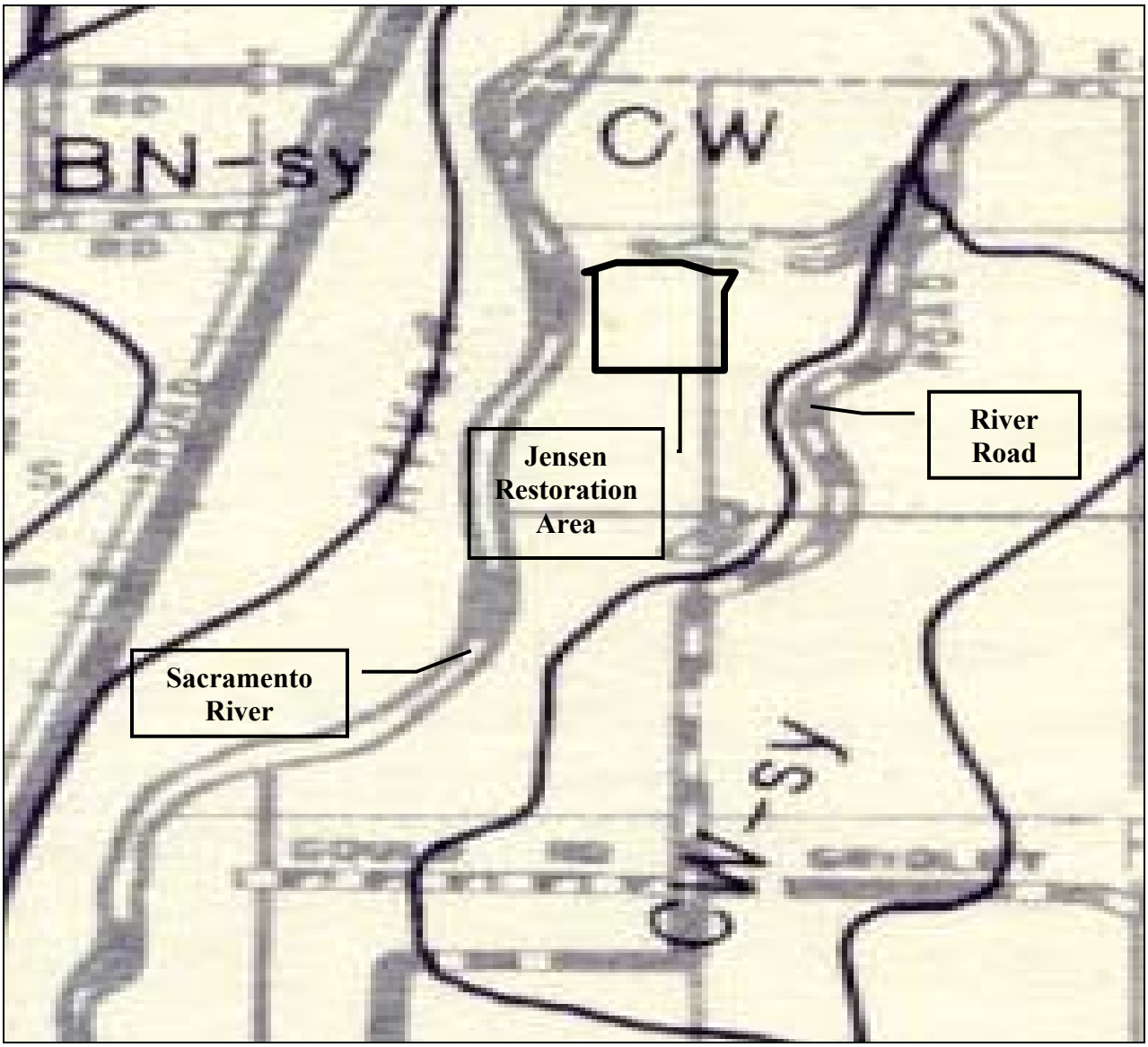


Soil Series Contours
- 7= Sycamore loam
- 9= Columbia loam, gently undulating
- 20= Sycamore clay loam
- 21= Sycamore clay loam, gently undulating
- 29= Columbia soils undifferentiated, variable microrelief, 0-2% slope, gently undulating
- 97= Riverwash

1 mile= approximately 4 inches

Figure 7. Approximate boundary and location of the Jensen Restoration Area on the 1948 Soil Survey map, Colusa County, California (Harradine 1948).

Jensen Restoration Area:
1967 Soil Series



Soil Series Contours
CW= Columbia association
CW-sy= Columbia-Sycamore association
BN-sy= Brentwood-Sycamore association

1 mile= approximately 2 inches

Figure 8. Approximate boundary and location of the Jensen Restoration Area on the 1967 Soil Survey map, Colusa County, California (USDA Soil Conservation Service).

