

**BASELINE ASSESSMENT
FOR
RIPARIAN RESTORATION
AT THE
WARD RESTORATION AREA**

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SECTION ONE

WARD

RESTORATION PLANTING RECOMMENDATIONS

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Introduction

The Ward tract is located approximately 1 mile north of Colusa in Colusa County on the west side of the Sacramento River at river mile 145.5 and is owned by The Nature Conservancy. The entire tract is 238 acres in area including land that is covered by flood control levees. The Ward Restoration Area (hereafter “Restoration Area”) comprises 143 acres of the tract inside the levees, consisting of annual row crops and a few patches of riparian vegetation. North of the Restoration Area going from west to east (toward the river) is a fallow walnut orchard, then a thin band of mixed riparian forest right along the northern boundary, then row crops and finally cottonwood riparian forest. To the north of the mixed riparian forest band, again going from west to east, is a small patch of cottonwood riparian forest, buttonbush and blackberry scrubs, and then a large patch of cottonwood riparian forest. Cottonwood riparian forest and mixed riparian forest border the Restoration Area to the east with the mixed riparian forest wrapping around to the south and being interrupted by buttonbush scrub before returning on the southern portion of the western border. The middle of the western border is a lowland area with cottonwood riparian forest bordering the Restoration Area. A levee forms the remainder of the Restoration Area’s western border with a 58-acre mature walnut orchard on the other side. Within the Restoration Area there are a few patches of riparian vegetation. Two patches are dominated by California black walnut (*Juglans californica*) and Fremont cottonwood (*Populus fremontii*) along one of the roads in the middle of the Restoration Area. Another patch along the southeastern edge of the Restoration Area is dominated by box elder (*Acer negundo*), California black walnut, and arroyo willow (*Salix lasiolepis*). An isolated blue elderberry (*Sambucus mexicana*) occurs along the same edge.

Field surveys of nearby remnant riparian vegetation, site soils and birds were conducted between May and June, 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 six natural plant communities to the south and east of the Restoration Area on both sides of the Sacramento River, four of which occurred adjacent to the Restoration Area. General qualitative description of communities to the west and north of the Restoration Area were done although no sampling occurred there due to access limitations (e.g. flooded) and small size. Near or adjacent to the Restoration Area and on the west side of the Sacramento River five communities were sampled: Great Valley mixed riparian forest, Great Valley cottonwood riparian forest, buttonbush scrub, Great Valley willow scrub, and herbland (Holland 1986; Figure 1). To the east, across the Sacramento River are two communities: Great Valley cottonwood riparian forest and blackberry scrub (Holland 1986; Figure 1). With the exception of herbland, all of these communities in some form (i.e. may differ in nomenclature) are on the list of California Terrestrial Natural Communities recognized by The California Natural Diversity Database (CA DFG 2003). Five of these plant communities (excluding herbland) together comprise the estimated 83 acres of native riparian vegetation within the Ward 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 wildlife records and non-native mammal information is in Section Four.

Adjacent Landowners

The Ward tract is adjacent to six properties. To the east is the Sacramento River. To the south is the Colusa Sacramento River State Recreation Area, owned and managed by the Department of Recreation and Parks. This property is approximately 150-450 m from the Restoration Area, separated by remnant riparian vegetation on the Ward tract. To the southwest

is the small Ward property, separated from the Restoration Area by the levee and remnant riparian forest on the Ward tract by approximately 60 m. To the west is the Forry property, comprising 58 acres of mature walnut orchard. This property is approximately 40 m from the Restoration Area separated by the levee at the north end and approximately 60 m separated by the levee and remnant riparian forest at the south end. To the northwest is the 53-acre Cherney property with 19 acres of remnant riparian vegetation and fallow walnut orchard adjacent to the Restoration Area. The Cherney orchards (34 acres) are approximately 250-350 m from the Restoration Area separated by the levee and remnant riparian vegetation. Adjacent to the Restoration Area to the north, separated by a dirt road, is the 87-acre Halsey property with row crops. To the northeast of the Restoration Area is the California Department of Fish and Game's Colusa-North Unit consisting of remnant riparian vegetation.

Methods

The 143-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 1-5; Sections Two and Three). In the figures, the information on flood frequency comes from Department of Water Resources (DWR) 1997 data whereas the aerial photographs are from 1999. 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 ACOE 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 Efsaef 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) 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. Although the Restoration Area is close to the main channel of the Sacramento River, mainly lies in the estimated 1-2 year floodplain, and has generally similar elevations (U.S. ACOE 1997) as the adjacent remnant riparian vegetation, active restoration is still recommended because the area closest to the river has the highest elevation, limiting flood waters. This suggests that much of the Restoration Area itself will probably not flood to the degree required for natural process restoration to be successful. Higher floodplain lands such as found in Sections A and C (Figure 4) 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.

It may be feasible to attempt semi-natural process restoration in the lowland (Figure 4, Section B; U.S. ACOE 1997), since a comparison of air photos from 1999 to 2004 shows an expansion of the lowland remnant riparian vegetation south of Section B during that period (not shown). Semi-natural process restoration of Section B would entail removal of unwanted natives (e.g. California black walnut) and taking weed control measures to provide a jumpstart for natural process restoration. Should colonization of native species not happen in a timely manner then at least Section B is prepared for horticultural restoration. Natural process restoration without any intervention (i.e. unwanted natives removal and weed control) is not recommended.

Restoration Planting Recommendations

Figure 5 depicts the potential plant communities with 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. Mixed riparian forest is suggested for section A of the Restoration Area to extend the existing adjacent mixed riparian forest into the approximate 2- and 4-year floodplains and higher grounds. Mixed riparian forest sampled generally occurs from 60-64 feet (U.S. ACOE 1997). The surrounding cottonwood riparian forests are found at two elevations adjacent to the Restoration Area and are likely due to different colonization processes. Near the main channel of the Sacramento River they are found from 60-64 feet, where colonization is likely from a time when the gravel bar was exposed. Away from the channel (often nearer the levee) cottonwood riparian forest is found in the lowlands from 50-60 feet, where floodwaters remain longest, providing a colonization opportunity for seedlings of cottonwood riparian forest species. Thus the recommendation is for both sections B and C to be restored as cottonwood riparian forest despite the differing elevations. Cottonwood riparian forest in section B would extend the adjacent lowland cottonwood riparian forest into the Restoration Area lowland with its high water table. Cottonwood riparian forest in section C, the eastern portion of the Restoration Area, would connect two existing patches of cottonwood riparian forest across the approximate 1-year floodplain. Here, cottonwood riparian forest is limited to the area where historic channels have occurred in the last 109 years, the soils here being slightly coarser textured and thus better drained than those where mixed riparian forest is recommended (Table 11, Figure 3).

Ward Restoration Area: Remnant Riparian Plant Communities

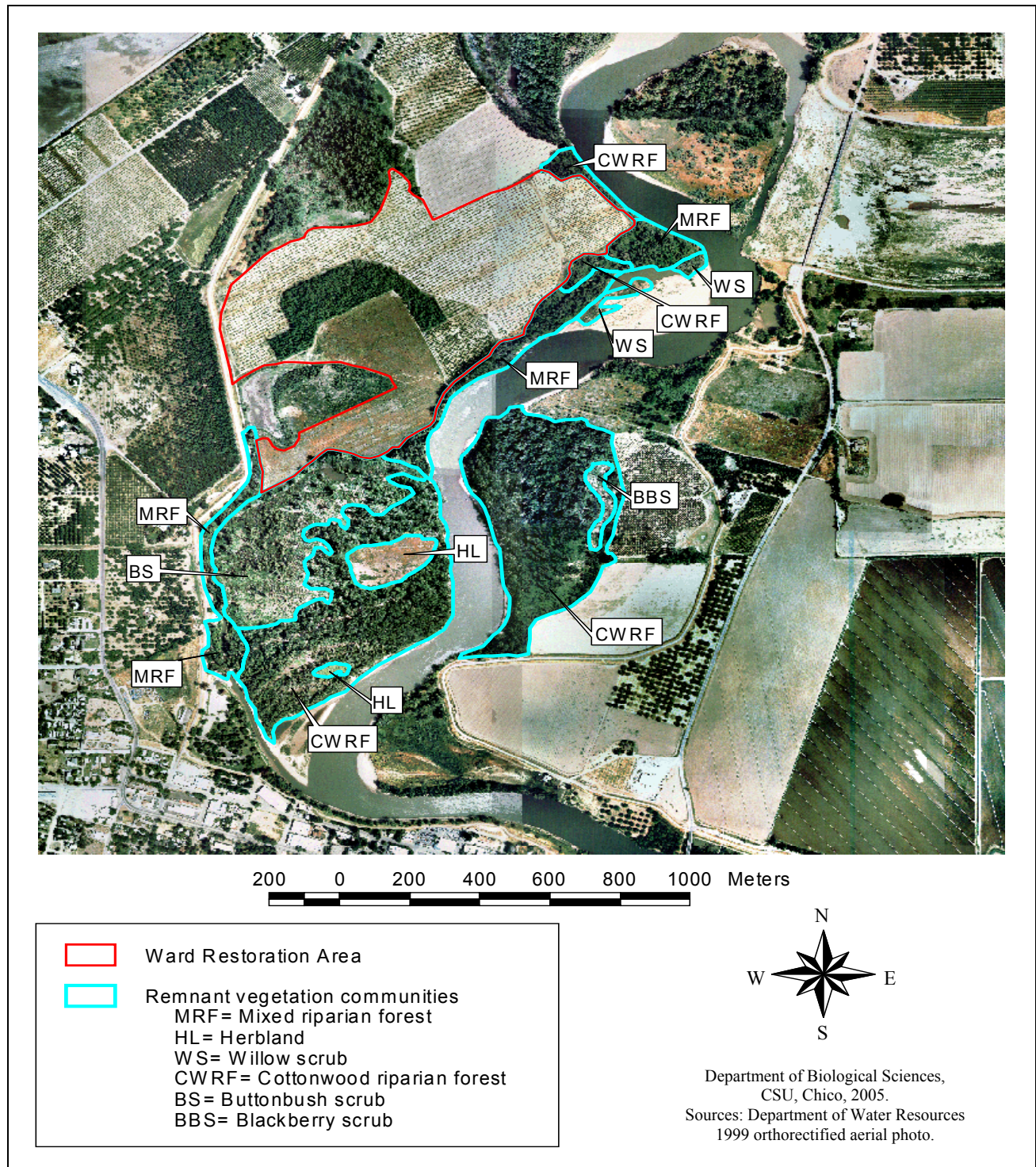


Figure 1. Remnant riparian plant communities nearby the Ward and Cruise n'Tarry Restoration Areas, Colusa County, California.

Ward Restoration Area: Estimated Flood Frequency and Soil Sampling Locations

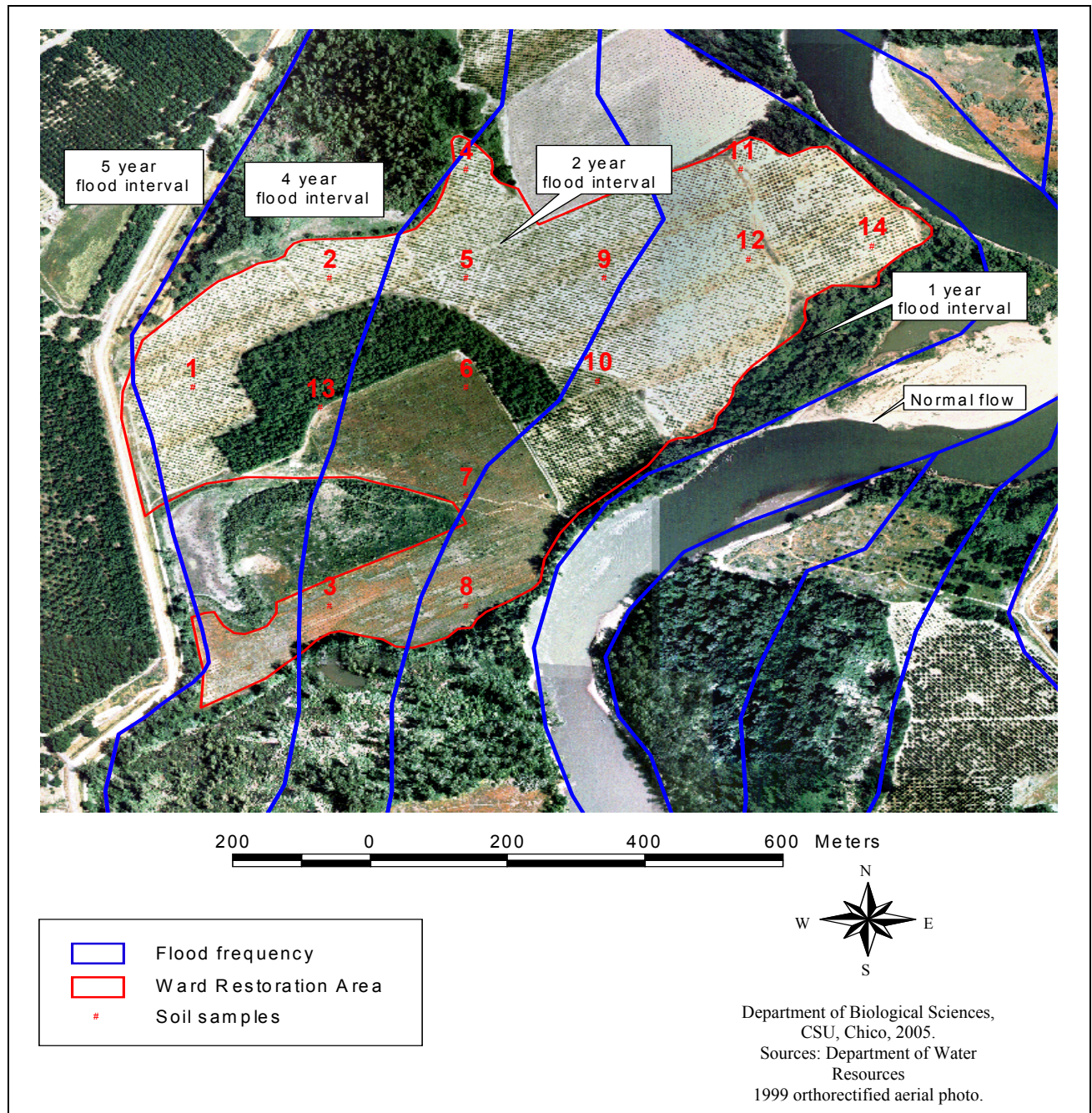


Figure 2. Flood frequency and soil sampling locations at the Ward Restoration Area, Colusa County, California. The 1923 river channel is the same as 1908 for this stretch of the river. Flood frequencies are from Department of Water Resources 1997 data; air photos are from 1999.

