Colusa Subreach Planning
Pest and Regulatory Effects Study
Final Project Report



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Submitted to:

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ACRONYMS AND ABBREVIATIONS

Advisory Workgroup	Colusa Subreach Planning Advisory Workgroup
BMP	best management practice
BO	Biological Opinion
CalPIP	California Pesticide Information Portal
CCR	California Code of Regulations
CDFA	California Department of Food and Agriculture
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CITES	Convention on International Trade in Endangered Species
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Conservation Area	Sacramento River Conservation Area
DFG	California Department of Fish and Game
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ERP	CALFED Ecosystem Restoration Program
ESA	federal Endangered Species Act
External Experts Group	Pest and Regulatory Effects Study External Experts Group
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
GNP	Good Neighbor Policy
HCP	Habitat Conservation Plan
IPM	integrated pest management
Irrigated Lands Waiver	Regional Water Quality Control Board Irrigated Lands Waiver
MBTA	Migratory Bird Treaty Act
MOA	Memoranda of Agreement
MOU	Memoranda of Understanding
NCCP	Natural Community Conservation Plans
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
Porter-Cologne	Porter-Cologne Water Quality Control Act
PRC	Public Resources Code
PRES	Pest and Regulatory Effects Study
PRESCRIBE	Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine
PSHA	Programmatic Safe Harbor Agreement
PUR	Pesticide Use Report
regional water boards	Regional Water Quality Control Boards
RM	River Mile
SRCAF	Sacramento River Conservation Area Forum
State Water Board	State Water Resources Control Board
TID	Turlock Irrigation District
TMDL	total maximum daily loads
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

BACKGROUND AND PURPOSE OF THE STUDY

The Nature Conservancy (TNC) has been actively engaged in conserving riparian wildlife habitat along the middle Sacramento River for over twenty years through its Northern Central Valley Region Office in Chico, California. Since 2000, TNC has pursued subreach planning which has involved the comprehensive analysis of distinct segments of the Sacramento River corridor in order to best address the restoration of habitat areas. Building upon previously completed subreach planning for the Chico Landing and Beehive Bend subreaches, in 2004 TNC was awarded a three-year CALFED Ecosystem Restoration Program (ERP) grant for Colusa Subreach Planning (CSP). The Subreach extends from the City of Colusa upstream twenty miles to the community of Princeton. CSP includes planning and research projects that have been identified by local stakeholders to address their questions and concerns regarding habitat conservation. TNC is partnering with the Sacramento River Conservation Area Forum (SRCAF) to conduct an extensive public outreach process as part of CSP. This outreach effort focuses on a Colusa Subreach Planning Advisory Workgroup (Advisory Workgroup) which is composed of representatives of the SRCAF, local interests and the agencies that are responsible for management of habitat in the project area. A goal of CSP is to develop riparian habitat restoration plans that are compatible with neighboring land uses. As part of this process, portions of eight tracts totaling 390 acres have been proposed for restoration from actively farmed and fallow agricultural lands to native riparian habitat. These tracts are located on public and private lands that have been purchased for conservation and are owned by TNC, the California Department of Fish and Game (DFG), and the California Department of Water Resources (DWR).

Although the residents of California have expressed strong support for the conservation and restoration of the Sacramento and other rivers, some local landowners, farmers, business interests, and local government officials have expressed concerns regarding the restoration of agricultural land to riparian habitat. These concerns relate to a wide range of potentially adverse effects including increased crop damage by wildlife and additional regulatory controls related to protected species and habitats.

This Pest and Regulatory Effects Study (PRES) was selected by the Advisory Workgroup as a topic of concern warranting further study under the CSP grant. This study aims to provide objective scientific information regarding environmental regulations and pest damage potentially affecting crops and agricultural operations in the Colusa Subreach. This study focused on several regulatory and pest effect issues, including identification and prioritization of regulatory constraints and pest species, characterization of potential changes with restoration of riparian habitat, and identification and prioritization of solutions to address potential regulatory constraints and pest damage. A total of seven federal and eight state laws and regulations and 26 high and medium priority pests identified by an Advisory Workgroup and External Experts Group were analyzed in this study. Due to scope limitations, low priority pest species were not addressed.

As part of the Colusa Subreach planning process, TNC and SRCAF are partnering with local stakeholders and experts in an Advisory Workgroup and External Experts Group to conduct an extensive public outreach process related to the proposed restoration plans. The Advisory Workgroup is composed of representatives of the SRCAF, local interests, and the agencies that are responsible for management of habitat in the project area. The Advisory Workgroup is responsible for conducting an extensive public outreach process as part of CSP. The External Experts Group is a collection of local experts in matters of agricultural land use, regulations, and pests and is responsible for providing expert guidance on the study design and interpretation of results. To ensure that stakeholder concerns would be adequately addressed by this study, EDAW facilitated multiple meetings with the Advisory Workgroup, External Experts Group, and individual landowners with property adjoining the proposed restoration sites. Discussions with these stakeholders framed the initial design of this study; the priority pests, crops and regulatory issues to be analyzed; and led to contributions to the study.

KEY REGULATORY FINDINGS

Of the seven federal and eight California laws and regulations analyzed, only one potentially significant increase in agricultural regulatory constraints is likely to result from the restoration of riparian habitat in the Colusa Subreach: restrictions within 100 feet of elderberry shrubs which is habitat for the valley elderberry longhorn beetle, a species that is federally-listed as threatened. However, because the open canopy types of riparian habitat (e.g., savannah) that are most suitable to the growth of elderberry shrubs constitute only a small percentage of the proposed restoration area and because only a small percentage of the proposed restoration perimeter borders agricultural land, the potential increase in valley elderberry longhorn beetle-related regulatory constraints on adjacent agricultural parcels is expected to be small. Riparian habitat restoration is not expected to increase agricultural regulatory constraints associated with the other 14 regulations, 14 protected species, and 6 protected habitats analyzed in this study.

To comply with Endangered Species Act (ESA) protections for the valley elderberry longhorn beetle, activities within 100 feet of elderberry shrubs with stem diameters 1.0 inches or greater at ground level could be restricted, and riparian habitat restoration may result in a small increase of such shrubs within 100 feet of farm activities. These practices are not limited, however, adjacent to smaller elderberry shrubs, and such shrubs may be removed by landowners before they reach the protected 1 inch stem diameter size. Restrictions to activities may be removed within the next several years, as the USFWS has proposed to delist the valley elderberry longhorn beetle (USFWS 2006). However, this USFWS recommendation is not a guarantee that the species will be delisted, and the official decision may not be finalized for a number of years. A variety of practical solutions available to prevent limitations surrounding larger elderberry shrubs are discussed in Chapter 3, Regulatory Solutions, and are summarized in the next section.

Of the remaining laws and regulations analyzed, four federal and two state laws do not have potential to increase restrictions on agricultural operations as a result of riparian habitat restoration anywhere in the United States. (While these conclusions are geographically broad, they apply only to the restoration of riparian habitat and not to the restoration of wetlands or other habitat types.) These regulations include:

FEDERAL:

- National Environmental Protection Act (NEPA),
- Migratory Bird Treaty Act (MBTA),
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and
- Bald and Golden Eagle Protection Act of 1940.

CALIFORNIA:

- California Environmental Quality Act (CEQA), and
- Sections 1602 and 3503 of the California Fish and Game Code.

The potential for riparian habitat restoration to increase agricultural constraints associated with the remaining laws and regulations is dependent upon regional factors that vary across California. The federal Clean Water Act would not become more restrictive to agricultural operations as a result of riparian habitat restoration in the Central Valley floor including the Colusa Subreach. For Central Valley farms under the jurisdiction of the Central Valley Regional Water Quality Control Board (including the Colusa Subreach), the Regional Water Quality Control Board Irrigated Lands Waiver would not become more restrictive to agricultural operations as a result of riparian habitat restoration. This regulation does not apply to farms outside of the Central Valley board's jurisdiction, and the eight other Regional Water Quality Control Boards may have different regulations. Similarly, California's Porter-Cologne Water Quality Control Act is implemented by these nine regional boards, each of which is regulated with a different set of total maximum daily loads (TMDLs). Riparian habitat restoration would not

increase agricultural constraints related to the Central Valley board's TMDLs and the application of Porter-Cologne in the Central Valley. TMDLs set by other regional boards have not been analyzed in this study.