Jensen Restoration Area:
1998 Soil Series

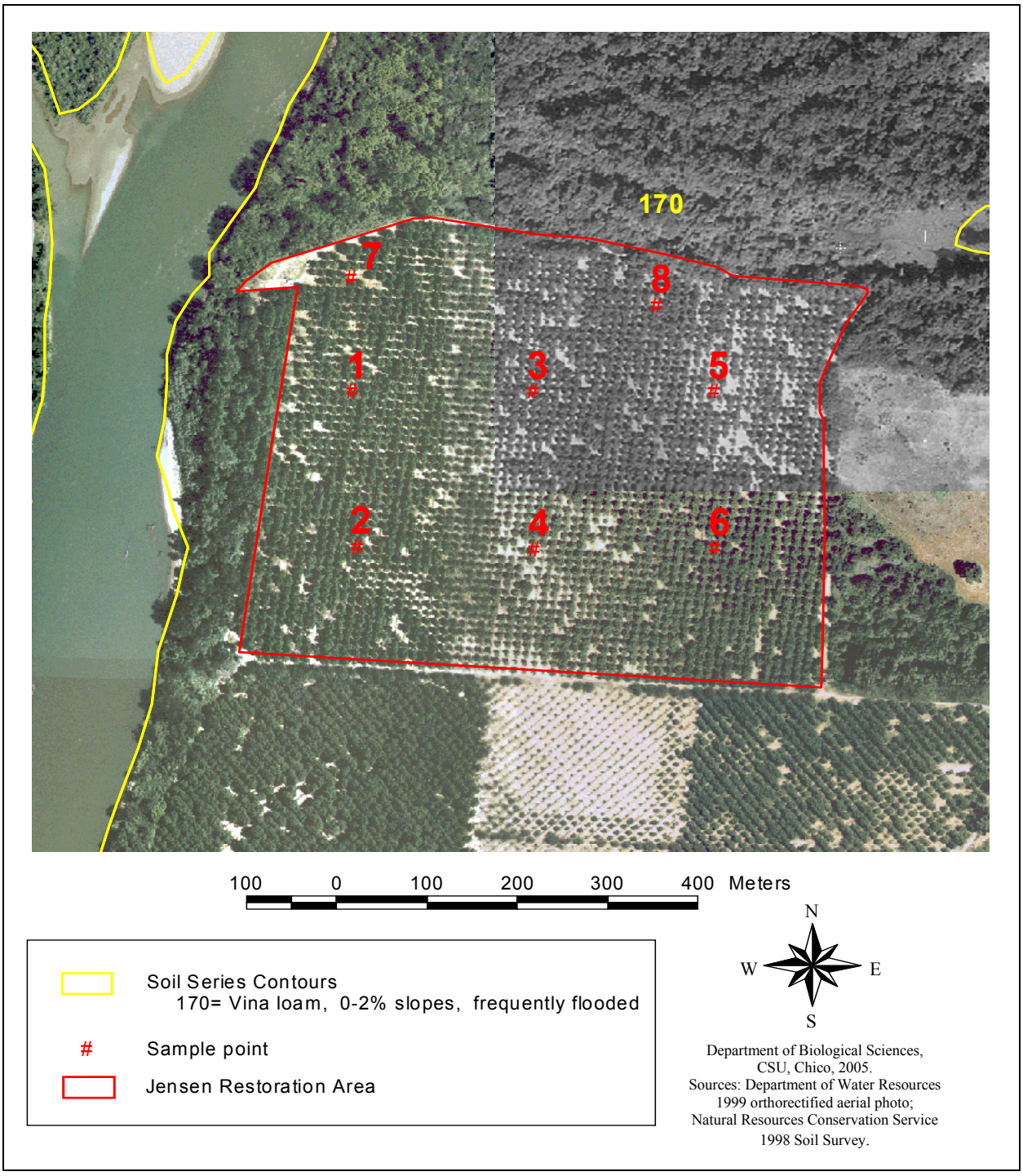


Figure 9. Soil series contours from the 1998 Colusa County Soil Survey at the Jensen Restoration Area, Colusa County, California (Natural Resources Conservation Service).