Ward Restoration Area: Soil Sampling Locations and Historic River Channels

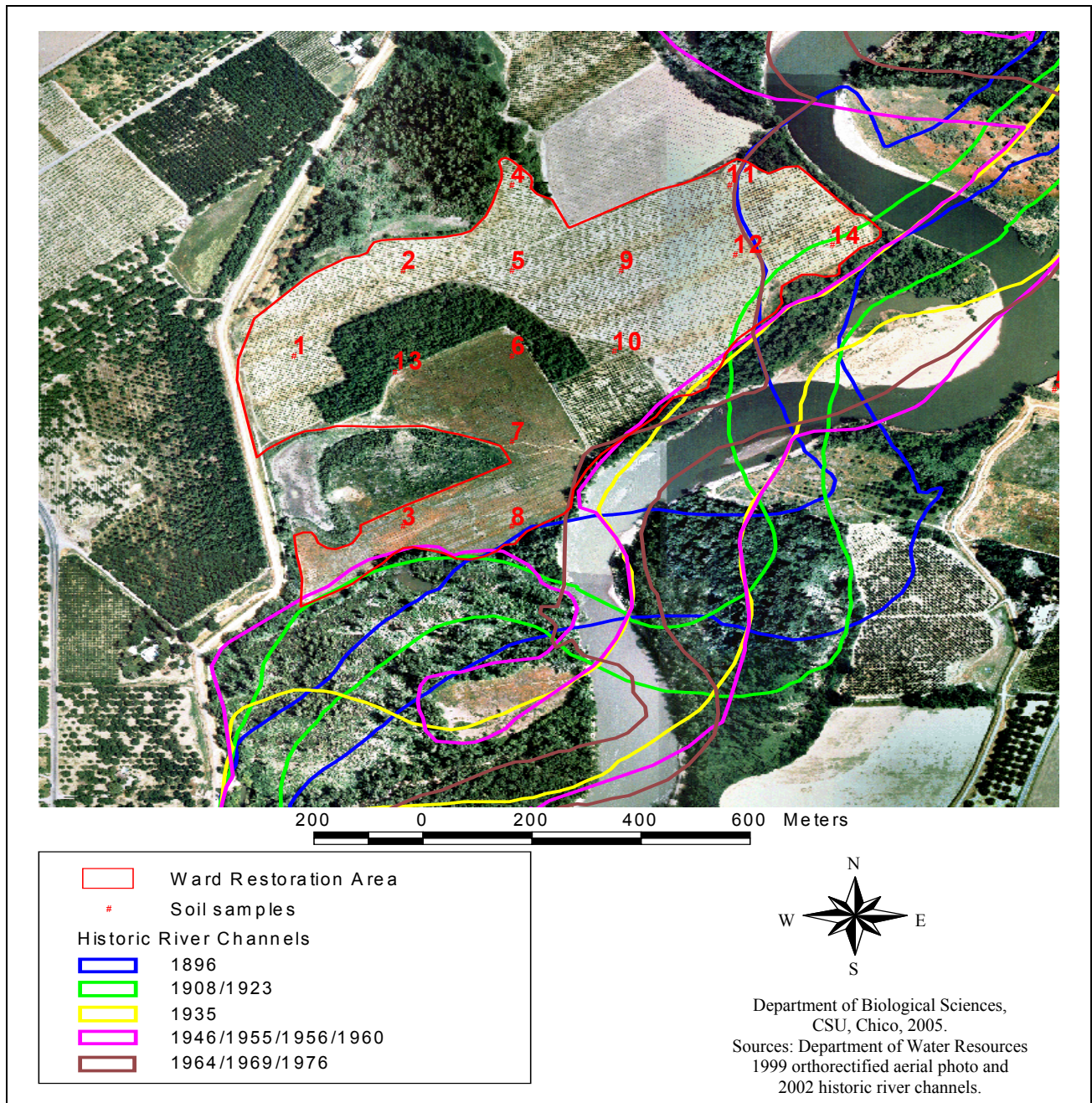


Figure 3. Soil sampling locations and historic river channels from 1896, 1923, 1935, 1960 and 1976 at the Ward Restoration Area, Colusa County, California. The 1923 river channel is the same as 1908; the 1960 river channel is the same as 1946, 1955, and 1956; and the 1976 river channel is the same as 1964 and 1969 for this stretch of the river.

Ward Restoration Area: Potential Plant Communities

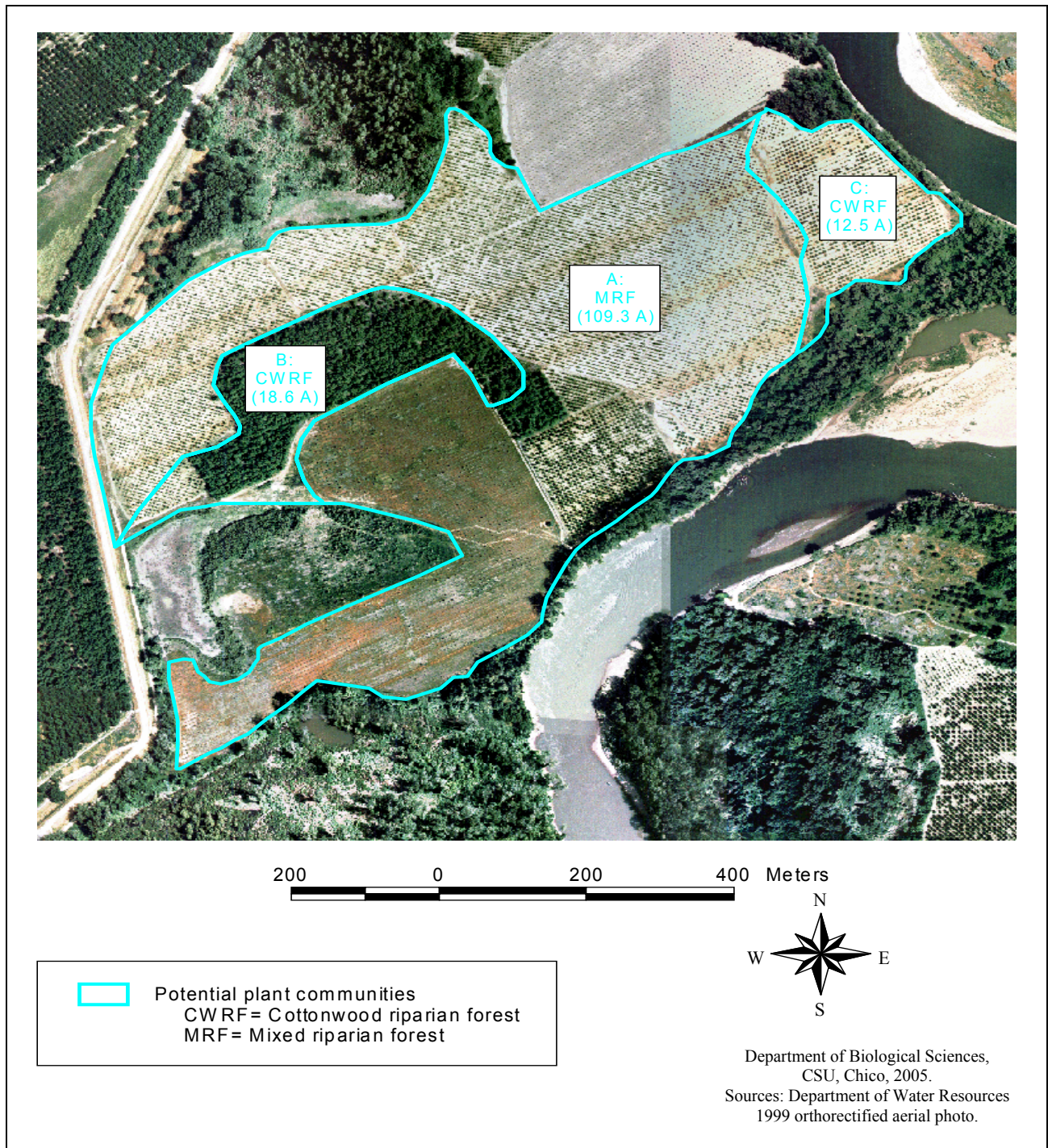


Figure 4. Potential plant communities for the Ward Restoration Area, Colusa County, California.

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

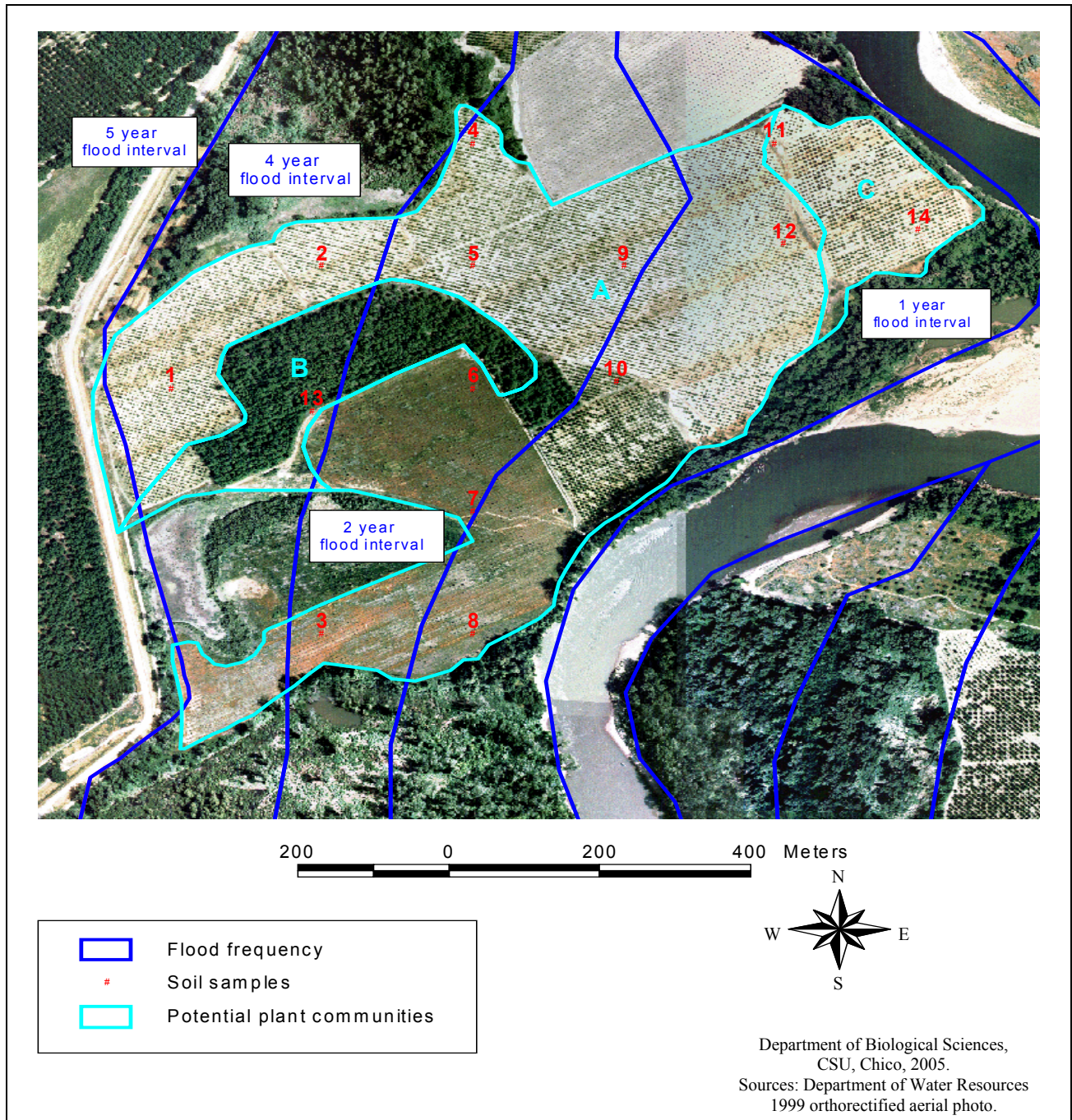


Figure 5. Estimated flood frequency, soil sampling locations, and potential plant communities at the Ward Restoration Area, Colusa County, California. A is mixed riparian forest (109.3 acres), B and C are cottonwood riparian forest (18.6 and 12.5 acres, respectively). Flood frequencies are from Department of Water Resources 1997 data; air photos are from 1999.