Analysis of two additional regulations and one voluntary program concluded they would not increase restrictions to agricultural operations as a result of riparian habitat restoration in the Colusa Subreach: pesticide label restrictions, the voluntary PRESCRIBE program, and the California Food and Agricultural Code. These regulations and programs are applied variously depending on the pesticide products used, and only the pesticide products used in the Colusa Subreach were analyzed in this report.

Restrictions to agriculture associated with the remaining three laws, the federal and state endangered species acts and the fully protected species provisions of the California Fish and Game Code, vary according to the species being protected. Fourteen federal and state special-status species known or with potential to occur in the Colusa Subreach are examined in this report. Regulatory constraints to agriculture related to the following species are unlikely to be affected by riparian habitat restoration in the study area:

- giant garter snake,
- southern bald eagle,
- golden eagle,
- American peregrine falcon,
- greater sandhill crane,
- little willow flycatcher,
- bank swallow,
- chinook salmon,
- Central Valley steelhead, and
- green sturgeon.

For three state-protected bird species, Swainson's hawk, white-tailed kite, and western yellow-billed cuckoo, increased regulatory constraints to agriculture may occur but are unlikely and would be insignificant. The only potentially restricted farm activity related to these species is the removal of nest trees within the 15–79 day incubation and nestling period. Because these three species are more likely to nest in riparian trees than farm or orchard trees, and because nest trees may legally be removed by farmers before eggs have been laid, after the chicks have fledged, or after the nests have failed, restrictions to the timing of nest tree removal are not considered a significant constraint to farm activities.

Restoration of riparian habitat adjacent to agricultural lands may also provide an economic and regulatory benefit to farmers by providing a forested buffer between agricultural lands and the federally and state-protected Sacramento River. Vegetated buffers are encouraged by federal and state water quality and pesticide use agencies and laws, to reduce the risk of runoff and spray drift of agricultural pollutants into the water column. Vegetated buffers are included among the best management practice (BMP) options encouraged by the Central Valley TMDL program and Irrigated Lands Waiver, some pesticide labels, and the PRESCRIBE program. Physical barriers, such as riparian habitat, provide a higher standard of protection and can be more economical than traditional pesticide mitigation measures.

REGULATORY SOLUTIONS

This study describes and evaluates eight potential solutions to prevent the potential for slightly increased restrictions surrounding elderberry shrubs and the ESA-protected valley elderberry longhorn beetle in the Colusa Subreach. The discussion is limited to the valley elderberry longhorn beetle because that is the only species for which there is potential for increased regulatory constraints. Three solutions appear to be the most promising, including:

- maintained buffer zones,

- Programmatic Safe Harbor Agreement (PSHA) as part of the SRCAF Good Neighbor Policy (GNP), and
- Memoranda of Agreement/Memoranda of Understanding (MOA/MOU).

A maintained buffer zone could consist of a vegetated or unvegetated 100-foot strip on the restoration property along its border with a farm or orchard. This zone would be subject to long-term maintenance to ensure that it would remain free of protected elderberry shrubs. A PSHA is a permit authorized by USFWS in which landowners who choose to sign on may receive federal protection from increased ESA restrictions related to habitat restoration in the region. The SRCAF is currently developing a PSHA onto which Colusa Subreach farmers may voluntarily sign. An MOA/MOU could also be drafted in which Colusa Subreach restoration proponents "protect and release" neighboring landowners from increased ESA constraints by assuming responsibility for incidental take of elderberry shrubs by farmers. All three potential solutions offer high long-term landowner assurance for protection from increased restrictions related to the valley elderberry longhorn beetle and flexibility for restoration proponents and neighboring landowners to collaborate in the decision-making process. In addition, a PSHA may reduce ESA constraints to farmers below the current level by offering protection from restrictions relating to new elderberry shrubs that may spread from currently existing populations in the Subreach. The SRCAF GNP also outlines recommendations for buffer zones and a PSHA, and offers a framework for public involvement in the decision-making process.

Other potential solutions to slightly increased regulatory constraints include habitat type configuration, planting protocols, and Habitat Conservation Plans (HCPs). The potential for USFWS to delist the valley elderberry longhorn beetle from ESA protection in the future is also described in Chapter 3, Regulatory Solutions.

Habitat type configuration and planting protocols are two types of restoration design solutions that could further reduce the likelihood of elderberry shrubs dispersing from the restoration sites to within 100 feet of neighboring agricultural lands. Restoration proponents could plant open-canopy habitat types that are likely to host elderberry shrubs (e.g., open woodland, savannah) at least 100 feet away from borders with agricultural lands, and plant closed-canopy habitat types that are unlikely to support this shade-intolerant shrub adjacent to borders with agricultural lands. Alternatively, elderberry shrubs could be omitted from restoration planting protocols, either altogether or within 100 feet of neighboring farms. Although these potential solutions may offer additional benefits when combined with buffer zones or regulatory agreements, by themselves they offer low landowner protection from ESA constraints, as they contain no protection against the natural dispersal of off-site elderberry shrubs that may occur in the future. In addition, other ecological considerations may outweigh or preclude locating closed canopy habitat types adjacent to borders with agricultural land. For instance, on particular restoration sites, soil conditions, hydrology, or ecological objectives may suggest providing closed canopy habitats in other configurations or not planting them at all. Further research is recommended on planting configurations adjacent to agricultural areas to help determine the need for, and effectiveness of, different border habitat types for both regulatory (valley elderberry longhorn beetle-related restrictions) and pest considerations.

Restoration proponents could apply for an HCP for incidental take of existing elderberry shrubs during their initial restoration activities; this take would be mitigated by elderberry shrub planting and by the long-term benefits that restoration would have on valley elderberry longhorn beetle populations. A major drawback of this approach is that because the restoration proponents would hold the take permit and do not have regulatory authority over neighboring farmers to ensure permit compliance, the restoration proponents would be required to be the responsible parties removing all shrubs covered under the HCP, even those present on neighboring farmlands. This arrangement is unlikely to be amenable to either the restoration proponents or the neighboring farmers. Additional drawbacks to the HCP approach are the high cost and lengthy timeframe typically associated with drafting and negotiating such agreements. A programmatic HCP is thus the least favored of the potential regulatory solutions examined in this study.

The most beneficial approach may be one that offers maximum flexibility to meet the needs of both neighboring landowners and restoration proponents, by combining buffer zones, a PSHA, an MOA/MOU, and public outreach as recommended in the GNP. In this approach, landowners wishing to reduce their ESA constraints below the

current level could choose to sign on to a PSHA under various options described in Chapter 3 of this document. The options vary in their site survey requirements from no surveys required, to site surveys, and to aerial photograph-based estimates to determine the baseline number of elderberry shrubs present on either conservation properties, adjacent landowner properties, or both. Landowners who do not wish to sign on to the PSHA would be under no obligation to do so. These landowners would have the option to instead sign an MOA/MOU which would not involve any federal agencies and in which the restoration proponents would "protect and release" their neighbors from responsibility for take of valley elderberry longhorn beetles, or they may choose to sign no agreement at all.

Restoration proponents could maintain 100-foot buffer zones on the restoration sites adjacent to properties of landowners who do not wish to sign a PSHA or MOA/MOU, to ensure that existing ESA constraints on these landowners will not be increased by the restoration. On the other hand, for restoration sites adjacent to properties of landowners who do sign the PSHA, no buffer zones would be needed to reduce regulatory constraints. This would allow the additional ecological benefit of restoring the entire site to riparian habitat (if buffer zones are also not needed on those properties for pest control). If buffer zones are needed on a farm property for pest control, the PSHA would enable greater flexibility in the buffer zone design and maintenance.