Jensen Restoration Area:
Historic River Channels 1896-1923

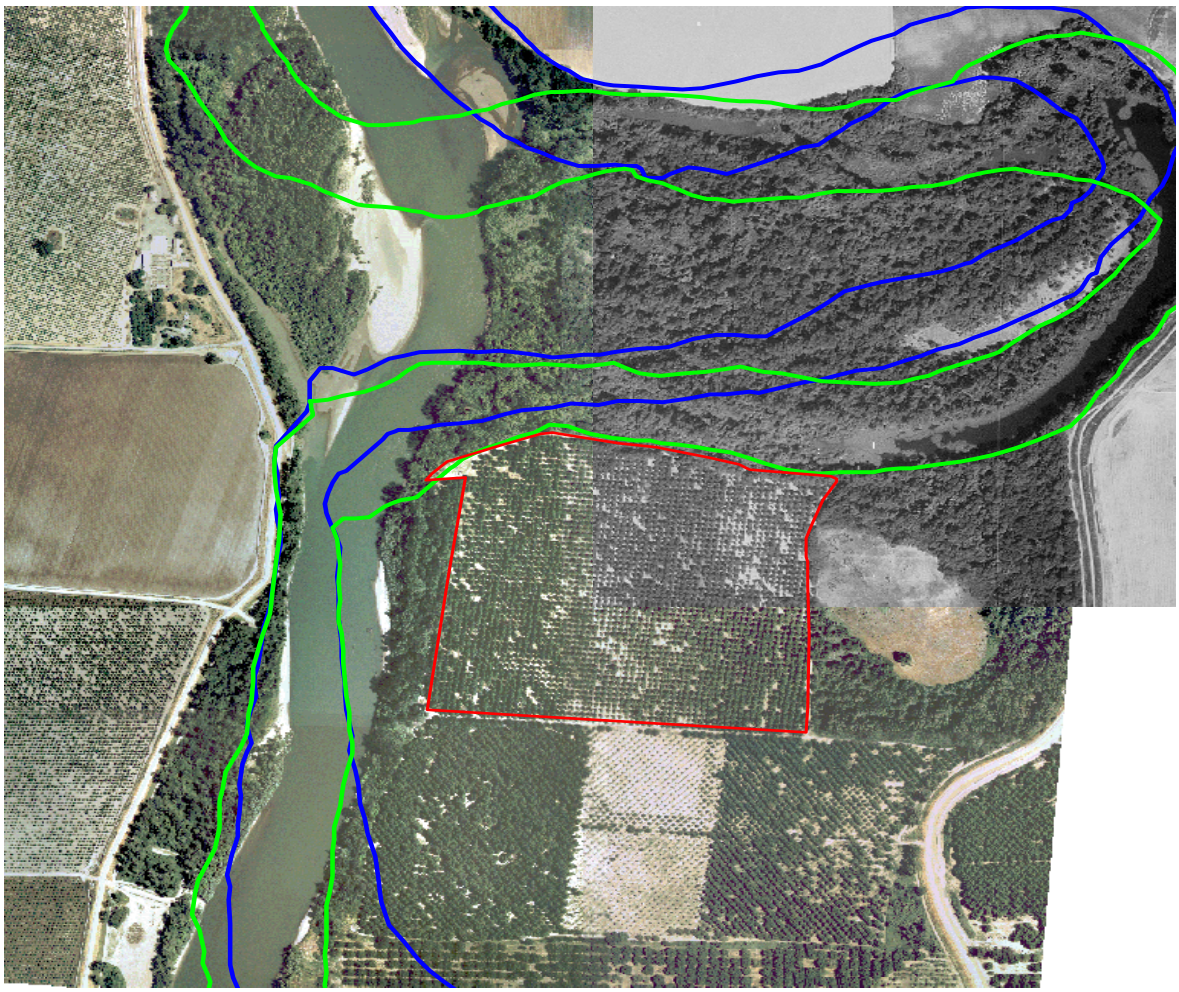


Figure 10. Historic river channels from 1896, 1908 and 1923 at the Jensen Restoration Area, Colusa County, California. The 1908 and 1923 channel is the same for this stretch of the river.

Jensen Restoration Area:
Historic River Channels 1935-1960

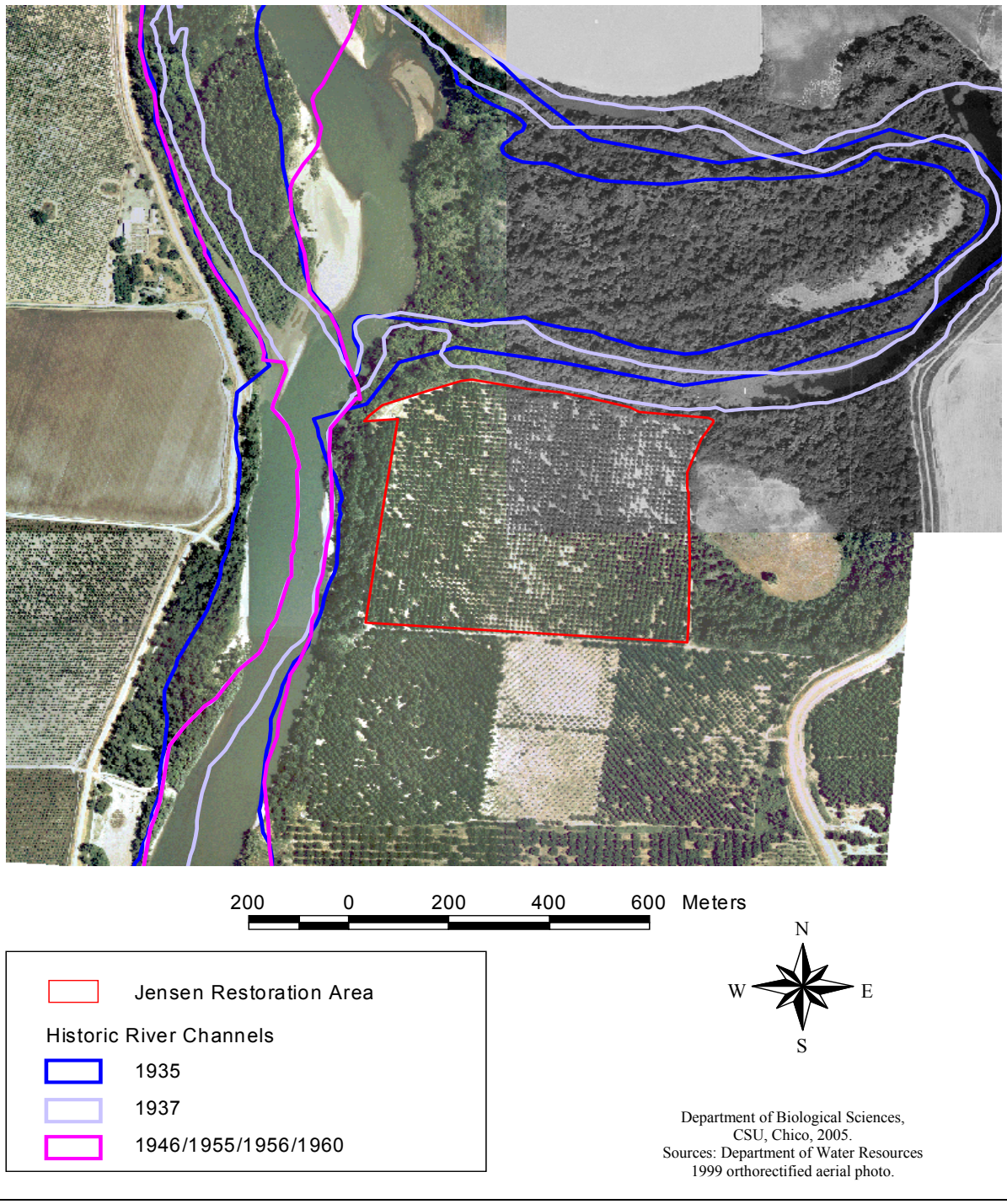


Figure 11. Historic river channels from 1935, 1937, and 1960 at the Jensen Restoration Area, Colusa County, California. The 1960 channel is the same for this stretch of the river as 1946, 1955 and 1956.