Table 1. Composition frequency by community type for potential woody overstory restoration species for the Ward 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. A blank indicates not observed. H indicates a species added since listed by Holland. Nomenclature follows The Jepson Manual (Hickman 1993).

Common Name	Scientific Name	Composition Frequency (%)			
		Remnant Vegetation		Ward Recommendations	
		Ward/Cruise'n Tarry			
Woody Species		MRF (n=40)	CWRF (n=52)	MRF	CWRF
box elder	<i>Acer negundo</i>	49	54	16	13
western sycamore	<i>Platanus racemosa</i>	H		4	
Fremont cottonwood	<i>Populus fremontii</i>	7	63	5	26
valley oak	<i>Quercus lobata</i>	7		5	
narrow-leaved willow	<i>Salix exigua</i>	2	H	4	3
Goodding's black willow	<i>Salix gooddingii</i>	2	10	4	10
arroyo willow	<i>Salix lasiolepis</i>	15	H	10	3
Oregon ash	<i>Fraxinus latifolia</i>	H	H	4	3
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	2	H	3	5
California rose	<i>Rosa californica</i>	2	4	3	2
California blackberry	<i>Rubus ursinus</i>	28	13	9	4
blue elderberry	<i>Sambucus mexicana</i>	12		4	
western poison oak	<i>Toxicodendron diversilobum</i>	22	14	7	3
red willow	<i>Salix laevigata</i>	H	H	2	3
shining willow	<i>Salix lucida</i> ssp. <i>lasiandra</i>	H	H	2	3
virgin's bower	<i>Clematis ligusticifolia</i>	H		4	
California pipevine	<i>Aristolochia californica</i>	3		4	
California wild grape	<i>Vitis californica</i>	63	65	10	22
Total Coverage				100	100

Table 2. Distribution frequency by community type for potential woody overstory restoration species for the Ward Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest. 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	Ward Recommendations	
		Distribution Frequency (%)	
Woody Species		MRF	CWRF
box elder	<i>Acer negundo</i>	70	77
western sycamore	<i>Platanus racemosa</i>	10*	
Fremont cottonwood	<i>Populus fremontii</i>	20	92
valley oak	<i>Quercus lobata</i>	30	
narrow-leaved willow	<i>Salix exigua</i>	10	10*
Goodding's black willow	<i>Salix gooddingii</i>	10	31
arroyo willow	<i>Salix lasiolepis</i>	20	10*
Oregon ash	<i>Fraxinus latifolia</i>	10*	10*
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	10	10*
California rose	<i>Rosa californica</i>	10	8
California blackberry	<i>Rubus ursinus</i>	50	31
blue elderberry	<i>Sambucus mexicana</i>	30	
western poison oak	<i>Toxicodendron diversilobum</i>	30	31
red willow	<i>Salix laevigata</i>	10*	10*
shining willow	<i>Salix lucida</i> ssp. <i>lasiandra</i>	10*	10*
virgin's bower	<i>Clematis ligusticifolia</i>	75*	
California pipevine	<i>Aristolochia californica</i>	10	
California wild grape	<i>Vitis californica</i>	80	85

Table 3. Mean percent cover by community type for potential herbaceous understory restoration species at the Ward Restoration Area, Colusa County, California. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest. Abundances in italics are from Holl and Crone (2004). A blank indicates not observed. “E” indicates species to be planted on the edge. The “*” indicates that the source data are for this genus, and one or more appropriate species were selected to represent the genus. “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		Ward Recommendations	
		Ward/Cruise'n Tarry			
Herbaceous Species		MRF (n=10)	CWRF (n=13)	MRF	CWRF
mugwort	<i>Artemisia douglasiana</i>	3.00	3.00	18	27
horseweed	<i>Conyza canadensis</i>	0.05		2	
fireweed	<i>Epilobium ciliatum</i>	0.05		2	
goose grass	<i>Galium aparinum</i>	27.00	2.00	18	5
lotus	<i>Lotus purshianus</i>	0.05		2	
bugleweed	<i>Lycopus americanus</i>	0.09	0.10	2	2
nettle	<i>Urtica dioica</i>	0.40		2	4
western goldenrod	<i>Euthamia occidentalis</i>			10	10
California goldenrod	<i>Solidago californica</i>			10	10
hairy evening-primrose (E)	<i>Oenothera elata</i>			5	5
Santa Barbara sedge	<i>Carex barbarae</i>	1.00*	2.60*	5	10
clustered field sedge	<i>Carex praegracilis</i>	1.00*	2.60*	2	3
false nutsedge	<i>Cyperus strigosus</i>		0.08		2
blue wildrye	<i>Elymus glaucus</i>	3.49	0.40	DS	DS
creeping wildrye	<i>Leymus triticoides</i>		H	DS	DS
meadow barley	<i>Hordeum brachyantherum</i>			DS	DS
Total Coverage				79	78

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SECTION TWO

WARD

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. Vegetation surveys were conducted in May and June 2005.

North of the Restoration Area going from west to east (toward the river) is a fallow walnut orchard, then a thin band of mixed riparian forest right along the northern boundary, then row crops and finally cottonwood riparian forest. To the north of the mixed riparian forest band, again going from west to east, is a small patch of cottonwood riparian forest, buttonbush and blackberry scrubs, and then a large patch of cottonwood riparian forest. Cottonwood riparian forest and mixed riparian forest border the Restoration Area to the east with the mixed riparian forest wrapping around to the south being interrupted by buttonbush scrub before returning again on the southern portion of the western border. The middle of the western border is a lowland area with cottonwood riparian forest bordering the Restoration Area. A levee forms the remainder of the Restoration Area's western border with a 58-acre mature walnut orchard on the other side. Within the Restoration Area there are a few patches of riparian vegetation. Two patches are dominated by California black walnut (*Juglans californica*) and Fremont cottonwood (*Populus fremontii*) along one of the roads in the middle of the Restoration Area. Another patch along the southeastern edge of the Restoration Area is dominated by box elder (*Acer negundo*), California black walnut, and arroyo willow (*Salix lasiolepis*). An isolated blue elderberry (*Sambucus mexicana*) occurs along the same edge. Details of adjacent landowners can be found in Section One.

Remnant riparian vegetation surveyed occurs on the Ward tract and on Department of Parks and Recreation land on the west side of the Sacramento River. This remnant riparian vegetation bounds the Restoration Area to the east and south. General qualitative plant community descriptions of remnant riparian vegetation to the west and north of the Restoration Area were done although no sampling occurred there due to access limitations (e.g. flooded) and small size. California Department of Fish and Game's Colusa-South Unit was surveyed on the east side of the Sacramento River. The same remnant vegetation was sampled for both the Ward and Cruise n' Tarry Restoration Area Baseline Assessments.

Six natural communities were found to occur close to the Restoration Area: Great Valley mixed riparian forest, Great Valley cottonwood riparian forest, buttonbush scrub, Great Valley willow scrub, blackberry scrub, and herbland (Figure 6). 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). Five of these communities (excluding herbland) comprise the estimated 83 acres of native riparian vegetation within the Ward 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 in the remnant riparian vegetation to the south and east of the Restoration Area (Figures 1 and 6). 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 adjacent riparian vegetation at least two sampling points were established (if possible). Twenty-nine sampling points, each with four quadrants, were established along several transects running roughly perpendicular to the bands of vegetation. A large portion of the riparian vegetation was not sampled due to access issues. 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 including Moulton Weir, Sanborn Slough, Colusa, and Meridian. An electronic copy of the CNDDB records is included on the Baseline Assessment CD.

River Channel History

On the west side of the present Sacramento River, the main river channel scrolled across the remnant riparian vegetation from at least 1896 through 1981 (CA DWR 2002; Figures 3, 11-13). By 1981 the main channel had moved to the eastern edge of the present day forests in the

northern portion of the remnant vegetation, making these forests between 24 and 45 years old (Figures 11-13). The point bar area in the north was the main channel in 1981, but by 1997 the channel had migrated to the eastern edge of the current point bar (Figure 13). The present day forests in the southern portion of the remnant vegetation was the main channel between 1946 and 1960, and the channel had migrated to the eastern edge by 1991, making these forests between 14 and 45 years old (Figures 12 and 13). The point bar area in the south was the main channel in 1991 and by 1997 the channel had migrated to the eastern edge of this point bar (Figure 13).

On the east side of the present Sacramento River, the main river channel scrolled across most of the remnant vegetation from at least 1896 through 1976 (CA DWR 2002; Figures 3, 11-13). There is a small area of forest in the southern portion of the remnant vegetation which does not appear to have been main channel since before 1896. Therefore, this forest could be over 109 years old (Figures 11-13). By 1981 the main channel had moved to the western edge of the majority of the present day forests, making them between 24 and 82 years old (Figures 11-13). The blackberry scrub area was the main channel in 1923 and then it migrated west by 1935 (Figures 11 and 12). Therefore, the blackberry scrub is between 70 and 82 years old.

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 6. The northern portion of the sampled remnant riparian vegetation is located along the eastern border of the Restoration Area. The majority of this section is a mixed riparian forest in two patches (13 acres and 7 acres) dominated by box elder (*Acer negundo*) and interspersed with other species such as Fremont cottonwood (*Populus fremontii*), valley oak (*Quercus lobata*), arroyo willow (*Salix lasiolepis*), and blue elderberry (*Sambucus mexicana*). This community is a fairly mixed, dense forest with various levels of tree canopies, with several shrub and vine species present. There are two patches of cottonwood riparian forest (both 3 acres) in this northern section of riparian vegetation that are dominated primarily by Fremont cottonwood and Goodding's black willow (*Salix gooddingii*) with a subcanopy of box elder. Closer to the river there are two areas of willow scrub (1 acre and 2 acres) that are dominated by narrow-leaved willow (*Salix exigua*). The northern area is dominated by large, mature, narrow-leaved willows, creating a willow scrub forest community.

The southern portion of the sampled remnant riparian vegetation that borders the Restoration Area to the south is composed mostly of cottonwood riparian forest and buttonbush scrub with a narrow corridor of mixed riparian forest along the edge and a herbland community near the center. The mixed riparian forest (10 acres) community along the levee is similar to the community described above. The cottonwood riparian forest is much more open than the cottonwood riparian forest in the northern portion of the remnant riparian vegetation. It is composed of widely spaced Fremont cottonwood trees interspersed with Goodding's black willow trees and blanketed with California wild grape (*Vitis californica*) vines. The buttonbush scrub (40 acres) community is dominated by California button willow (*Cephalanthus occidentalis* var. *californicus*) and large California wild grape hummocks with occasional Fremont cottonwood and Goodding's black willow trees. There are two herbland communities (7 acres and 1 acre) within the cottonwood riparian forest that were not sampled due to access issues.

Across the river to the east the remnant riparian vegetation is composed of a cottonwood riparian forest surrounding a small area of blackberry scrub (Figure 6). The cottonwood riparian forest (56 acres) is dominated by Fremont cottonwood interspersed with occasional Goodding's black willow and California black walnut (*Juglans californica*) trees, a subcanopy of box elder,

and pockets of edible fig (*Ficus carica*). There are several native vines present including California blackberry (*Rubus ursinus*), western poison oak (*Toxicodendron diversilobum*), and California wild grape. The blackberry scrub (3 acres) is an open scrub community dominated by California blackberry.