KEY PEST FINDINGS

Potential increases in pest populations and/or damage presented in this study are based on expert information and the best available science. Based on this study's analyses, riparian habitat restoration proposed in the Colusa Subreach is likely to provide both benefits and some minimal risks in pest effect changes to agricultural operations compared to existing conditions. However, with 55% of the Subreach in existing riparian habitat and only 7% of the Subreach proposed for riparian habitat restoration, the anticipated change in pest populations and pest effects is unlikely to be substantial. Overall, there may be a decrease in pest effects. This is because riparian habitat does not support most agricultural pests evaluated in this study, as discussed in Section 4.2. Pest effects that do occur, however, could shift to new farmlands in a few of the restoration sites. All of those farmlands already are bounded by at least some riparian habitat and in some cases, they are substantially surrounded by riparian habitat. Only 11% of the perimeters of the eight restoration tracts are directly adjacent to cropland (Table 1.4, Exhibits 1-3 to 1-8). Of six cropland properties that adjoin proposed restoration areas, 60% of the perimeter of these cropland areas is directly adjacent to existing riparian habitat. Following restoration, the percentage would increase to 84%. Each of these adjacent cropland areas already is subjected to riparian habitat influences to a substantial degree. As a result, it is expected that the proposed restoration will not introduce completely new influences on the existing cropland (Exhibit 1-9).

Strategic planning can further increase the likelihood of benefits while reducing the potential for adverse effects. This conclusion is based on the limited amount of information available on transboundary invertebrate pest effects arising from riparian habitat restoration adjacent to agricultural operations. Indeed, studies in the ecology of many pest species are lacking, especially in relation to riparian habitat uses and influences. The likelihood of changes in pest populations and effects depends on a number of factors including the type, size and location of the target riparian community to be restored; the community's plant species composition; the ecology of the pest, including its home and dispersal range; the tendency for adjacent agricultural land to provide the pest's preferred food and habitat; the likelihood of pests to be present on restored riparian habitat; and the effectiveness of current pest management practices.

Of the 25 species identified by the Advisory Workgroup and External Experts Group as high or medium priority pests, four are likely to have some increases in pest effects, eleven are expected to remain the same in pest effects, and ten are likely to yield decreased pest effects in both the short (0-4 years) and long term (more than 5 years) following restoration plantings. Of the species that have potential to increase in population size or crop damage, the overall change is expected to be small. This is based on the relatively small proportion of the Subreach that will be restored relative to existing riparian habitat in the Subreach, the relatively small proportion of restoration

tract border area that adjoins agricultural land, and the determination that adjoining agricultural parcels already border substantial amounts of riparian habitat.

Based on information from local pest experts and limited data from previous studies on crop pests, the summary below indicates anticipated pest effect changes from existing conditions where riparian habitat restoration is proposed. However, due to the lack of research data on many of these species, additional research is needed to ultimately confirm or refute these findings based on clear analyses of pest species' preferences, usage and pest effects in agricultural and riparian habitat settings.

- Pest effects of four species (California ground squirrel, western gray squirrel, California vole, and lygus bug) have the potential to increase on adjacent or nearby agricultural lands in the short term (i.e., first few years).

    - Local studies on the effects of riparian habitat restoration indicated that ground squirrels are common in agricultural habitats but not in riparian habitat. This suggests that riparian habitat restoration will not lead to increased ground squirrel populations in adjacent agricultural lands. However, there may be a short term shift in populations to adjacent farms that provide suitable habitat when restoration projects are first implemented. In the long term, ground squirrel populations are expected to decrease in the Subreach with loss of their preferred (agricultural) open habitat and with closure of the riparian forest habitat areas as they mature.

    - Voles may increase in riparian restoration sites during the first few years (0 to 4 years) when an open canopy and herbaceous vegetation are present. Vole populations in most restoration areas would diminish at maturity since most proposed riparian restoration areas are closed canopy types that don't support substantial vole populations.

    - Western tarnish (aka lygus bug) populations will likely initially increase in young riparian restoration sites until the weedy host plants that support them are outshaded or outcompeted by the planted native vegetation as the restoration sites reach maturity.

    - Restoration of mature riparian forest habitat may lead to localized increases in gray squirrels in established riparian forest restoration sites (over 10 years old). While not confirmed during local research studies thus far conducted, these populations may browse on nearby walnuts. The western gray squirrel population is unlikely to substantially increase in the Subreach because only 7% of the Subreach land is proposed to be restored.

- Pest effects of eleven species (mule deer, black-tailed jackrabbit, Audubon's cottontail, coyote, American beaver, northern river otter, common muskrat, Brewer's blackbird, European starling, American crow, and brown rot) are expected to remain the same.

    - Mule deer, black-tailed jackrabbit, Audubon's cottontail, coyote, Brewer's blackbird, European starling, and American crow tend to use both agricultural and riparian habitats; thus, while there would be a change in habitat types from agricultural to riparian, the populations and effects would not likely change substantially from existing conditions. However, depending on the target habitat type, some of these species may decrease in population size. For instance, black-tailed jackrabbit and cottontail would likely decrease in population in areas with closed canopy riparian habitat. Coyote populations might serve to control some rodent pests.

    - Beavers, river otters, and muskrats, generally forage and use burrows near to or along waterways (e.g., beaver tend to forage no more than about 300 feet from water). Any potential increase in damage would be in areas near waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed near waterways.

- No known potential exists for riparian habitat restoration to affect brown rot (*Monilinia* spp.) incidence or spread.

► Ten species (Botta's pocket gopher, codling moth, navel orangeworm, walnut husk fly, peach twig borer, fruit-tree leafroller, oblique-banded leafroller, omnivorous leafroller, walnut blight, and root and crown rot) are likely to decrease in pest effects.

- Pocket gophers are expected to decline in populations and pest effects with riparian habitat restoration due to a decrease in preferred habitat.

- Riparian habitat restoration may lead to a decrease in populations of codling moth, navel orangeworm, and walnut huskfly by removing its preferred orchard habitat and by harboring natural enemies such as ground beetles and birds. In addition, while California black walnut and black walnut hybrids (invasive plants spread from the rootstock of existing orchards) may serve as a host for these pests, they will not be planted and they are unlikely to substantially invade areas that are planted with competing native trees and shrubs. Thus, if they do colonize, they are unlikely to be at densities greater than existing walnut orchards.

- Peach twig borers and leafrollers (fruit-tree, oblique-banded, and omnivorous) are mainly confined to orchards. Peach twig borer is unlikely to use riparian habitat and, in fact, may be controlled by natural enemies (some ant, wasp, and other species) found in riparian habitats. Although alternate host species such as valley oak and wild rose may support some of these pests, the density of these hosts will be lower than agricultural crop host plants and will be mixed in with non-host native plants. Riparian habitats may reduce pest population densities by subsidizing natural enemies, but studies are lacking to refute or support this.

- Orchards infested with either walnut blight or root and crown rot may be more likely to serve as sources of export from infested orchards to riparian habitats or other orchards since irrigated monocultures typically support higher infestations than natural systems.

PEST SOLUTIONS

Solutions to potential increases in pest populations and/or damage presented in this study are based on expert information and the best available science. The importance of agricultural factors that affect pest populations can also vary substantially. Determining which of the potential solutions to apply will depend on factors such as weather, soil type, proximity to habitat features, crop variety, the biology and ecology of the pest species, and interactions with non-target species. In other words, what may work well in one location and under one set of conditions to control a particular pest species may be ineffective in a different location and/or conditions and is unlikely to be effective against all pest species. The best solutions are likely to be those that integrate many pest solutions and customize them to each situation. Therefore, an adaptive management strategy of planning, monitoring, evaluating, and refining the approach based on results, would be a recommended strategy to use with all solutions. The following are pest solutions that could minimize or reduce potential pest effects when riparian habitat is restored in the Colusa Subreach.

PEST PREVENTION SOLUTIONS

Pest prevention solutions include restoration design components, biological control, and adaptive management, pest monitoring, and research.

RESTORATION DESIGN

Restoration design components may limit pest populations in restored habitat or limit pest movement between restored habitat and adjacent agricultural lands. These pest prevention solutions include habitat type configuration, planting protocols, and buffer zones.