Jensen Restoration Area:
Historic River Channels 1964-1991

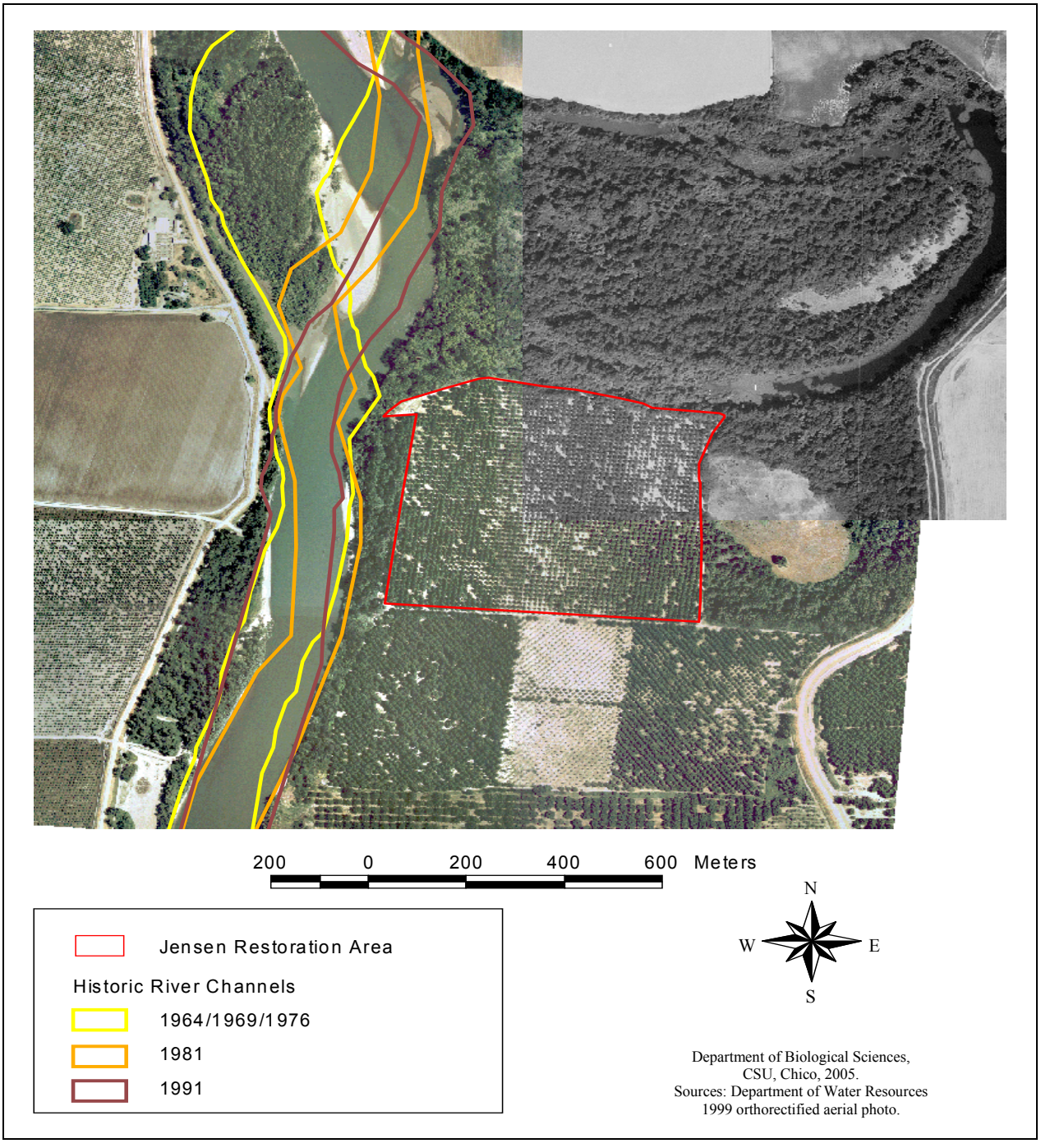


Figure 12. Historic river channels from 1976, 1981, and 1991 at the Jensen Restoration Area, Colusa County, California. The 1976 channel is the same for this stretch of the river as 1964 and 1969.

Acknowledgements

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SECTION FOUR

JENSEN

SPECIAL STATUS ANIMAL SPECIES,

BIRD COUNTS, AND NON-NATIVE MAMMALS

John W. Hunt, M.S.
David Koenig
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Introduction

Animals such as wildlife and birds will benefit from the increased habitat created through natural process or active restoration. Information on wildlife and bird species present or known to occur near the Restoration Area can be used to better judge the value of restoration actions at a particular site. Non-native mammal species are important due to their probable negative impact on native wildlife species. Non-native mammal species can prey upon, directly compete with, and significantly disturb native wildlife.