The remnant riparian vegetation north of the Restoration Area that was visually surveyed but not sampled appears to be dominated by a cottonwood riparian forest consisting primarily of Fremont cottonwood interspersed with Goodding's black willow and covered in California wild grape. There are large open areas within this forest that are visually dominated by California button willow, California blackberry, California wild grape, and cocklebur and thus are best described as buttonbush and blackberry scrubs. On the southern edge of this forest and scrubs, closest to the Restoration Area, appears to be a thin band of mixed riparian forest with additional visually obvious species such as narrow-leaved willow, California black walnut, valley oak, arroyo willow, and Himalayan blackberry (*Rubus discolor*). In the southwest corner of this northern remnant riparian vegetation there is a fallow English walnut grove (*Juglans regia*).

The remnant riparian vegetation in the western lowland surrounded by the Restoration Area on three sides and the levee road to the west that was visually surveyed but not sampled appears to be dominated by young or stunted Fremont cottonwood, Goodding's black willow, and narrow-leaved willow, suggesting cottonwood riparian forest. The area closest to the levee road appears to have a narrow band of willow scrub composed mainly of narrow-leaved willow, young Fremont cottonwood, and one valley oak. In between the willow scrub and the eastern cottonwood riparian forest is a more moist area composed primarily of cocklebur (*Xanthium strumarium*) and some Fremont cottonwood seedlings.

Ward Restoration Area: Remnant Riparian Vegetation Sampling Locations

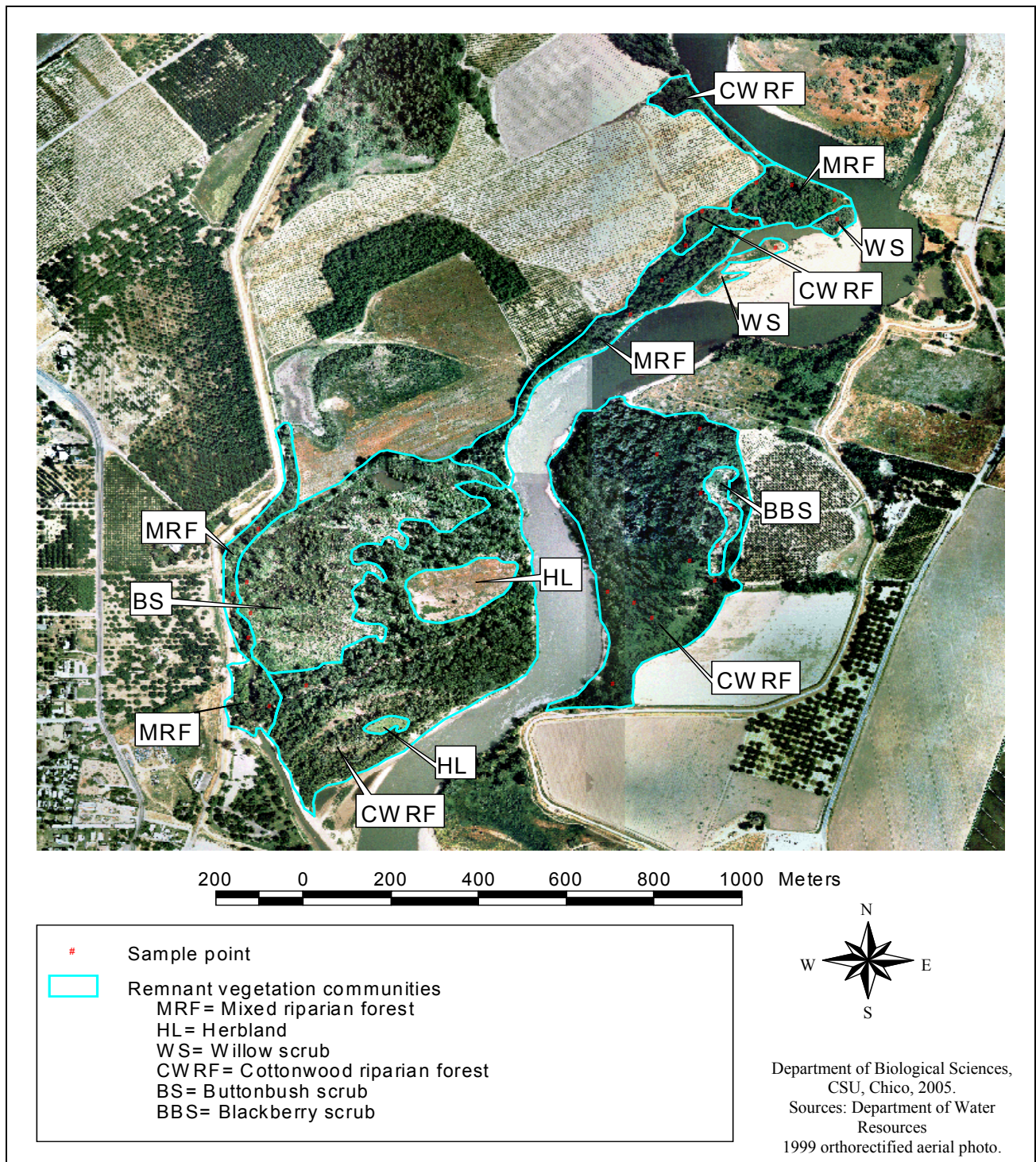


Figure 6. Remnant riparian plant communities and vegetation sampling locations within riparian plant communities close to the Ward and Cruise n'Tarry Restoration Areas, Colusa County, California.

Table 4. Composition and distribution frequencies by community type for potential native woody restoration species found in remnant riparian vegetation close to the Ward Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for composition frequency represents the number of quadrants sampled. The sample size (n) for distribution frequency represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest; BS=Buttonbush Scrub; BBS=Blackberry Scrub; WS=Willow Scrub. A blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Trees			MRF (n=40)	CWRP (n=52)	BS (n=8)	BBS (n=8)	WS (n=8)	MRF (n=10)	CWRP (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)
box elder	<i>Acer negundo</i>	Aceraceae	35	6				60	15			
Fremont cottonwood	<i>Populus fremontii</i>	Salicaceae	5	63	13			10	92	50		
valley oak	<i>Quercus lobata</i>	Fagaceae	5					20				
narrow-leaved willow	<i>Salix exigua</i>	Salicaceae					63					100
Goodding's black willow	<i>Salix gooddingii</i>	Salicaceae		10					31			
arroyo willow	<i>Salix lasiolepis</i>	Salicaceae	3					10				
blue elderberry	<i>Sambucus mexicana</i>	Caprifoliaceae	5					20				
Shrubs												
box elder	<i>Acer negundo</i>	Aceraceae	14	48				50	69			
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	Rubiaceae	2		100			10		100		
Fremont cottonwood	<i>Populus fremontii</i>	Salicaceae	2					10				
valley oak	<i>Quercus lobata</i>	Fagaceae	2					10				
California rose	<i>Rosa californica</i>	Rosaceae	2	4				10	8			
narrow-leaved willow	<i>Salix exigua</i>	Salicaceae	2				63	10				100
Goodding's black willow	<i>Salix gooddingii</i>	Salicaceae	2				13	10				50
arroyo willow	<i>Salix lasiolepis</i>	Salicaceae	12					20				
blue elderberry	<i>Sambucus mexicana</i>	Caprifoliaceae	7					10				
western poison oak	<i>Toxicodendron diversilobum</i>	Anacardiaceae	17	6			25	30	15			50

Table 4 continued.

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Vines			MRF (n=40)	CWRF (n=52)	BS (n=8)	BBS (n=8)	WS (n=8)	MRF (n=10)	CWRF (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)
California pipevine	<i>Aristolochia californica</i>	Aristolochiaceae	3					10				
California blackberry	<i>Rubus ursinus</i>	Rosaceae	28	13		100	38	50	31		100	50
western poison oak	<i>Toxicodendron diversilobum</i>	Anacardiaceae	5	8				10	15			
California wild grape	<i>Vitis californica</i>	Vitaceae	63	65	100			80	85	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 Ward Restoration Area, Colusa County, California. The sample size (n) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest ; CWRP=Cottonwood Riparian Forest; BS=Buttonbush Scrub; BBS=Blackberry Scrub; WS=Willow Scrub. A blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Mean Cover (%)					Distribution Frequency (%)				
Herbs			MRF (n=10)	CWRP (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)	MRF (n=10)	CWRP (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)
mugwort	<i>Artemisia douglasiana</i>	Asteraceae	3.00	3.00				30	15			
sedge	<i>Carex</i> sp.	Cyperaceae	1.00					10				
goose grass	<i>Galium aparine</i>	Rubiaceae	27.00	2.00				60	15			
nettle	<i>Urtica dioica</i>	Urticaceae	0.40					20				
nutsedge	<i>Cyperus</i> sp.	Cyperaceae		0.08					8			

Table 6. Composition and distribution frequencies by community type for woody plant species not recommended, but found in remnant riparian vegetation close to the Ward Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for composition frequency represents the number of quadrants sampled. The sample size (n) for distribution frequency represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest; BS=Buttonbush Scrub; BBS=Blackberry Scrub; WS=Willow Scrub. A blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Trees			MRF (n=40)	CWRP (n=52)	BS (n=8)	BBS (n=8)	WS (n=8)	MRF (n=10)	CWRP (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)
California black walnut	<i>Juglans californica</i>	Juglandaceae	30	8				70	23			
white mulberry	<i>Morus alba</i>	Moraceae	13					30				
cherry plum	<i>Prunus cerasifera</i>	Rosaceae	3					10				
Shrubs												
edible fig	<i>Ficus carica</i>	Moraceae	10	38				30	69			
California black walnut	<i>Juglans californica</i>	Juglandaceae	7	4		13		20	15		50	
white mulberry	<i>Morus alba</i>	Moraceae	5					20				

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 Ward Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; BS=Buttonbush Scrub; BBS=Blackberry Scrub; WS=Willow Scrub. A blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Mean Cover (%)					Distribution Frequency (%)				
Herbs			MRF (n=10)	CWRF (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)	MRF (n=10)	CWRF (n=13)	BS (n=2)	BBS (n=2)	WS (n=2)
dog-fennel	<i>Anthemis cotula</i>	Asteraceae	0.20					10				
bur-chervil	<i>Anthriscus caucalis</i>	Apiaceae	9.00					10				
ripgut grass	<i>Bromus diandrus</i>	Poaceae	7.00					10				
black mustard	<i>Brassica nigra</i>	Poaceae		2.00					8			
grass	Grass sp.	Poaceae	2.00	7.00				20	8			
Italian ryegrass	<i>Lolium multiflorum</i>	Poaceae	0.30					10				
curly dock	<i>Rumex crispus</i>	Polygonaceae	0.20					10				
lady's thumb	<i>Polygonum persicaria</i>	Polygonaceae		0.23					8			
cocklebur	<i>Xanthium strunarium</i>	Asteraceae		0.08					8			

Special-status Plant Species

Information about known and potential occurrences of special-status plant species was obtained from the California Natural Diversity Database (CNDDDB; CA DFG 2005). Based on the quadrangle search of the CNDDDB, five species were initially identified to potentially occur within 1 mile of the Restoration Area. 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 Ward 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
<i>Astragalus tener</i> var. <i>ferrisiae</i>	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.
<i>Atriplex depressa</i>	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.
<i>Cordylanthus palmatus</i>	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.
<i>Hibiscus lasiocarpus</i>	rose-mallow	Marshes and swamps (freshwater); elevation 0-120 meters.	CNPS 2	May occur. No known occurrences within 1 mile of the restoration area.
<i>Lasthenia glabrata</i> ssp. <i>coulteri</i>	Coulter's goldfields	Marshes and swamps (coastal salt), playas, vernal pools; elevation 1-1220 meters.	CNPS 1B	Unlikely to occur due to the lack of suitable habitat. No known occurrences within 1 mile of the restoration area.

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SECTION THREE

WARD

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 Ward tract, owned by The Nature Conservancy, is located about one mile north of Colusa in Colusa County. The Restoration Area comprises 143 acres of the tract inside of the levees on the west side of the Sacramento River at river mile 145.5. Currently the Restoration Area consists of annual row crops and a few patches of riparian vegetation.

Methods

Soil data were gathered from digging 14 auger holes by hand across the existing orchards during May and June 2005 (Figures 2, 3, 10). These 14 holes were located on a grid at approximately 200 meter intervals across the Restoration Area to meet the minimum of 5 holes per Restoration Area, or 1 hole per 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.

<u>Texture</u>	<u>% Sand</u>
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.