Habitat Type Configurations

Configuring a restoration site design to avoid certain habitat types near farmland would reduce the chance of pest damage to those areas. Restoring closed canopy habitat types near farmland may prevent the potentially slight increases in pest effects from California ground squirrel, California vole, and Lygus bug which prefer open canopy habitat types such as savanna, open woodland, or shrub-grassland community. However, since the likelihood of increased pest effects from these species is small, and because little is currently known regarding the real value of planting different habitat types to further reduce potential pest problems, further research should be conducted before making decisions on planting configurations based only on this potential. Also, western gray squirrel, a fourth potential pest species, favors closed canopy habitats.

Planting Protocols

Although there may be some potential for native species such as valley oak, wild rose, box elder, ash, coyote brush, and blackberry to be a host for leafroller pests, the density of these hosts will be lower than agricultural crop host plants and will be mixed in with non-host native plants. Thus, the pest effects are likely to be reduced from existing conditions. Since these native species provide important ecosystem functions and it is uncertain how much pest species might use these plants and be kept in check by predators in riparian habitat settings, project proponents should not avoid planting them near adjacent farmland. However, long term research should be considered to determine the extent to which pest populations are supported by these plants when planted in restored habitat and the tendency for pest effects to occur on agricultural lands as a result.

California black walnut (*Juglans californica* var. *hindsii*) and invasive hybrid walnut trees that have escaped to wildlands from orchard rootstock (discussed in the northern California black walnut section within "Section 4.2 – codling moth") have limited potential to be an alternate host for several insect pest species, in particular walnut husk fly. These species are not included in riparian restoration plantings along the Sacramento River. While there is some potential for the spread of hybrid black walnut trees into restoration sites from adjacent riparian areas, the spread would be controlled by the planting of competitive native plants. The density of walnut trees in new restoration sites is likely to be low compared to walnut orchards and the trees would be mixed in with non-host native plants. Regardless, further reduction of this potential spread could be achieved by short-term monitoring and treatment by the project proponent to actively search for and remove all hybrid black walnut saplings in the proposed restoration sites, depending on the size of sites. However, a long-term monitoring program may be logistically infeasible as the restoration sites mature and become more structurally complex.

If applicable, a neighboring orchard grower could also plant a cultivar on his or her farm that repels particular pest species (Flint 1998). In the Subreach, walnut farmers have begun planting walnut varieties that are less susceptible to codling moth and blight infestations (Pickel, pers. comm., 2007).

Buffer Zones

A buffer zone is a tool useful to consider to reduce pest effects; however, buffer zones may be unnecessary given the likelihood that pest populations will be reduced or show only small increases following riparian habitat restoration. The goal of a buffer zone or barrier is to provide an area between different land use types that would reduce or eliminate potential damages to the adjacent land uses and assist with a successful transition between them. Buffer zones located between riparian habitat and farmland may be unvegetated (e.g., disced firebreak), vegetated (e.g., grassland, scrub), or a primary or secondary crop (e.g., orchard, row crop, pasture). The buffer

zone may be located on conservation property or farm property. Buffer zones are discussed in Chapter 3 as a potential solution for regulatory constraints, and in Chapter 5 as a potential solution for minimizing pest effects.

Buffer zones may not be effective against all possible pests. In general, they are likely to be fairly ineffective in stopping vertebrate pest damage, depending on the species. For example, a vegetated buffer of mowed grass may be effective in preventing the exchange of codling moth between orchards and riparian forests by providing a barrier to movement, but would not be expected to deter the spread of vertebrate pests such as California voles, Botta's pocket gopher, or California ground squirrel in the Subreach unless it was at least 400–900 feet wide (based on home and dispersal ranges for these species) and did not itself provide habitat for those species.

Appropriate buffer zones for the Colusa Subreach may be focused primarily on further reduction in California ground squirrel, California vole, and Lygus bug population sizes. The most appropriate habitat type to minimize these populations would be a dense closed canopy shrub or tree type with low cover of herbaceous plants. These might include willow scrub, densely planted rose/Bachharis scrub, cottonwood riparian forest, or valley oak riparian forest. The forest habitats could, however, promote population increases of western gray squirrel.

BIOLOGICAL CONTROL

Biological control, or biocontrol, may be used by riparian habitat restoration proponents on the restoration site as a preventative pest control measure. Examples of biocontrol measures applicable to the Subreach include bird nest boxes and/or bat boxes, and parasitic wasps. Birds and bats are important insect predators, particularly during the spring and summer when they are raising their young. Birds, including hawks and owls, feed on small rodents such as mice and voles, while bats feed on mosquitoes, moths, and other nocturnal insects. To be effective near areas infested with rodent pests, four to six owl nest boxes should be established for every 50 acres of habitat (Hoffman 1997). For bats, three to five houses that accommodate 500–800 bats each per restoration site would be necessary. There is minimal cost and maintenance required for either box type. Neighboring farmers would have no responsibility for cost or maintenance when the bird nest and bat boxes are placed in the riparian habitats.

Generally biocontrol for insect pests can be effective on or near small farms and with minor infestations or population levels. However, biocontrol is not as effective when the pest infestation or population is already high or for large operation farms (Flint 1998). Biocontrol cannot always keep codling moth populations below economically damaging levels and must be supplemented with other control methods in order to be effective. In addition, there is often a high amount of maintenance involved.

ADAPTIVE MANAGEMENT, PEST MONITORING, AND RESEARCH

Adaptive management, pest monitoring, and research can be applied to all areas of pest management. Simply stated, adaptive management is the practical cycle of planning, implementing, monitoring, evaluating and refining the plans and implementation, based on whether and how well the approach is achieving the planned goals and objectives. With a goal of minimizing pest effects and maximizing benefits in terms of pest effect reductions to nearby and adjacent farmland, riparian habitat restoration projects and farmlands can be monitored for pests and pest effects related to various combinations of crops; habitat types, sizes, distances, and ages; plant composition; restoration management approaches; and other factors.

Pest monitoring is conducted throughout the year to determine when pest populations reach a threshold that warrants a response with one or more pest solutions (Flint 1998). Monitoring makes all pest solutions more cost-effective when properly conducted. It can be applied to restoration sites in transboundary areas adjacent to agricultural lands as an early warning system that facilitates early application of potential solutions. If problems persist, monitoring can be used to determine if and when pests reach a threshold at which to apply a specific treatment. The monitoring can be conducted by either the riparian habitat restoration proponent or the farmer, or both, in a cooperative agreement.

Long term research is clearly needed to provide sound scientific understanding of agricultural-riparian habitat transboundary pest effects and potential solutions. Suggested research topics are included in the "Recommendations" section below. Adaptive management, pest monitoring, and research are likely to provide a better understanding of pest effects and solutions, and facilitate the development of guidelines to avoid restoration-related increases in pest effects and further reduce pest effects in comparison to existing conditions.

PEST ABATEMENT SOLUTIONS

There are several pest control solutions involving abatement once a pest population has been established. These include lethal removal of pests using chemical and non-chemical measures.

PESTICIDES

Pesticides are frequently used as a part of a multi-layered control approach that involves timely harvest and monitoring of crops and pests within a farm. Pesticides have many advantages, including high efficacy and low cost. However, pesticides such as organophosphates and pyrethroids can lead to pesticide resistance, toxicity to non-target wildlife, and increases in public health concerns. As an alternative, many farmers and The Nature Conservancy now use low-impact pest specific control methods such as insect growth regulators.

TRAPPING AND SHOOTING

Trapping and/or shooting are frequently used to reduce vertebrate and occasionally insect pest populations. Trapping and shooting are very effective approaches for controlling particular species such as mule deer and American beaver, although these populations are not expected to change in population size or pest effects following the proposed restoration. Trapping can be effective for insect pests such as codling moth (i.e., by using pheromone traps) when combined with sanitation and other control methods. Farmers can use trapping or shooting methods on their property, or project proponents can bear the responsibility of conducting control measures. For example, the project proponent could set up pheromone bait stations for codling moth at key sites near riparian habitat.