Methods

A computer search for known occurrences of special status animal species (federal and state threatened and endangered species and species of special concern) occurring within 1.0 mile of the Restoration Area was conducted using the California Natural Diversity Database (CA DFG 2005). An assessment of potential non-native mammals and special status animal species occurring at or within 1.0 mile of the Restoration Area was performed in July 2005. This assessment was based on aerial photographs, field surveys of remnant riparian vegetation and associated nearby habitat, field experience of the authors and habitat characteristics of the species involved. During the bird point count survey (see below), any occurrences or signs of special status species or non-native mammals were noted. General habitat characteristics were gathered from vegetation surveys (Section Two). Information on species status was taken from California Wildlife Habitat Relations 8.0 (CA DFG 2002) and the California Natural Diversity Database (CA DFG 2005).

Bird species were surveyed on July 2-3, 2005, following an adaptation of the methods proposed by Ralph et al. (1993). Eleven point count stations set approximately 200 m apart were established in remnant riparian habitat adjacent to the Jensen tract (Figure 13). All birds observed (either seen or heard) within an eight-minute observation period were recorded. To reduce the possibility of individuals being recorded a second time at another station, only data on species encountered within 50 m of each station are presented here. To compute frequency of occurrence for a species, the total number of observations for that species was divided by the total number of observations for all species.

Special Status Animal Species

Table 13 lists California Natural Diversity Database special status species occurrences within 1.0 mile of the Restoration Area. More than one record indicates multiple sightings of a species in different years and/or locations. Table 14 is a list of special status wildlife species with potential or known to occur or reside within 1.0 mile of the Restoration Area.

Table 13. California Natural Diversity Database special status species occurrences occurring within 1.0 mile of the Jensen Restoration Area, Colusa County, California. FE/FT=federally endangered/federally threatened; FSC=Federal species of special concern; SE/ST=state endangered/state threatened; SSC=California species of special concern.

Common Name	Scientific Name	Status	# of known occurrences
Swainson's hawk	*Buteo swainsonii*	ST	2
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	SE	2
Bank swallow	*Riparia riparia*	ST	3
Osprey	*Pandion haliaetus*	SSC	1

Table 14. Special status animal species with potential or known to occur or reside within 1.0 mile of the Jensen Restoration Area, Colusa County, California. FE/FT=federally endangered/federally threatened; FSC=Federal species of special concern; SE/ST=state endangered/state threatened; SSC=California species of special concern; SSC1=species that face immediate extirpation of their entire California population or their California breeding population if current trends continue (these species may qualify as state endangered or threatened, but are not yet listed); SSC =species on the decline in a large portion of their range in California, which require management to prevent their becoming SSC1; SSC3=species not in any present danger of extirpation and their populations within most of their range do not appear to be declining seriously, however, due to their small populations in California they are vulnerable to extirpation should a threat materialize; ?=not enough information.

Common Name	Scientific Name	Status	Breeding
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT	probable
Sacramento splittail	*Pogonichthys macrolepidoptus*	SSC1	potential
Steelhead – Central Valley ESU	*Oncorhynchus mykiss*	FT	potential
Chinook salmon (fall run)	*Oncorhynchus tsawytscha (fall run)*	SSC	potential
Chinook salmon (spring run)	*Oncorhynchus tsawytscha (spring)*	FT/ST	potential
Chinook salmon (winter run)	*Oncorhynchus tsawytscha (winter)*	FE/SE	probable
Hardhead	*Mylopharodon conocephalus*	SSC3	
Western spadefoot toad	*Spea hammondii*	SSC	potential
Western pond turtle	*Clemmys marmorata*	SSC	probable
Giant garter snake**	*Thamnophis gigas*	FT/ST	potential
American white pelican	*Pelecanus erythrorhynchos*	SSC	
Double-crested cormorant	*Phalacrocorax auritus*	SSC2	potential
White-faced ibis	*Plegadis chihi*	SSC	
Osprey	*Pandion haliaetus*	SSC2	known
Bald eagle	*Haliaeetus leucocephalus*	FT/SE	
Northern harrier*	*Circus cyaneus*	SSC2	probable
Sharp-shinned hawk	*Accipiter striatus*	SSC3	probable
Cooper's hawk	*Accipiter cooperii*	SSC3	probable
Swainson's hawk	*Buteo swainsoni*	ST	known
Ferruginous hawk	*Buteo regalis*	SSC	
Golden eagle	*Aquila chrysaetos*	SSC3	
Peregrine falcon	*Falco peregrinus*	SE	
Prairie falcon	*Falco mexicanus*	SSC3	
California gull	*Larus californicus*	SSC3	
Burrowing owl	*Athene cunicularia*	SSC2	potential
Short-eared owl	*Asio flammeus*	SSC2	potential
Long-eared owl	*Asio otus*	SSC	
Greater sandhill crane	*Grus canadensis tabida*	ST	
Long-billed curlew	*Numenius americanus*	SSC	
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	FSC/SE	known
Willow flycatcher	*Empidonax traillii*	SE	?
Loggerhead shrike	*Lanius ludovicianus*	CSC	probable
Purple martin	*Progne subis*	SSC2	
Bank swallow	*Riparia riparia*	ST	known
Yellow warbler	*Dendroica petechia*	SSC2	potential
Yellow-breasted chat	*Icteria virens*	SSC2	probable
California horned lark	*Eremophila alpestris actia*	SSC	potential
Tricolored blackbird	*Agelaius tricolor*	SSC	potential

Table 14 continued.