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

Soils Description

The soils of the Restoration Area are dominated by clay loams which generally concur with every other soil survey of Colusa County starting with the historic surveys of 1907, 1948, 1967 and including the current 1998 survey (Figures 7-10; Harradine 1948, USDA 1907, 1967, 1998). In the historic surveys of 1907 and 1967 the majority of the Restoration Area soils are described as Sacramento silty clay loam (USDA 1907), and Columbia-Sycamore Association with textures ranging from fine sandy loam to silty clay loam (USDA 1967) which concurs with soil auger data. The Restoration Area soils are generally more fine-textured than the designations in the 1948 and 1998 soil surveys. These surveys describe the Restoration Area soils as Columbia loam, Columbia silt loam, Columbia fine sandy loam and Columbia soils undifferentiated (Harradine 1948) and as Vina loam, except for some of the southwest limb which is delineated as Corbiere silt loam (Figure 10; USDA 1998). Table 11 gives the auger hole data, and Table 12 lists comments (if any) for each hole. Surface textures across the site are relatively uniform, consisting of sandy clay loam or clay loam (Table 11). The Restoration Area has a relatively homogeneous profile of coarser and finer clay loams occasionally overlaying sandy loam (Table 11). Most of this Restoration Area has deep to very deep soils with refusal from 3.5 to 15.5 feet.

The Ward Restoration Area soils appear to be more typical of alluvial soils further from the active channel despite 3/4s of the area being located in the modeled 1-2 year floodplain. Active floodplain soils typically show stratification from various flooding events whereas alluvial soils further from the active channel and floodplain tend to have a uniform fining upward sequence (where coarser material is found at depth and finer textures make up the upper layers of the profile; Andrew Conlin Pers. Comm. 2003). The soils fall into three groups: one where the subsoil is completely homogeneous (holes 6, 7, 8 and 13); a second with at least one fining upward sequence (holes 1-5, 9, 12 and 14) and the third where the subsoil is heterogeneous (holes 10 and 11). Those auger holes with homogeneous subsoils are less than 5 feet in depth and are located near one another in an area that was partially inundated during the first sampling in May (Table 11). The homogeneity of these profiles may be due to the shallow depth of the auger holes, making extensive stratification less evident. The sample locations with fining upward sequences had either an essentially uniform fining upward sequence typical of alluvial soils further from the active floodplain (e.g. hole 12) or a series of two fining upward sequences (e.g. hole 14). Most of these sampling holes are less than 7 feet. Again, it should be noted that the Restoration Area was extremely wet during sampling with several areas still inundated with flood waters in late May, making for shallower depths and less evident stratification. However, auger hole 12 has a single fining upward sequence and is twice as deep at 14 feet and in the annual floodplain.

The two sample locations (9, 14) with the series of fining upward sequences are likely occurring in old river channels and thus represent channel deposits. Sample hole 14 is located in the Sacramento River historic channels from 1896 through at least 1923, because by 1935 the main channel had migrated east of the Restoration Area (Figures 10-13). Although there is no documentation for sample hole 9 in the historic soil surveys (Harradine 1948, USDA 1907, 1961) or the Sacramento River GIS (CA DWR 2002), it is plausible that the main channel could have flowed there between 1896 and 1907. It is more likely, given the scrolling pattern over the last 109 years in this area, that sample hole 9 was in a pre-1896 Sacramento River channel (Figures 10-13). Also, sample locations 1-3 and 5 appear to be in an old channel based on the 1999 aerial photo and Restoration Area topography, despite a lack of profile data to support channel deposits (Table 11, Figures 5, 10). There is no documentation in the historic soil surveys (USDA 1907, 1961, Harradine 1948) or the Sacramento River GIS (CA DWR 2002) for the channel being in this area in the last 109 years. Thus, similar to sample hole 9, it is more likely

that a pre-1896 Sacramento River channel flowed through the western portion (Figures 10-13). Note that sample 3 is less than 75 m from the edge of the 1908, 1923 and 1946 to 1960 Sacramento River main channel (Figures 10-13).

The Restoration Area soils range from moderately to very deep soils with the water table being reached between 2.5 and 9.5 feet in late May and between 3 and 15.5 feet in late June (Table 11). The shallower soils are found in the lower lying portion from north to south in the western half of the Restoration Area as represented by points 2, 3, 7 and 13 (Figures 5, 10; Table 11). A north-south pattern of shallow soils due to a high water table and composed of sampling points 2, 13, 3 and 7 occurs between two wet areas of remnant vegetation (Figures 5, 10). Due north of sample point 2 is an area that was Sabine Lake in 1907 (Figure 7) and due south of sample point 3 is a small lake on the 1999 aerial photograph. It is quite plausible there is a water table link across this area. The deep soils are represented by points 1, 6, and 8 surrounding the shallow soil area (Figures 5, 10; Table 11). The very deep soils occur in the eastern half of the Restoration Area as shown by points 4, 5, 9-12 and 14 (Figures 5, 10; Table 11).

The water table was reached at all 14 sampling holes, seven of which had reduced oxygen features at depths ranging from 2 to 14 feet. Mottling, a reduced oxygen characteristic (redox feature), was encountered within two feet of saturation at these seven sampling holes (Tables 11, 12, Figures 5, 10). 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. Six of the samples with redox features occur where saturated conditions are expected--mainly within the annual floodplain in the east and adjacent to the remnants of Sabine Lake. Due to the wet spring it is likely that the entire Restoration Area flooded and thus mottling even in sampling hole 1 in the western portion is not surprising. Further, hole 1 is likely in a pre-1896 channel or may even be influenced by what was Sabine Lake to the north. A gleyed layer occurred in hole 14 at a depth of 2.5 feet. This reduced or "gleyed" layer is the extreme example of redox features where no oxygen is present in the soil resulting in the minerals remaining in a reduced form. These locations have periods of inundation longer than those just showing redox features. This holds true here as sample 14 was not done in May due to it being under water. This was a particularly wet spring and early summer and thus the water table may be more elevated than in a typical year.

Table 11. Soil texture by depth across the Ward Restoration Area, Colusa County, California.

Date Sampled	5/23/2005	5/23/2005	5/23/2005	5/23/2005	5/23/2005	5/23/2005	5/23/2005	5/23/2005
Point	1	2	3	4	5	6	7	8
Surface	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam	Sandy Clay Loam
1 ft	Silty Clay Loam	Silty Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam	Clay Loam
2 ft	Silty Clay Loam	Clay Loam	Sandy Loam	Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam	Clay Loam
3 ft	Silty Clay Loam			Clay Loam	Sandy Clay Loam	Clay Loam		Clay Loam
4 ft	Clay Loam			Clay Loam	Sandy Clay Loam			Clay Loam
5 ft				Clay Loam	Sandy Clay Loam			
6 ft				Sandy Clay Loam	Sandy Loam			
7 ft								
8 ft								
9 ft								
10 ft								
11 ft								
12 ft								
13 ft								
14 ft								
15 ft								
16 ft								
17 ft								
18 ft								
Total	4 ft 6 in	2 ft 6 in	2 ft 6 in	6 ft 6 in	6 ft 6 in	3 ft 6 in	2 ft 6 in	4 ft 6 in
Refusal	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation

Table 11 Continued.

Date Sampled	5/23/2005	5/23/2005	5/23/2005	6/23/2005	6/23/2005	6/23/2005
Point	9	10	11	12	13	14
Surface	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Clay	Clay	Clay Loam
1 ft	Sandy Clay Loam	Clay	Sandy Clay Loam	Clay	Clay	Sandy Loam
2 ft	Clay Loam	Sandy Clay Loam	Clay Loam	Clay	Clay	Sandy Loam
3 ft	Sandy Clay Loam	Clay Loam	Clay Loam	Clay Loam		Clay
4 ft	Sandy Clay Loam	Clay Loam	Sandy Clay Loam	Clay Loam		Clay Loam
5 ft	Sandy Loam	Clay Loam	Clay Loam	Clay Loam		Clay Loam
6 ft	Sandy Loam			Clay Loam		Clay Loam
7 ft	Loam			Sandy Loam		Sandy Clay Loam
8 ft	Sandy Loam			Sandy Loam		Sandy Loam
9 ft	Sandy Loam			Sandy Loam		Sandy Loam
10 ft				Sandy Loam		Sandy Loam
11 ft				Sandy Loam		Sandy Loam
12 ft				Sandy Loam		Sandy Loam
13 ft				Sandy Loam		Sandy Loam
14 ft						Sandy Loam
15 ft						Sandy Loam
16 ft						
17 ft						
18 ft						
Total	9 ft 6 in	5 ft 6 in	5 ft 6 in	14 ft	3 ft	15 ft 6 in
Refusal	Saturation	Saturation	Saturation	Saturation	Saturation	Saturation

Table 12. Soil auger hole comments for the Ward 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 4 ft.

Hole #2- Moisture increase at 2 ft.

Hole #3- No comments.

Hole #4- Moisture increase at 2 ft. Mottling at 5 ft. Gleying and mottling at 6 ft.

Hole #5- No comments.

Hole #6- No Comments.

Hole #7- Mottling between 2 and 3 ft.

Hole #8- Mottling at 4 ft. and between 4 and 5 ft.

Hole #9- No comments.

Hole #10- Mottling at 4 ft.

Hole #11- Mottling at 4 ft.

Hole #12- No comments.

Hole #13- No comments.

Hole #14- Gleying at 2 ft. 6 in. Red mottling at 14 ft.

Ward Restoration Area: 1907 Soil Series

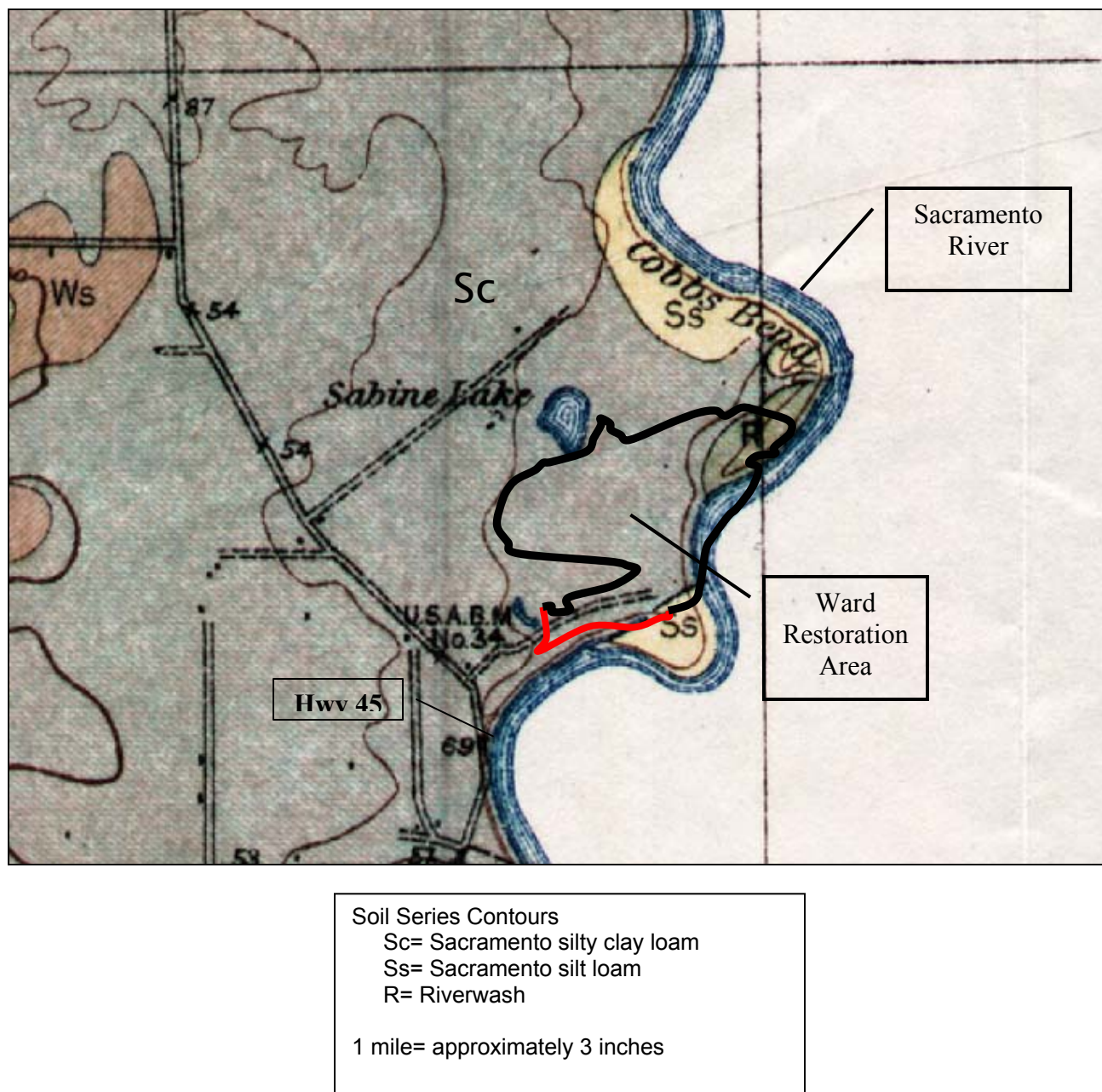


Figure 7. Approximate boundary and location of Ward Restoration Area on the 1907 Soil Survey map, Colusa County, California (USDA Bureau of Soils).