COORDINATION WITH NEIGHBORING PROPERTY OWNERS

The three approaches described below have been successfully implemented by the project proponent in previous restoration efforts in the Sacramento River Valley. These actions have the potential to make the riparian habitat restoration process run more smoothly and avoid and/or minimize potential problems. They include following the Good Neighbor Policy, coordination with neighbors during restoration design, and coordination during restoration implementation.

GOOD NEIGHBOR POLICY

Portions of the SRCAF Good Neighbor Policy (GNP) are especially relevant to pest effects. These include recommendations for actions such as increased communication between involved parties, conducting studies to evaluate potential adverse effects to neighboring land uses, consideration for buffer zones, and consideration of contingency funds to provide for unforeseen adverse effects. Many of the recommendations made in this report are consistent with what is called for under the GNP. Advantages to a GNP include an emphasis on personal responsibility for all involved parties, and an intended prompt response to potential conflicts. However, it may be difficult for the project proponent at a moment's notice to allocate funds and decide who would pay for damage. GNPs can be used as a tool to facilitate collaboration, as discussed below.

COORDINATION DURING RESTORATION DESIGN

The project proponent has several methods available to create an atmosphere of positive collaboration and cooperation with neighboring landowners and TNC has incorporated these into the approach for this project. The first is to designate a specific contact person to field any questions or concerns of landowners. Gregg Werner and Ryan Luster are designated contacts for the proposed restoration in the Colusa Subreach. The second is to develop baseline assessments of the proposed habitat restoration and provide these assessments to interested parties. Interested parties can then determine where and how their property may be affected. Chapter 1 of this document provides exhibits showing the location of the eight proposed restoration areas and adjacent agricultural lands based on the baseline assessments for each of the eight proposed restoration tracts that have been prepared by California State University, Chico (CSUC 2006, 2007). The third method is to arrange multiple meetings with concerned parties during the design process. TNC has participated in establishing the Advisory Workgroup and External Experts Group to provide assistance and advice to neighboring landowners. Finally, the project proponent could provide to neighboring landowners draft restoration plans containing explicit details of the proposed restoration areas incorporating modifications to address landowners' concerns. These draft plans take the design process a step further than what is provided in a baseline assessment by refining potential restoration locations and habitats based on factors such as soil survey and hydraulic modeling results. Interested landowners may obtain copies of the draft restoration plans by contacting Ryan Luster or Gregg Werner with TNC at the number indicated on the title page of this document.

COORDINATION DURING RESTORATION IMPLEMENTATION

Once the proposed project has been implemented, the project proponent could discuss these effects and concerns with neighboring landowners in order to focus on preventing these problems in future projects. The project proponent could also adjust restoration protocols, as needed, by using approaches such as adaptive management as described above in "Pest Prevention Solutions."

RECOMMENDATIONS

This study has led to both general recommendations and recommendations specific to individual regulatory constraints and pest effects. General recommendations include:

1. Consider compatibility with potential regulatory and pest constraints to neighboring landowners when designing the configuration of riparian habitat types within proposed restoration sites, along with traditional restoration design considerations such as hydrology, soils, habitat connectivity, and target species.

2. Consider that the best approach is likely to be one that integrates multiple measures and customizes the measures to each farm. Therefore, an adaptive management strategy for dealing with potential effects may be an effective general approach.

REGULATORY SOLUTION RECOMMENDATIONS

1. Continue to communicate regularly through collaborative public outreach.

2. Monitor future updates in laws and regulations applicable to land uses within the Colusa Subreach including but not limited to possible delisting of valley elderberry longhorn beetles from the ESA list; and

3. Engage in a combination of regulatory solutions that offers high landowner assurances, ecological benefit, longevity, and flexibility through the use of maintained buffer zones, a voluntary Programmatic Safe Harbor Agreement as part of the SRCAF Good Neighbor Policy, and an optional MOA/MOU.

PEST EFFECT RECOMMENDATIONS

1. Conduct long term research to provide scientific understanding of agricultural-riparian habitat transboundary pest effects on the following areas:

    a. usage patterns and the abundance of key Subreach pests such as California ground squirrel, mule deer, black-tailed jackrabbit, Audubon's cottontail, western gray squirrel, coyote, vole, and lygus bug in different Sacramento River habitat types,

    b. the potential for restored open-canopy riparian habitats such as valley oak – elderberry savannah to support agricultural pest species,

    c. the potential for local cross-boundary effects in riparian-agricultural versus agricultural-agricultural field settings,

    d. the potential for restored natural systems to serve as reservoirs for agricultural pest species; specifically, how much will a pest proliferate and spread to agricultural areas from different riparian habitats that contain the pest's host plant,

    e. the extent to which riparian habitat restoration may also reduce pest population densities by subsidizing natural enemies of agricultural pests,

    f. the effectiveness of different buffer types between various habitat types and crop types, and

    g. the effectiveness of combining solutions; specifically, the effectiveness of combining owl nest boxes with closed canopy buffer zones to minimize pest (primarily ground squirrel, western gray squirrel, vole and lygus bug) populations and effects on agricultural properties.

2. Develop guidelines, based on research results, to avoid increases in pest effects and possibly reduce pest effects in comparison to existing conditions;

3. If feasible, assess current and planned future crops and determine consistent key pest issues on adjacent or nearby agricultural properties;

4. Choose buffer zone habitat types based on the pest species effects to minimize. Open canopy habitat types may actually increase pest damages from vertebrate pest species by providing habitat for small vertebrate populations. Closed canopy types such as dense riparian scrub communities and forests may be best for the Colusa Subreach, to minimize effects from ground squirrel, vole, and lygus bug; however these habitat types may promote western gray squirrel.

5. Conduct best restoration area management practices such as clearing away woody debris from decommissioned orchards and removing weeds from newly establishing riparian habitat restoration sites so they cannot serve as potential pest habitat areas, including overwintering sites for pest species;

6. Enhance existing riparian habitat, where feasible, by removing invasive plants that may serve as pest hosts, such as black walnut hybrids;

7. Utilize monitoring of riparian restoration sites for pests and pest effects to serve as an early warning system for agricultural and riparian habitat management;

8. Conduct best pest management practices including active treatment of pest infestations, as needed;

9. Coordinate and establish a forum for regular communication with adjacent and nearby landowners and floodplain or levee maintenance entities to resolve issues and maximize good neighbor actions during restoration planning, and during and following implementation; and

10. Establish an adaptive management approach (monitor, evaluate, and refine management actions) to better understand how and where to modify planted riparian habitats to minimize or reduce pest effects.

CONCLUSIONS

Restoring riparian habitat in the Colusa Subreach is unlikely to substantially increase either regulatory constraints or pest effects to agricultural lands. Of the seven federal and eight California laws and regulations analyzed, only one potentially significant increase in agricultural regulatory constraints is likely to result from the restoration of riparian habitat in the Colusa Subreach: restrictions within 100 feet of elderberry shrubs which is habitat for the valley elderberry longhorn beetle, a species that is federally-listed as threatened. However, because the open canopy types of riparian habitat (e.g., savannah) that are most suitable to the growth of elderberry shrubs constitute only a small percentage of the proposed restoration area and because only a small percentage of the proposed restoration perimeter borders agricultural land, the potential increase in valley elderberry longhorn beetle-related regulatory constraints on adjacent agricultural parcels is expected to be small. Riparian habitat restoration is not expected to increase agricultural regulatory constraints associated with the other 14 regulations, 14 protected species, and 6 protected habitats analyzed in this study.

To comply with Endangered Species Act (ESA) protections for the valley elderberry longhorn beetle, activities within 100 feet of elderberry shrubs with stem diameters 1.0 inch or greater at ground level could be restricted, and riparian habitat restoration may result in an small increase of such shrubs within 100 feet of farm activities. These practices are not limited, however, adjacent to smaller elderberry shrubs, and such shrubs may be removed by landowners before they reach the protected 1 inch stem diameter size.