Common Name	Scientific Name	Status	Breeding
Townsend's big-eared bat**	*Corynorhinus townsendii*	SSC2	?
Pallid bat**	*Antrozous pallidus*	SSC	?
Western mastiff bat	*Eumops perotis*	SSC2	?

***Species observed within 1.0 miles of the Restoration Area by the authors.**
**** Species not known or with low probability of occurrence within area of consideration.**

Threatened and Endangered Wildlife Species

Seven threatened or endangered wildlife species are of particular interest in the vicinity of the Restoration Area. Following is a brief discussion of their status and any observations noted during fieldwork.

1. Valley elderberry longhorn beetle (*Desmocerus californicus dimorphicus*)

Valley elderberry longhorn beetle (VELB) is a federally threatened species. Potential VELB habitat occurs throughout the tract wherever blue elderberry (*Sambucus mexicana*) is present. This species is recorded in the California Natural Diversity Database (CNDDB) as occurring within 1.0 mile of the Womble Restoration Area and nearby remnant riparian habitat.

2. Steelhead (*Oncorhynchus mykiss*) – Central Valley Evolutionarily Significant Unit (ESU)

The Central Valley steelhead ESU is a federally threatened population. Steelhead is an anadromous fish species spawning in tributaries of the Sacramento River.

3. Chinook salmon (*Oncorhynchus tsawytscha*) – spring run

The spring run Chinook salmon is a federal and state threatened species. Spring run Chinook salmon is an anadromous species of fish that spawns in tributaries of the Sacramento River. Mill, Deer, and Butte Creek are the principal spawning grounds of this species.

4. Chinook salmon (*Oncorhynchus tsawytscha*) – winter run

Winter run Chinook salmon is a federal and state endangered species. Winter run Chinook salmon is known to spawn in cold gravels of the Sacramento River. This species is recorded as occurring throughout the lower Sacramento River below Keswick Dam.

5. Swainson's hawk *(Buteo swainsonii)*

Swainson's hawk is a state threatened species. This species is recorded in the CNDDB as occurring within 1.0 mile of the Restoration Area.

6. Bank Swallow (*Riparia riparia*)

Bank swallows are a state threatened species. This species is known to nest in colonies in undercut banks along the Sacramento River. This species is recorded in the CNDDB as occurring within 1.0 mile of the Restoration Area.

7. Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

Western yellow-billed cuckoos are a state endangered species known to nest in riparian forests along the Sacramento River. This species is recorded in the CNDDB as occurring within 1.0 mile of the Restoration Area.

Non-native Mammal Species

Table 15 lists the non-native mammal species known to occur or potentially occurring within 1.0 mile of the Restoration Area, and an estimate (where possible) of abundance. Due to the lack of available field data, information on non-native mammals presented here is highly qualitative and should be taken as such.

Domestic dogs were not observed on or near the Restoration Area. Because of the proximity of residences, domestic dogs potentially occur on the Restoration Area periodically. Feral cats were not observed at the Restoration Area, but this species is expected to occur periodically due to the fact that feral cats have been observed repeatedly at other restoration areas. Feral cats can cause significant depredation on small vertebrates as well as serving as a potential vector for disease to other mammals (e.g. feline distemper, feline leukemia, feline immune deficiency disease, and toxoplasmosus; Coleman et. al. 1997).

House mice, roof rats, and Norway rats all have potential to occur within 1.0 mile of the Restoration Area. These animals are relatively widespread in lower elevations in California, especially in association with residences and agriculture (Whitaker 1991) and have been documented in riparian areas. Roof rats have been shown to be important nest predators in remnant riparian and riparian restoration sites at Cosumnes River Preserve (Whisson and Engilis Jr. 2005). According to Whisson (unpublished), because of its arboreal habits, mixed riparian forests can provide an ideal habitat for roof rats. Norway rats are also a widespread invasive mammal species with a high potential of occurrence, but they lack the arboreal tendencies of roof rats.

Nutria were not observed on or near the Restoration Area. Potential effects of nutria on native wildlife are not well documented. Tracks of Virginia opossum were observed on and around the Restoration Area.

Domestic/feral dogs, feral cats, roof rats, Norway rats and Virginia opossum are all known predators of small mammals, birds, reptiles and amphibians. All non-native mammals listed below are likely to have a widespread occurrence within riparian habitat along the Sacramento River. Information is currently being gathered on the relative abundance of non-native rodent species, but more information on the presence/absence and relative abundance of other non-native mammals (such as feral cats) needs to be collected in order to determine the relative importance of these species.

Table 15. Non-native mammal species known or potentially occurring within 1.0 miles of the Jensen Restoration Area, Colusa County, California. Estimated abundances are based upon the experience of the authors and field observations at the Restoration Area and similar sites. A "common" indicates that the species was observed in abundance either during visual surveys or during small mammal trapping. An "unknown" indicates that either the species was never observed or that the site itself was not sampled.

Common Name	Scientific Name	Observed	Abundance
Domestic dog	*Canis domesticus*	No	Unknown
Feral Cat	*Felis catus*	No	Unknown
House Mouse	*Mus musculus*	No	Unknown
Roof Rat	*Rattus rattus*	No	Unknown
Norway Rat	*Rattus norvegicus*	No	Unknown
Nutria	*Myocastor coypu*	No	Unknown
Virginia Opossum	*Didelphus virginianis*	Sign (tracks)	Unknown

Bird Counts

Figure 13 shows sampling locations and Table 16 lists all bird species observed on the July 2-3, 2005 point counts. Figure 14 shows the frequency of occurrence for species observed more than once. Forty-three species were encountered during the survey. Species composition was fairly typical of riparian habitats along the Sacramento River. Black-headed grosbeak was the species most frequently observed (8.6%) followed by spotted towhee (7.5%), Bewick's wren (6.7%) and Nuttall's woodpecker (6.3%).