Ward Restoration Area: 1948 Soil Series

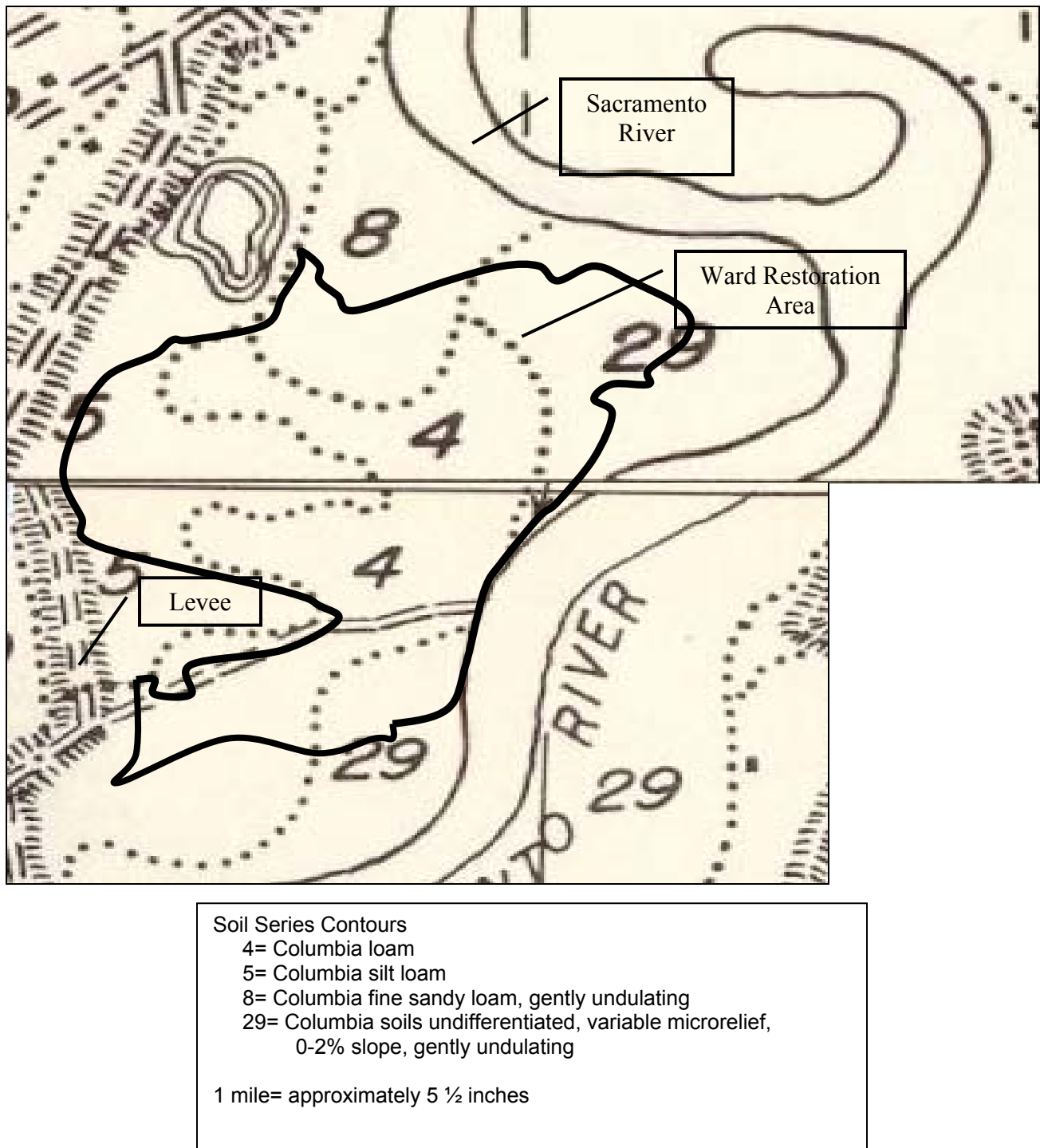


Figure 8. Approximate boundary and location of Ward Restoration Area on the 1948 Soil Survey map, Colusa County, California (Harradine 1948).

Ward Restoration Area: 1967 Soil Series

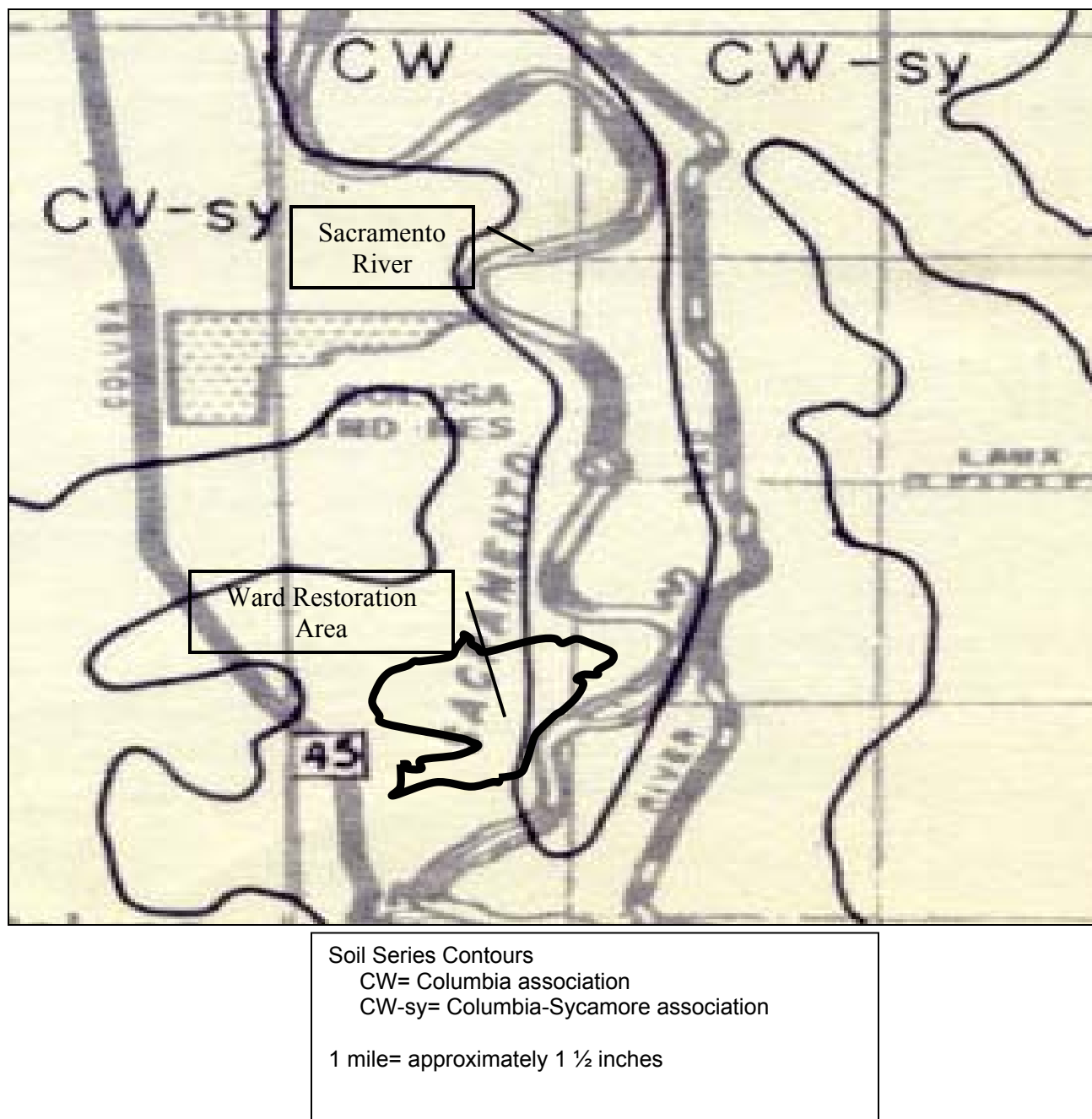


Figure 9. Approximate boundary and location of Ward Restoration Area on the 1967 Soil Survey map, Colusa County, California (USDA Soil Conservation Service).

Ward Restoration Area: 1998 Soil Series

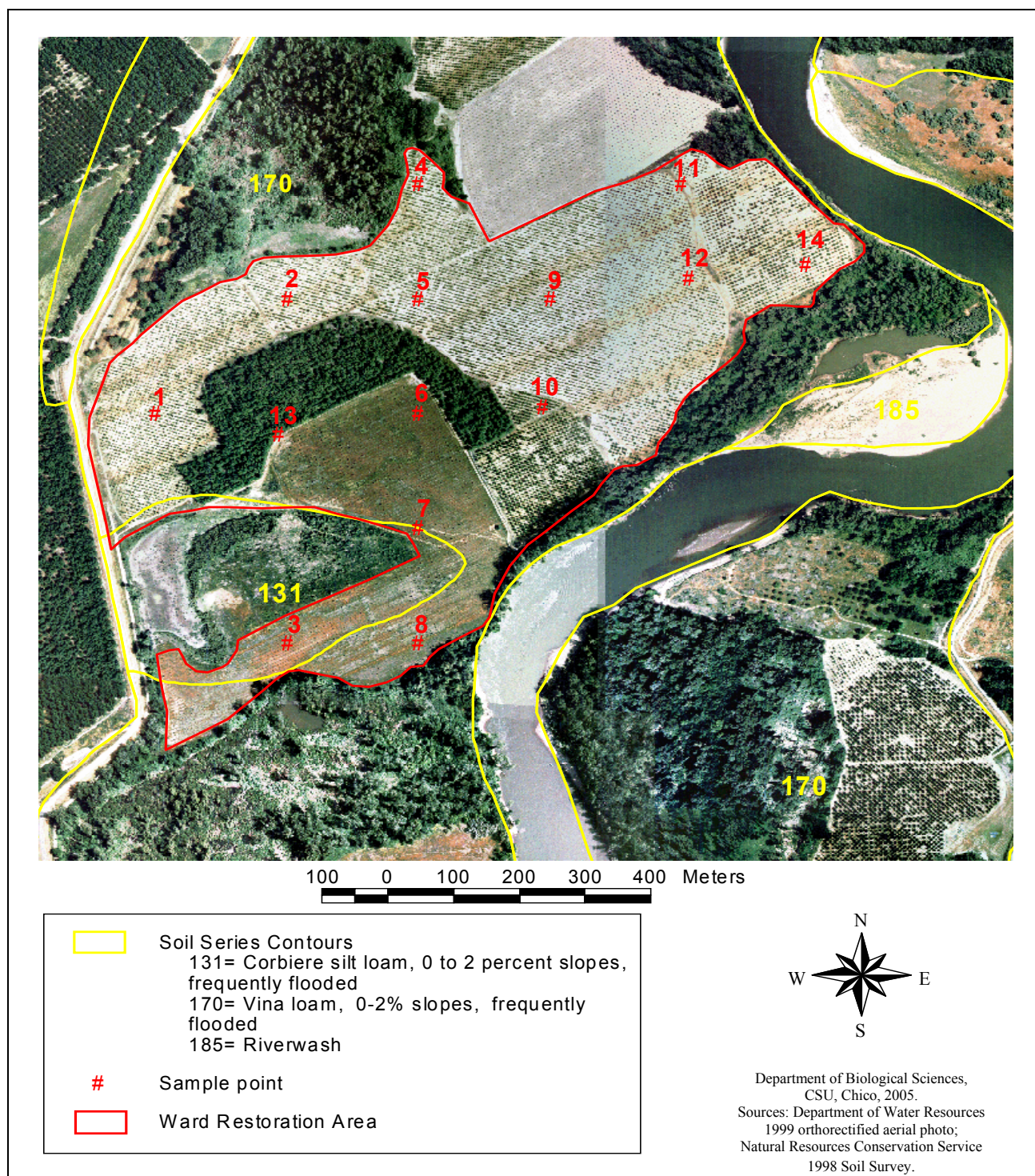


Figure 10. Soil series contours from the 1998 Colusa County Soil Survey at Ward Restoration Area, Colusa County, California (USDA Natural Resources Conservation Service) along with soil sample locations.