Inclusion of riparian habitat adjacent to agricultural lands may provide economic and regulatory benefits. This can be achieved if regulatory solutions are applied in a manner that alleviates potential valley elderberry longhorn beetle-related regulatory constraints arising from restoring riparian habitat while also reducing existing constraints to agricultural operations. Of the suite of potential regulatory solutions discussed in this report, three (buffer zones, programmatic safe harbor agreement [PSHA], and memoranda of agreement/memoranda of understanding) appear most promising to offer complete protection to landowners from slightly increased elderberry-related regulatory constraints related to the proposed restoration. If a combination of these solutions is chosen by the restoration proponents, Colusa Subreach landowners would have a great deal of flexibility in choosing the solution that works best for them. Landowners who prefer not to sign agreements and remain completely uninvolved in the restoration could be protected by buffer zones placed on restoration property and maintained by restoration proponents (or third-party entities funded by restoration proponents) to remain free of protected elderberry shrubs in the long term. Other landowners may receive an economic benefit by maintaining and harvesting a crop in an elderberry-free buffer zone on restoration property and maintained in accordance with USFWS guidelines. Farmers who voluntarily sign a PSHA, if offered, would be absolved from responsibility for incidental take of elderberry shrubs dispersing from existing riparian habitat in addition to shrubs associated with the proposed restoration.

Riparian habitat may also benefit farmers by providing a forested buffer between agricultural lands and the federally and state-protected Sacramento River. Vegetated buffers are included among the BMP options encouraged by the Central Valley TMDL program and Irrigated Lands Waiver, some pesticide labels, and the PRESCRIBE program, and can be more economical than traditional pesticide mitigation measures. Farmers adjacent to restored riparian habitat may find a benefit from having restored riparian habitat located between their farms and sensitive resources (e.g., the Sacramento River), where feasible.

In terms of pest effect changes, riparian habitat restoration proposed in the Colusa Subreach is likely to provide both benefits and some minimal risks to agricultural operations compared to existing conditions. With 55% of the Subreach in existing riparian habitat and less than 8 percent of the Subreach proposed for riparian habitat restoration, the anticipated change in pest populations and pest effects is unlikely to be substantial. Since riparian habitat does not support most agricultural pests evaluated in this study, a change from agricultural habitat to riparian may lead to a decrease in pest effects. Pest effects could shift to new farmlands at some restoration sites but will not introduce completely new influences on the existing cropland since they are already at least partly bounded by riparian habitat.

Of the 25 species identified by the Advisory Workgroup and External Experts Group as high or medium priority pests, four (California ground squirrel, western gray squirrel, California vole, and lygus bug) have potential to increase slightly in pest effects to agricultural lands in the short term (0–4 years). Of the remainder, eleven are expected to remain the same in pest effects, and ten are likely to yield decreased pest effects in both the short and long term (more than 5 years) following restoration plantings. Due to the lack of research data on many of these species, additional research is needed to ultimately confirm or refute these findings based on clear analyses of pest species' preferences, usage and pest effects in agricultural and riparian habitat settings. Strategic planning can also increase the likelihood of benefits while reducing adverse pest effects. Use of restoration design configurations or buffer zones with closed canopy habitat types adjacent to agricultural areas may help reduce potential increases in California ground squirrel, vole and lygus bug populations, but could promote western gray squirrel. Provision of bird and bat boxes can further reduce small rodents such as mice and voles, and nocturnal insects such as mosquitoes and moths. Neighboring farmers would have no responsibility for cost or maintenance when the bird nest and bat boxes are placed by the restoration proponent in the riparian habitats.

Overall, there are few studies specifically focused on the potential for restored natural systems to result in increased or decreased pest effects on agricultural operations. An adaptive management approach should be utilized to monitor and evaluate the effects of restored habitat on adjacent agricultural operations, then make adjustments to reduce any detrimental effects. In this way, monitoring can act as both an early warning system for agricultural and riparian habitat management, as well as part of a long term research element to enable improvements in planning for both agriculture and riparian habitat restoration. In conjunction with adaptive management, additional research studies should be conducted on how existing and restored riparian habitat affects pest populations on adjacent agricultural operations.

1 INTRODUCTION

1.1 BACKGROUND AND PURPOSE OF THE STUDY

The Nature Conservancy (TNC) has been actively engaged in conserving riparian wildlife habitat along the middle Sacramento River for over twenty years through its Northern Central Valley Region Office in Chico, California. These conservation efforts are intended to recover and support viable populations of native riparian plants, fish and wildlife. TNC has been principally involved in developing science to support habitat conservation, planning for habitat conservation, acquisition of property and the restoration of former habitat areas to riparian vegetation. Since 2000, TNC has pursued subreach planning which has involved the comprehensive analysis of distinct segments of the Sacramento River corridor in order to best address the restoration of habitat areas. Subreach planning was completed in 2003 for the Chico Landing and Beehive Bend Subreaches. In 2004, TNC was awarded a three-year CALFED Ecosystem Restoration Program (ERP) grant for Colusa Subreach Planning (CSP) which extends from the City of Colusa upstream twenty miles to the community of Princeton. CSP includes planning and research projects that have been identified by local stakeholders to address their questions and concerns regarding habitat conservation.

TNC is partnering with the Sacramento River Conservation Area Forum (SRCAF) to conduct an extensive public outreach process as part of CSP. This outreach effort is to a large degree directed by the Colusa Subreach Planning Advisory Workgroup (Advisory Workgroup) which is composed of representatives of the SRCAF, local interests and the agencies that are responsible for management of habitat in the project area. This outreach is intended to build trust and relationships among participants, identify and address concerns of area landowners in regard to restoration of riparian habitat, develop a shared understanding of information regarding habitat conservation, and generate stakeholder input as to the form of restoration and related uses within the Colusa Subreach.

TNC proposes to restore portions of eight tracts in the Colusa Subreach totaling approximately 390 acres of actively farmed and fallow agricultural lands to native riparian habitat (Exhibit 1-1). These tracts (Princeton Southeast (Womble), Jensen, Stegeman, 1,000-acre Ranch, Boeger, Colusa-North, Colusa-Sacramento River State Recreation Area (SRA)(Ward), and Cruise'n Tarry) are located on public and private lands that have been purchased for conservation and are owned by TNC, the California Department of Fish and Game (DFG), and the California Department of Water Resources (DWR).

Although the residents of California have expressed strong support for the conservation and restoration of the Sacramento and other rivers, some local landowners, farmers, business interests, and local government officials have expressed concerns regarding the restoration of agricultural land to riparian habitat. These concerns relate to a wide range of potential adverse effects including increased crop damage by wildlife and additional regulatory controls related to protected species and habitats.

This Pest and Regulatory Effects Study (PRES) was selected by the Advisory Workgroup as a topic of concern warranting further study under the CSP grant. This study aims to provide objective scientific information regarding environmental regulations and pest damage as they relate specifically to crops, protected natural resources, and agricultural pest species found in the Colusa Subreach. This study focused on several aspects of concerns regarding regulatory and pest effects, including identification and prioritization of regulatory constraints and pest species, characterization of potential changes with restoration of riparian habitat, and identification and prioritization of solutions to address potential regulatory constraints and pest damage issues identified in this study.

As part of the PRES, in addition to the Advisory Workgroup, TNC formed a Pest and Regulatory Effects Study External Experts Group (External Experts Group) to provide expert guidance on the study design and interpretation of results. To ensure that stakeholder concerns would be adequately addressed by this study, EDAW

facilitated multiple meetings with the Advisory Workgroup, External Experts Group, and individual landowners with property adjoining the proposed restoration sites. Discussions with these stakeholders framed the initial design of this study; identified priority pests, crops and regulatory issues to be analyzed; and provided data, observations and opinions. Complete lists of all members of the Advisory Workgroup and the External Experts group are included in Appendices A and B.