Table 16. Bird species observed within and adjacent to remnant riparian habitat nearby the Jensen Restoration Area, Colusa County, California (see Table 14 for definition of status).

Common Name	Scientific Name	Status
American crow	*Corvus brachyrhynchos*	
American goldfinch	*Cardeulis tristas*	
American pelican	*Pelecanus erythrorhynchos*	SSC
American robin	*Turdus migratorius*	
Ash-throated flycatcher	*Myiarchus cinerascens*	
Bewick's wren	*Thryomanes bewickii*	
Black-headed grosbeak	*Pheucticus melanocephalus*	
Brewer's blackbird	*Euphagus cyanocephalus*	
Brown-headed cowbird	*Molothrus ater*	nonnative
Bullock's oriole	*Icterus bullocki*	
Bushtit	*Psaltriparus minimus*	
California quail	*Calipepla californica*	
California towhee	*Pipilo crissalis*	
Cliff swallow	*Petrochelidon pyrrhonota*	
Common yellowthroat	*Geothlypis trichas*	
Downy woodpecker	*Picoides pubescens*	
European starling	*Sturnus vulgaris*	nonnative
Great blue heron	*Ardea herodias*	
Great egret	*Ardea alba*	
House finch	*Carpodacus mexicanus*	
House wren	*Troglodytes aedon*	
Killdeer	*Charadrius vociferus*	
Lark sparrow	*Chondestes grammacus*	
Lesser goldfinch	*Cardeulis psaltria*	
Mallard	*Anas platyrhynchos*	
Mourning dove	*Zenaida macroura*	
Northern flicker	*Colaptes auratus*	
Nutall's woodpecker	*Picoides nutalli*	
Oak titmouse	*Baeolophus inornatus*	
Pied-billed grebe	*Podilymbus podiceps*	
Red-tailed hawk	*Buteo jamaicensis*	
Spotted towhee	*Pipilo maculatus*	
Swainson's hawk	*Buteo swainsonii*	ST
Tree swallow	*Tachycineta bicolor*	
Turkey vulture	*Cathartes aura*	
Western bluebird	*Sialia mexicana*	

Table 16 continued.

Common Name	Scientific Name	Status
Western kingbird	*Tyrannus verticalis*	
Western scrubjay	*Aphelocoma californica*	
Western wood-pewee	*Contopus sordidulus*	
White-breasted nuthatch	*Sitta carolinensus*	
Wild turkey	*Meleagris gallopavo*	nonnative
Wood duck	*Aix sponsa*	
Yellow-billed magpie	*Pica nuttalli*	