Ward Restoration Area: Historic River Channels 1896-1923

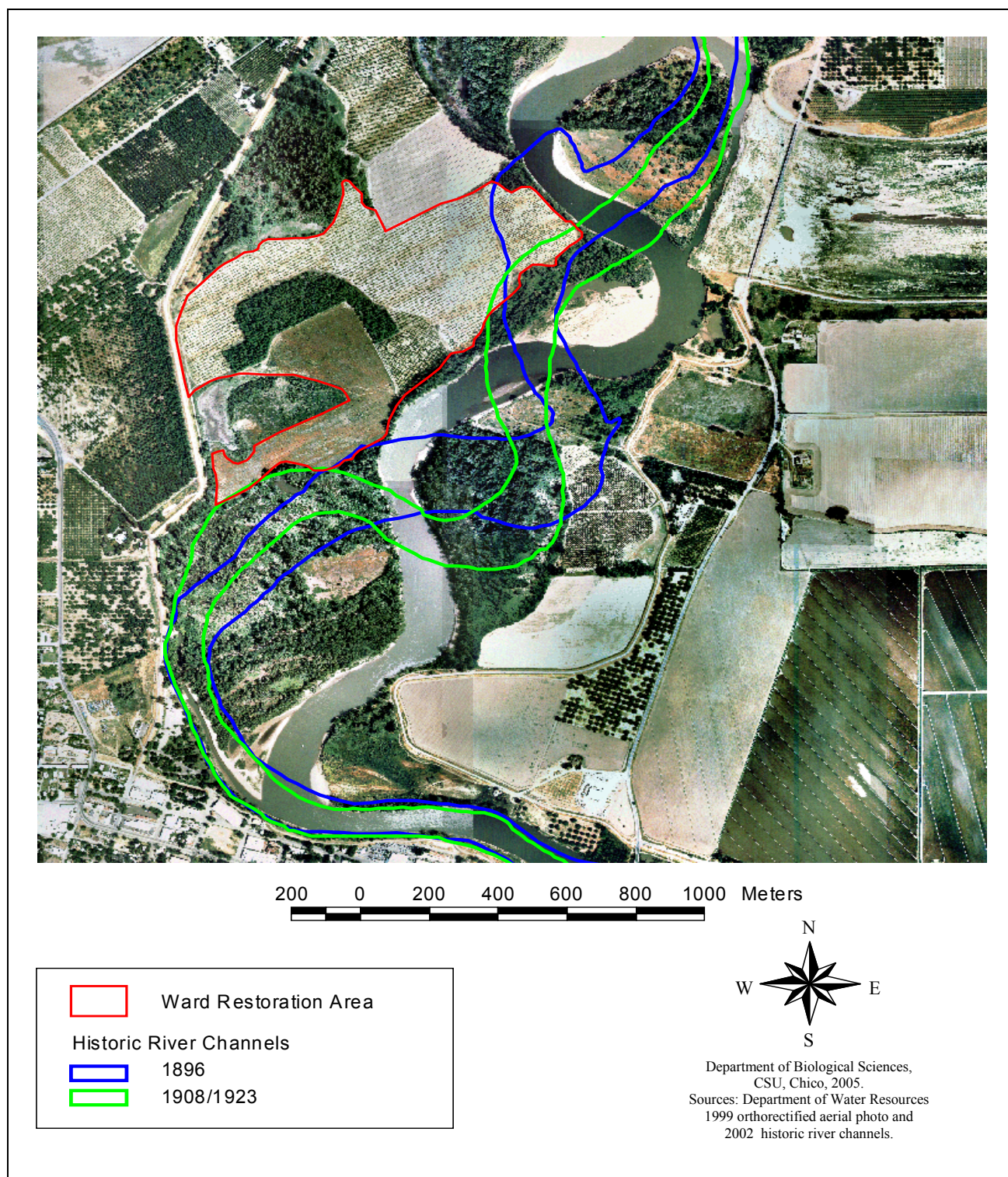


Figure 11. Historic River channels from 1896, 1908, and 1923 at Ward Restoration Area, Colusa County, California. The 1908 and 1923 channel is the same for this stretch of the river.

Ward Restoration Area: Historic River Channels 1935-1960

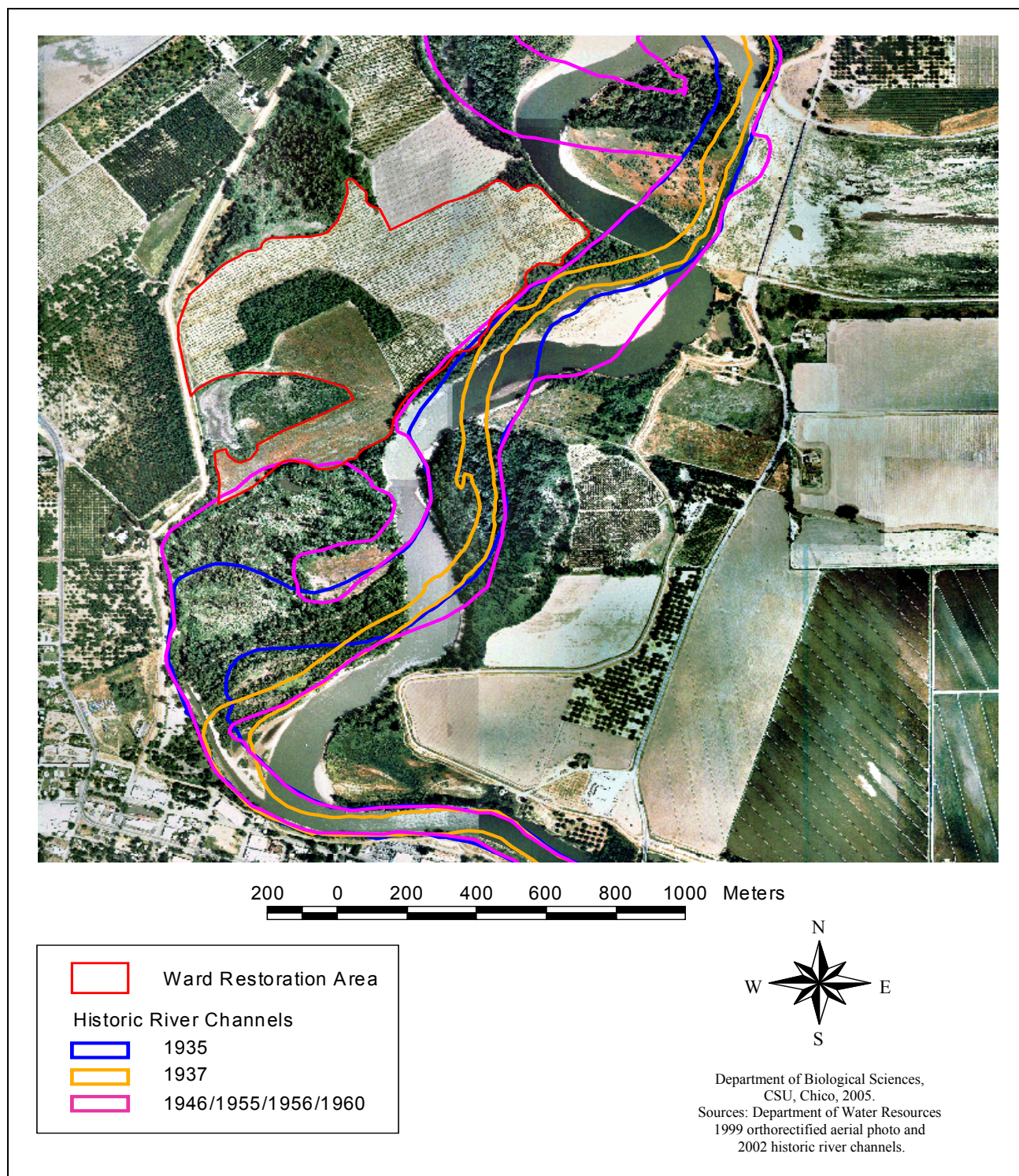


Figure 12. Historic River channels from 1935, 1937, 1946, 1955, 1956, and 1960 at Ward Restoration Area, Colusa County, California. The 1960 channel is the same for this stretch of the river as 1946, 1955 and 1956.

Ward Restoration Area: Historic River Channels 1964-1997

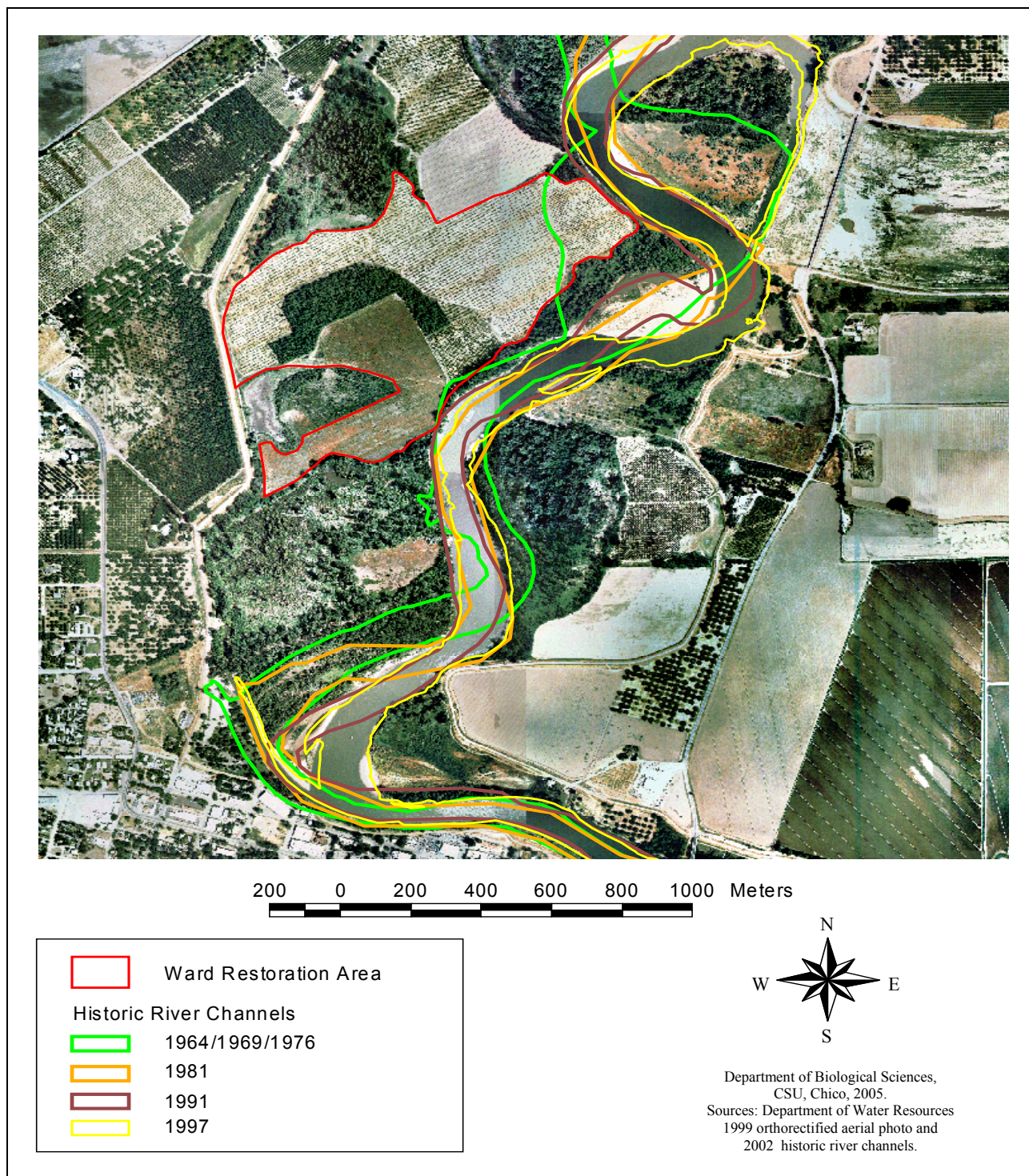


Figure 13. Historic River channels from 1964, 1969, 1976, 1981, 1991, and 1997 at Ward Restoration Area, Colusa County, California. The 1976 channel is the same for this stretch of the river as 1964 and 1969.