1.1.1 STUDY AREA

The Colusa Subreach of the Sacramento River extends 21 river miles between the unincorporated community of Princeton and the City of Colusa in northern California (Exhibit 1-1). Approximately 5,466 acres of land are located between the flood control levees of the Colusa Subreach, with approximately 5,094 acres in Colusa County and 372 acres in Glenn County (TNC 2005). In some parts of the Colusa Subreach, the levees are adjacent to the river's edge, while in other portions they are currently as far as 1.1 miles from the river. The study area addressed in this report includes all land within the Colusa Subreach located between flood control levees from River Mile (RM) 164.5, the location of the abandoned Princeton ferry crossing in the north, downstream and southward to RM 143.5 at the Colusa Bridge.

1.1.2 ECOLOGICAL AND LAND USE HISTORY IN THE COLUSA SUBREACH

Prior to 1850, the Sacramento River and Colusa Subreach comprised a 5-mile-wide mosaic of aquatic habitat, oxbow lakes, sloughs, seasonal wetlands, and riparian forests with diverse and abundant wildlife. Beginning in the 1850s, the Sacramento River and its floodplain were largely transformed for human uses, including water supply, flood control, and agriculture. From the mid-1800s through the 20th century, approximately 90% of the original riparian habitat adjoining the Sacramento River was converted to other uses (Katibah 1984). These changes have enabled the production of food and delivery of water to many people and have supported a vibrant agricultural economy. However, these changes have also contributed to the reduction and elimination of wildlife species from the Sacramento River ecosystem and contributed to the federal and state listing of 43 wildlife species as threatened, endangered, or of special concern (Riparian Habitat Joint Venture 2004).

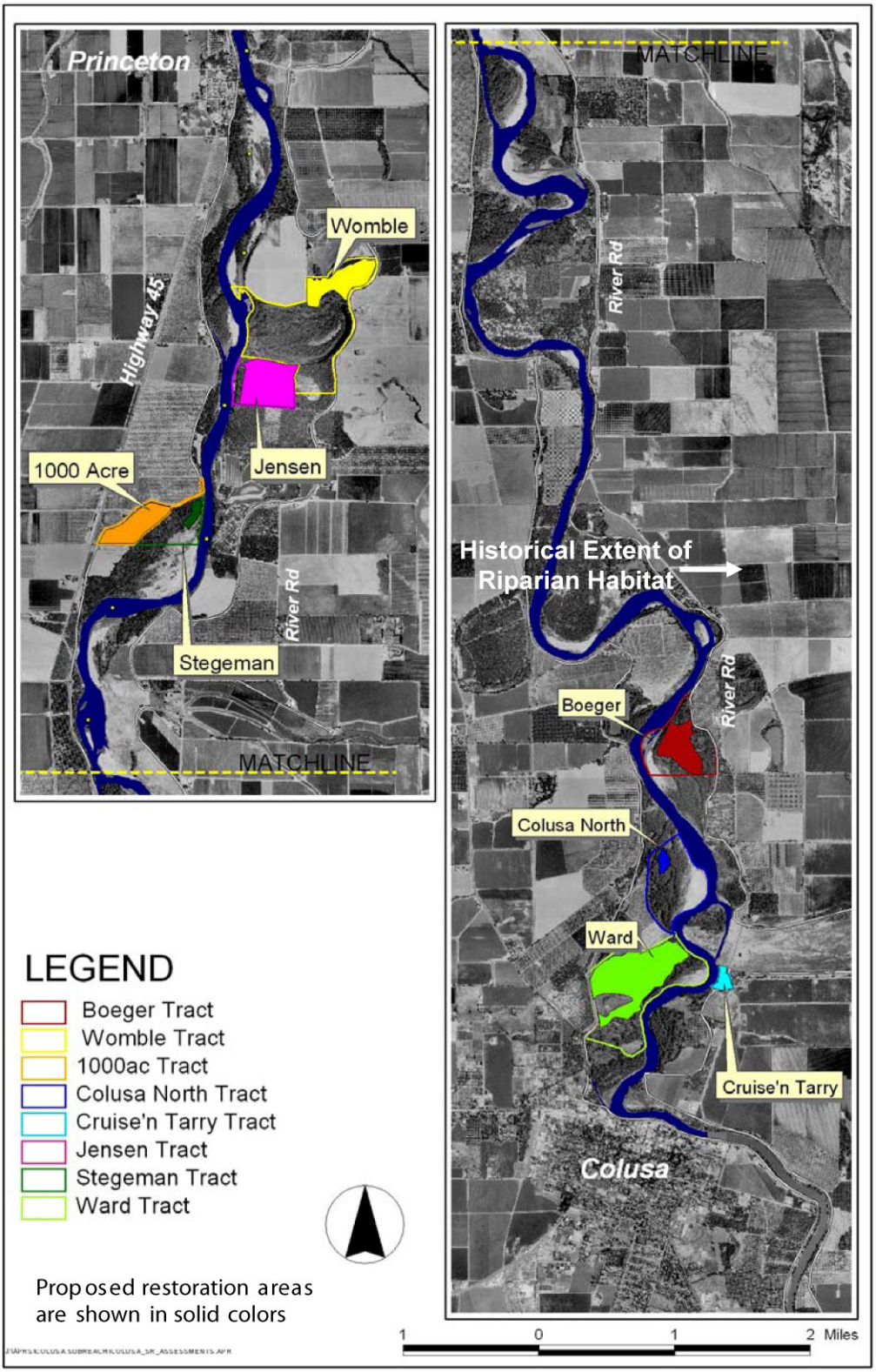
1.1.3 CURRENT ECOLOGY AND LAND USE IN THE COLUSA SUBREACH

Currently, 43% of the Colusa Subreach land between the flood control levees and nearly all of the land outside of the levees is in agricultural use (Table 1-1, Exhibit 1-2). The primary crops grown in the study area include walnuts, prunes, almonds, vine seeds, beans, alfalfa, and winter wheat. Safflower, tomatoes, rice, cotton, and corn are also grown, and a small portion of the study area consists of rangeland managed for sheep. Approximately 55% of the land use between the flood control levees consists of riparian habitat, 4% (124 acres) of which is the result of habitat restoration conducted in 1992 and 2001–2002 by River Partners (TNC 2005). This restoration took place within the Sacramento River Wildlife Area managed by DFG.

Table 1-1
Land Use between the Flood Control Levees of the Colusa Subreach

Land Use Category	Acres	Percent of Total Area
Agriculture – Orchard	1,204	22.0%
Agriculture – Row Crops or Fallow	1,163	21.2%
Riparian Habitat	3,031	55.4%
Other Open Area	23	0.4%
Flood Control	25	0.5%
Water Supply	5	0.1%
Recreation	14	0.3%
Residential	1	0.1%
Total	**5,466**	**100%**