Jensen Restoration Area:
Bird Survey Locations

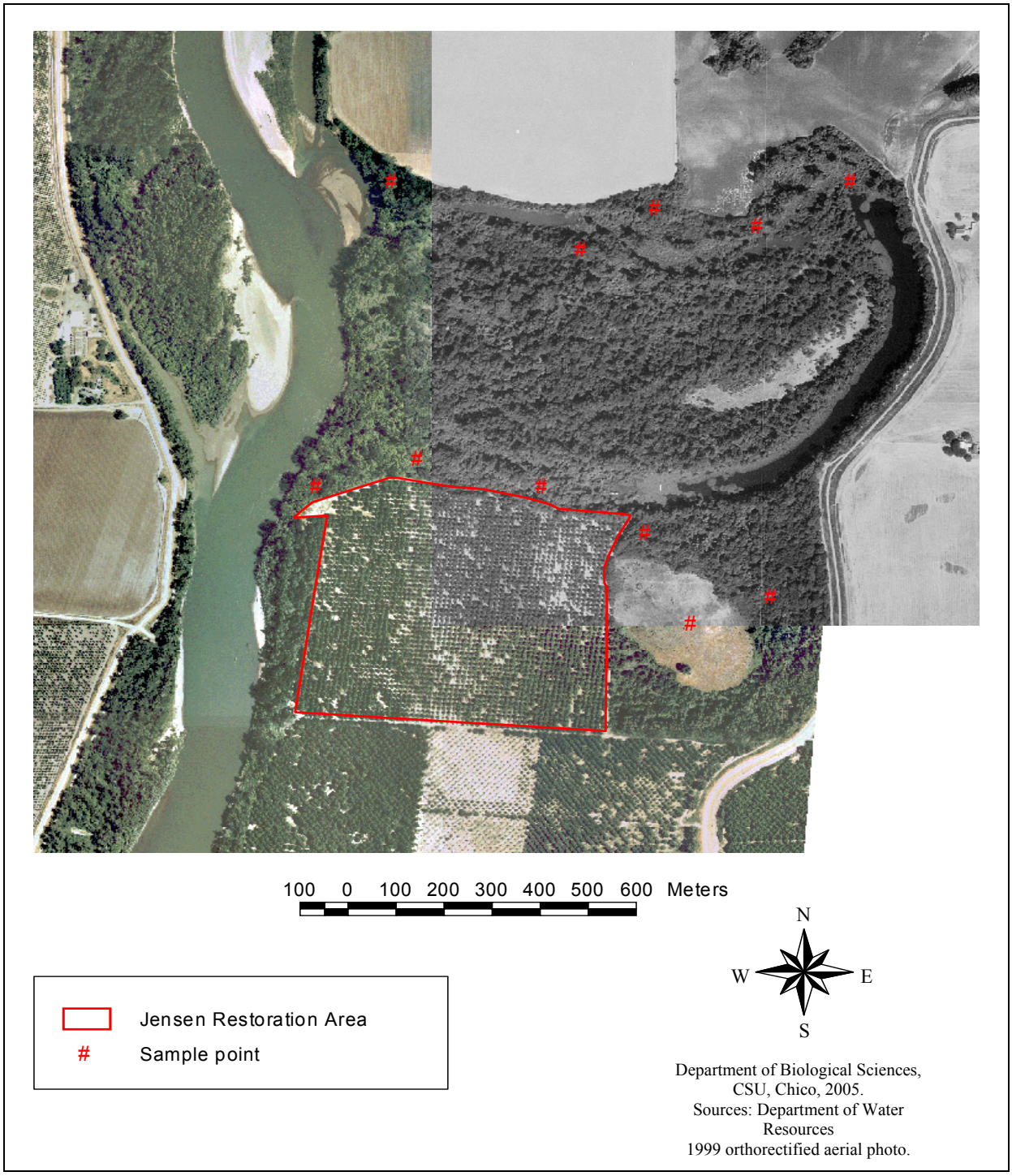

Figure 13. Bird survey station locations in riparian habitat adjacent to the Jensen Restoration Area, Colusa County, California.

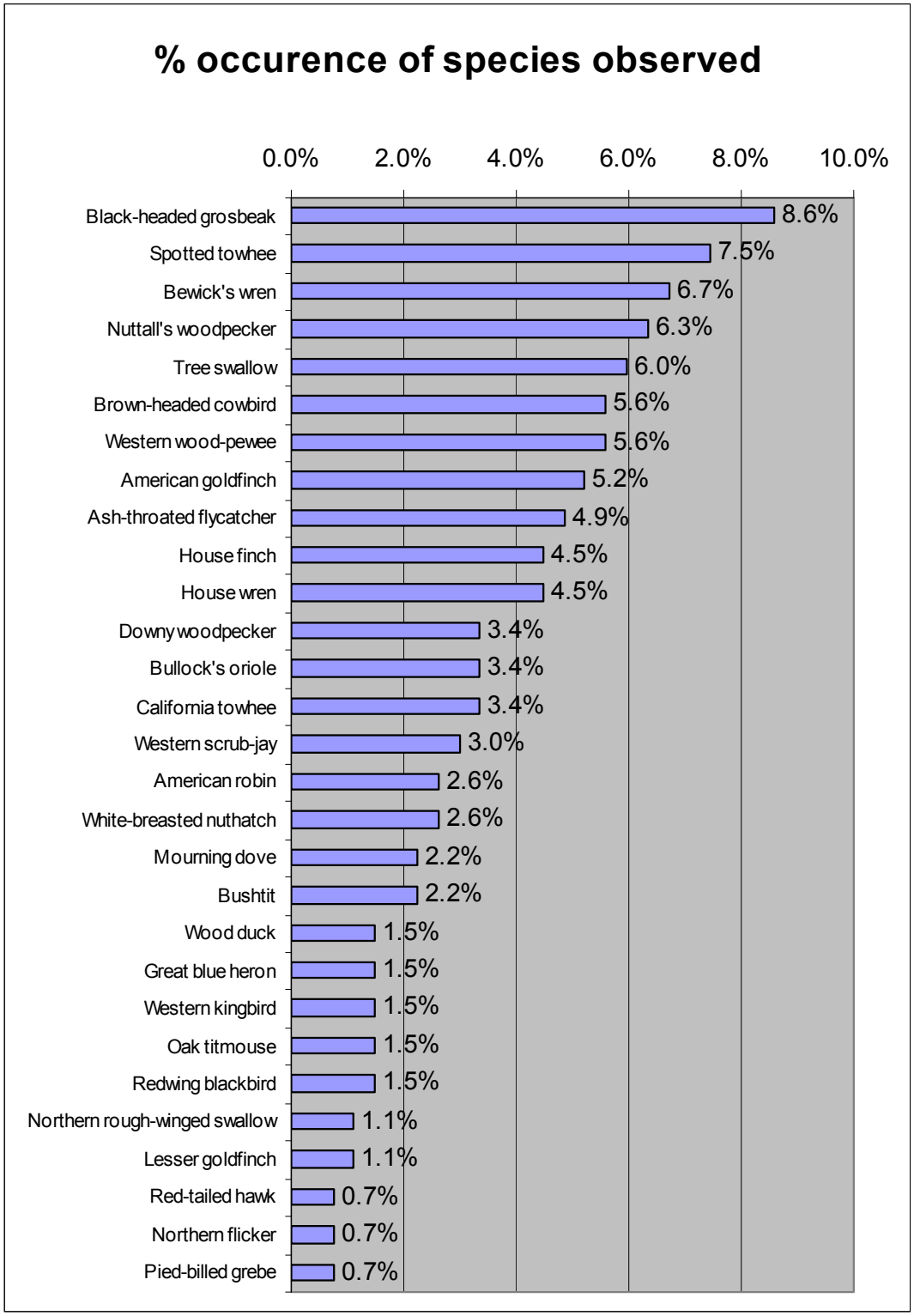

Figure 14. Frequency of bird species observed more than once within a 50 m radius of eleven 8-minute observation stations within remnant riparian habitat adjacent to the Jensen Restoration Area, Colusa County, California. Species observed only once are excluded for clarity.

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