Acknowledgements

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SECTION FOUR

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 July 2005 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 June and 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 June 22, 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 Ward tract (Figure 14). 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 Ward 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	Breeding
Valley elderberry longhorn beetle	<i>Desmocerus californicus dimorphus</i>	FT	4
Swainson's hawk	<i>Buteo swainsonii</i>	ST	1
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	SE	4
Bank swallow	<i>Riparia riparia</i>	ST	2

Table 14. Special status animal species with potential or known to occur or reside within 1.0 mile of the Ward 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	<i>Desmocerus californicus dimorphus</i>	FT	probable
Sacramento splittail	<i>Pogonichthys macrolepidoptus</i>	SSC1	potential
Steelhead – Central Valley ESU	<i>Oncorhynchus mykiss</i>	FT	potential
Chinook salmon (fall run)	<i>Oncorhynchus tshawytscha (fall run)</i>	SSC	potential
Common Name	Scientific Name	Status	Breeding
Chinook salmon (spring run)	<i>Oncorhynchus tshawytscha (spring)</i>	FT/ST	potential
Chinook salmon (winter run)	<i>Oncorhynchus tshawytscha (winter)</i>	FE/SE	probable
Hardhead	<i>Mylopharodon conocephalus</i>	SSC3	
Western spadefoot toad	<i>Spea hammondi</i>	SSC	potential
Western pond turtle	<i>Clemmys marmorata</i>	SSC	probable
Giant garter snake**	<i>Thamnophis gigas</i>	FT/ST	potential
American white pelican	<i>Pelecanus erythrorhynchos</i>	SSC	
Double-crested cormorant*	<i>Phalacrocorax auritus</i>	SSC2	potential
White-faced ibis	<i>Plegadis chihi</i>	SSC	
Osprey	<i>Pandion haliaetus</i>	SSC2	potential
Bald eagle	<i>Haliaeetus leucocephalus</i>	FT/SE	
Northern harrier	<i>Circus cyaneus</i>	SSC2	probable
Sharp-shinned hawk	<i>Accipiter striatus</i>	SSC3	probable
Cooper's hawk	<i>Accipiter cooperii</i>	SSC3	probable
Swainson's hawk*	<i>Buteo swainsoni</i>	ST	known
Ferruginous hawk	<i>Buteo regalis</i>	SSC	
Golden eagle	<i>Aquila chrysaetos</i>	SSC3	
Peregrine falcon	<i>Falco peregrinus</i>	SE	
Prairie falcon	<i>Falco mexicanus</i>	SSC3	
California gull	<i>Larus californicus</i>	SSC3	
Burrowing owl	<i>Athene cunicularia</i>	SSC2	potential
Short-eared owl	<i>Asio flammeus</i>	SSC2	potential
Long-eared owl	<i>Asio otus</i>	SSC	
Greater sandhill crane	<i>Grus canadensis tabida</i>	ST	
Long-billed curlew	<i>Numenius americanus</i>	SSC	
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	FSC/SE	known
Willow flycatcher	<i>Empidonax traillii</i>	SE	?
Loggerhead shrike	<i>Lanius ludovicianus</i>	CSC	probable
Purple martin	<i>Progne subis</i>	SSC2	
Bank swallow	<i>Riparia riparia</i>	ST	known
Yellow warbler	<i>Dendroica petechia</i>	SSC2	potential
Yellow-breasted chat	<i>Icteria virens</i>	SSC2	probable
California horned lark	<i>Eremophila alpestris actia</i>	SSC	potential
Tricolored blackbird	<i>Agelaius tricolor</i>	SSC	potential

Table 14 continued.

Townsend's big-eared bat**	<i>Corynorhinus townsendii</i>	SSC2	?
Pallid bat**	<i>Antrozous pallidus</i>	SSC	?
Western mastiff bat	<i>Eumops perotis</i>	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 Ward tract. 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 nearby remnant vegetation wherever blue elderberry (*Sambucus mexicana*) is present. This species is recorded in the CNDDDB as occurring within 1.0 mile of the 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 are an anadromous species of fish that spawns in tributaries of the Sacramento River. Mill, Deer, and Butte Creek are the principle 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 are 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. Swainson's hawks have been observed foraging within 1.0 mile of the Restoration Area by the authors. A pair of Swainson's hawks was also observed performing courtship displays over remnant riparian habitat adjacent to the Colusa North Restoration Area by the authors. It is expected that this pair has a nest location within riparian habitat adjacent to either the Ward or Colusa North Restoration Areas. This species is recorded in the CNDDDB as occurring within 1.0 mile of the Ward Restoration Area and adjacent remnant riparian habitat.

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 CNDDDB as nesting 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 CNDDDB as nesting 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 Ward Restoration Area, and an estimate (where possible) of abundance. Small mammal sampling is currently being conducted at the Restoration Area and within nearby remnant riparian habitat, but 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 have not been observed at the Restoration Area, but this species is expected to occur periodically due to the proximity of residences to the Restoration Area and 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 toxoplasmosis; 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 Ward 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	<i>Canis domesticus</i>	No	Unknown
Feral Cat	<i>Felis catus</i>	No	Unknown
House Mouse	<i>Mus musculus</i>	No	Unknown
Roof Rat	<i>Rattus rattus</i>	No	Unknown
Norway Rat	<i>Rattus norvegicus</i>	No	Unknown
Nutria	<i>Myocastor coypu</i>	No	Unknown
Virginia Opossum	<i>Didelphus virginianis</i>	Sign (tracks)	Unknown

Bird Counts

Figure 14 shows sampling locations and Table 16 lists all bird species observed on the June 22, 2005 point counts. Figure 15 shows the frequency of occurrence for species observed more than once. Forty-three species were encountered during the survey, and species composition was fairly typical of riparian habitats along the Sacramento River. Black-headed grosbeak was the species most frequently observed (8.8%), followed by spotted towhee (8.0%), house finch (7.7%) and Nuttall's woodpecker (6.5%).

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

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

Table 16 continued.

Western kingbird	<i>Tyrannus verticalis</i>	
Western scrubjay	<i>Aphelocoma californica</i>	
Western wood-pewee	<i>Contopus sordidulus</i>	
White-breasted nuthatch	<i>Sitta carolinensis</i>	
Wild turkey	<i>Meleagris gallopavo</i>	non-native
Wood duck	<i>Aix sponsa</i>	
Yellow-billed magpie	<i>Pica nuttalli</i>	

Ward Restoration Area: Bird Survey Locations

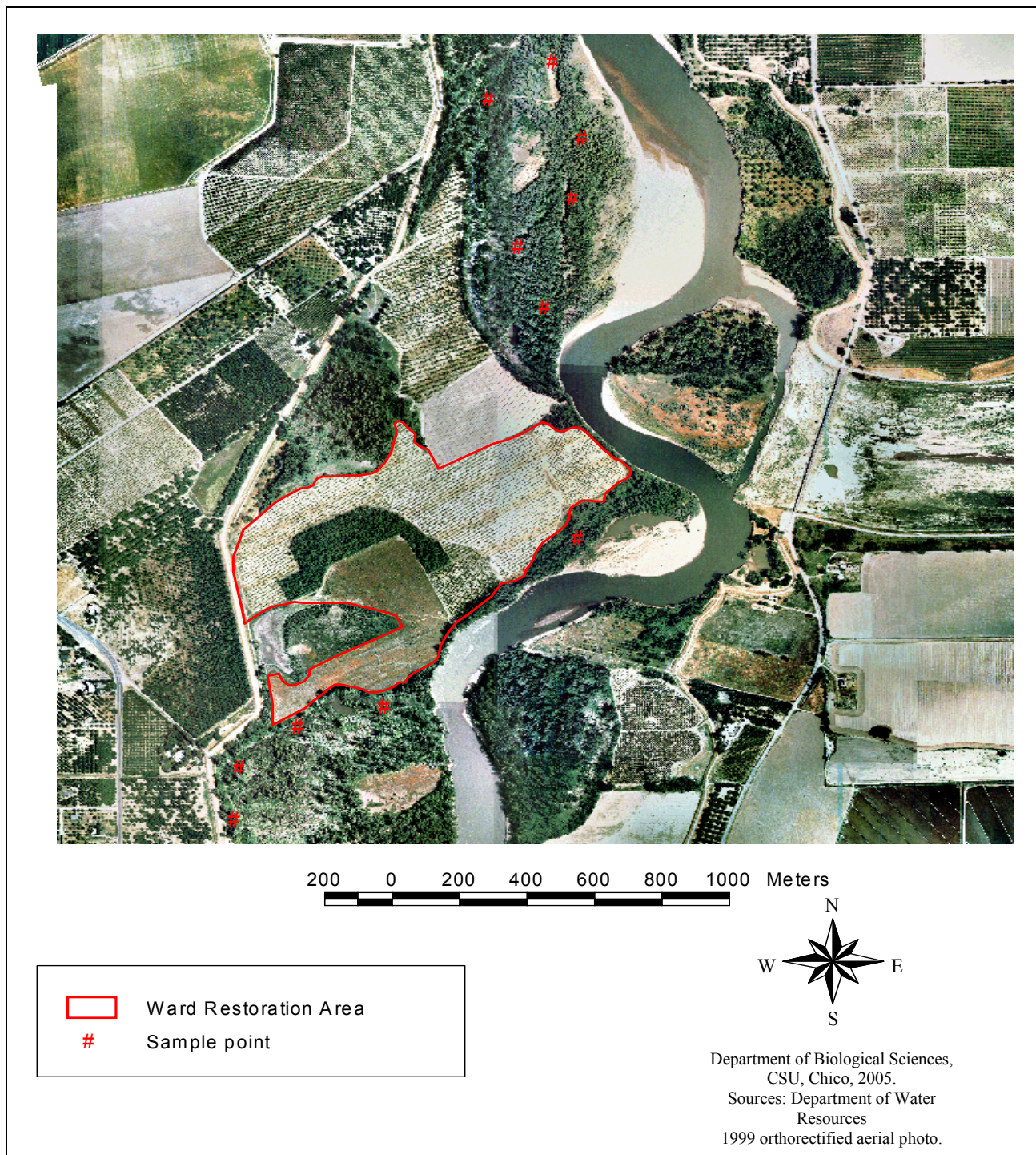


Figure 14. Bird survey station locations in riparian habitat close to the Ward Restoration Area, Colusa County, California.

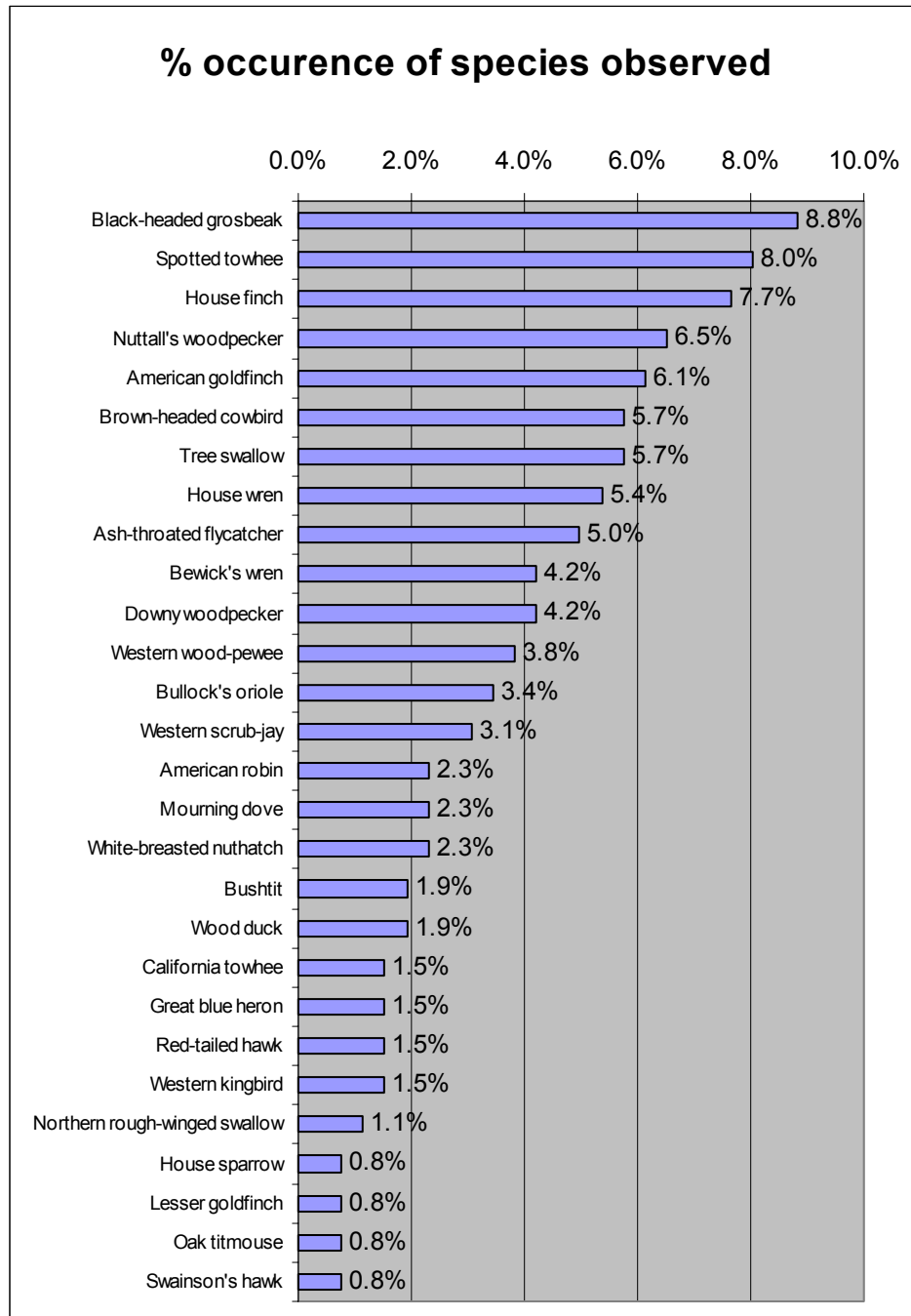


Figure 15. Frequency of bird species observed more than once within a 50 m radius of ten 8-minute observation stations within remnant riparian habitat close to the Ward Restoration Area, Colusa County, CA. Species observed only once are excluded for clarity.

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