Source: The Nature Conservancy 2005



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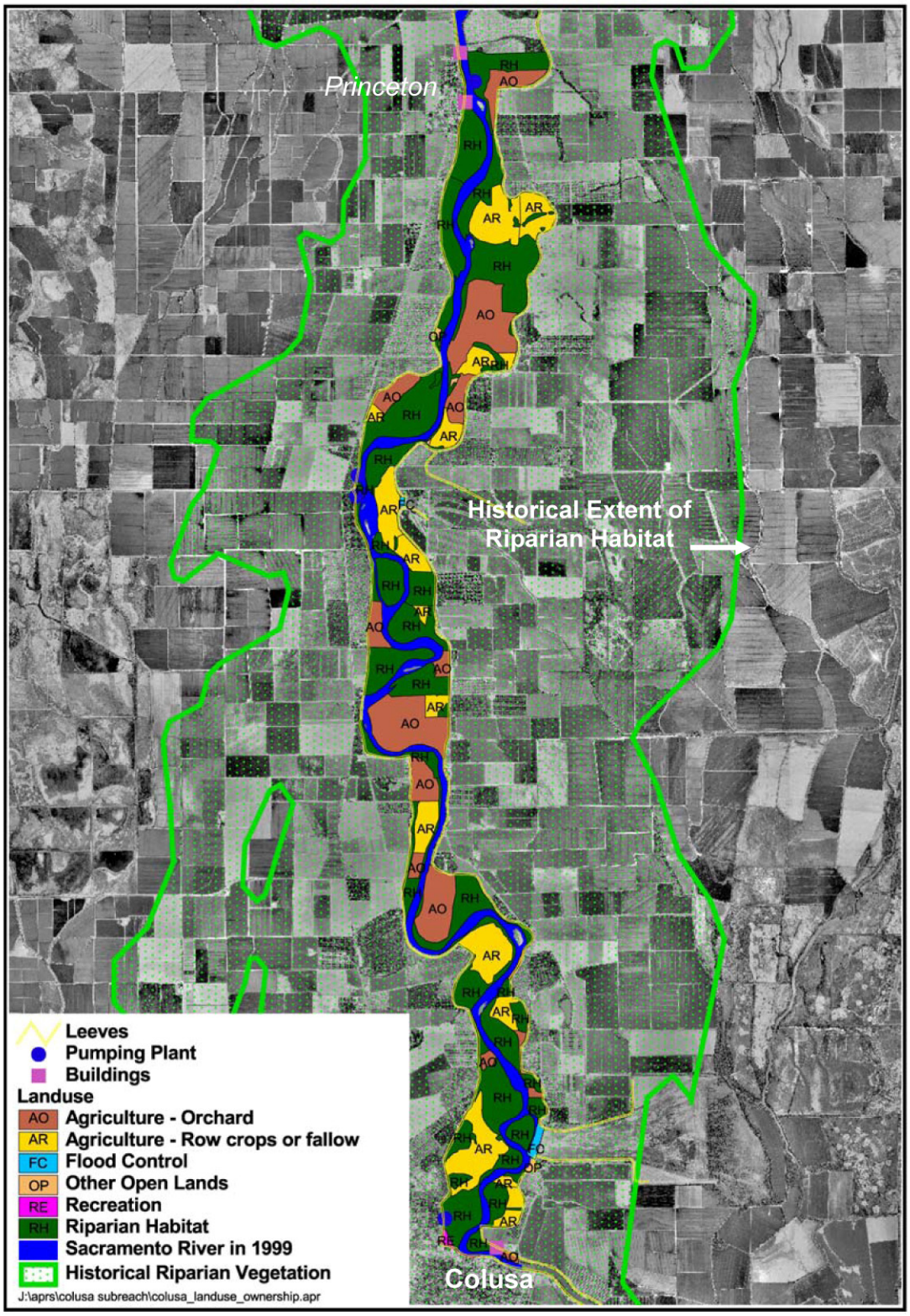
Source: The Nature Conservancy 2005

Proposed Habitat Restoration Tracts **Exhibit 1-1**



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Source: The Nature Conservancy 2005

Land Use in the Colusa Subreach **Exhibit 1-2**

1.1.4 PROPOSED ECOLOGICAL AND LAND USE CHANGE IN THE COLUSA SUBREACH

As part of the Colusa Subreach planning process described in Section 1.1, portions of eight tracts totaling approximately 390 acres have been proposed for restoration from existing active and fallow agricultural uses to native riparian habitat (Table 1-2, Exhibit 1-1). These tracts are located on public and private lands that have been purchased for conservation and are owned by TNC, DFG, DPR and DWR. Table 1-3 provides the proposed riparian habitat restoration types and acreage by tract.

Table 1-2
Proposed Restoration Sites

Tract	Total Acres	Restoration Acres	Existing Land Use	Owner
Princeton SE (Womble)	320	54	Agriculture – annual row crops	TNC option
Jensen	98	81	Agriculture – walnut orchard	TNC
Stegeman	69	8	Fallow – former orchard	State / DFG
1,000-acre Ranch	60	49	Agriculture – prune orchard	TNC
Boeger	125	51	Agriculture – annual row crops	TNC
Colusa-North	143	5	Fallow – former orchard	State / DFG
Colusa-Sacramento River SRA (Ward)	238	139	Agriculture – annual row crops	State / DPR
Cruise 'n' Tarry	10	3	Fallow – former marina	State / DWR
Total	**1,063**	**390***		

Source: The Nature Conservancy 2007
* Includes about 6 acres of proposed campground area on Ward Tract

Table 1-3
Proposed Riparian Habitat Types

Unit Name	MRF	CWRF	VORF	VORF-VNG	WS	WS/VWG	RBS	RBS/VWG	BBS	MFS	MFS/VWG	ES/VWG	VOES/VWG	Grassland	Savannah	Campground	Grand Total
Princeton SE (Womble)	32.4				8.7		7.9		4.7								53.7
Jensen	55.9	1.5						23.9									81.3
Stegeman	4.6	1.7			2.1												8.4
1,000-acre Ranch	26.5		22.6														49.1
Boeger	6.5	7.2	4.9			1.0		20.6			4.7		6.2				51.0
Colusa North	1.2		1.2		0.1					1.5		0.9					5.0
Colusa-Sacramento River SRA (Ward)	64.3	29.1												29.2	10.0	6.3	138.9
Cruise'n Tarry		0.7		1.8	0.1		0.3										2.8
Grand Total	191.4	40.2	28.7	1.8	11.0	1.0	8.2	44.5	4.7	1.5	4.7	0.9	6.2	29.2	10.0	6.3	390.4

Source: The Nature Conservancy 2007
Notes: MRF = Mixed riparian forest
CWRF = Cottonwood riparian forest
VORF = Valley oak riparian forest
VORF-VNG = Valley oak riparian forest/valley needlegrass grassland
WS = Willow scrub
WS/VWG = Willow scrub/valley wildrye grassland
RBS = /Rose/*Baccharis* scrub
RBS/VWG = Rose/*Baccharis* scrub/valley wildrye grassland
BBS = Blackberry scrub
MFS = Mule fat scrub
MFS/VWG = Mule fat scrub/valley wildrye grassland
ES/VWG = Elderberry scrub/valley wildrye grassland
VOES/VWG = Valley oak/elderberry scrub/valley wildrye grassland

The total amount of riparian habitat with the potential to be restored at the eight sites is approximately 390 acres, which represents an additional 7% of the total Colusa Subreach area (5,466-acres). Currently, the Subreach includes 3,031 acres of riparian habitat which represents 55% of the total Subreach area. Exhibits 1-3 to 1-8 show the proposed restoration areas, including depictions of different border types with adjacent lands.

For the purposes of this document, the term riparian habitat is used synonymously with the term riparian community or vegetation type. 'Vegetation type' is defined by the California Department of Fish and Game (CDFG 2003) as "a natural unit similar in definition to ecosystem, but defined primarily by the composition of plant species (compare also with habitat)." 'Habitat' is defined by DFG as "where a given plant or animal species meets its requirements for food, cover, and water in both space and time; [this] may or may not coincide with a single vegetation type." Each proposed riparian habitat type is described below. The characteristics of the existing habitat types, as described below, include nonnative species, some of which are considered invasive. However, the proposed habitat types to be restored will not include nonnative invasive species.

MIXED RIPARIAN FOREST

Mixed riparian forest is a dense forest characterized by multiple tree canopy layers with mixed and varied dominant species and with several shrub and vine species present. When present, the highest canopy layer is generally open and dominated by tall Fremont cottonwood (*Populus fremontii*) trees. The next canopy layer, frequently the uppermost, is typically moderately dense and composed of tree species such as valley oak (*Quercus lobata*), Oregon ash (*Fraxinus latifolium*), Goodding's black willow (*Salix gooddingii*), and box elder (*Acer negundo*). A discontinuous shrub layer is generally present within mixed riparian forest including native species such as blue elderberry (*Sambucus mexicana*), button bush (*Cephalanthus occidentalis*), wild rose (*Rosa californica*), poison oak (*Toxicodendron diversilobum*), wild grape (*Vitis californica*), and nonnative invasive species such as Himalayan blackberry (*Rubus discolor*). A sparse to densely vegetated herbaceous layer, when present, typically includes grasses such as creeping wildrye (*Leymus triticoides*) and forbs such as mugwort (*Artemisia douglasiana*). Invasive Himalayan blackberry will not be planted in restored habitats.

COTTONWOOD RIPARIAN FOREST

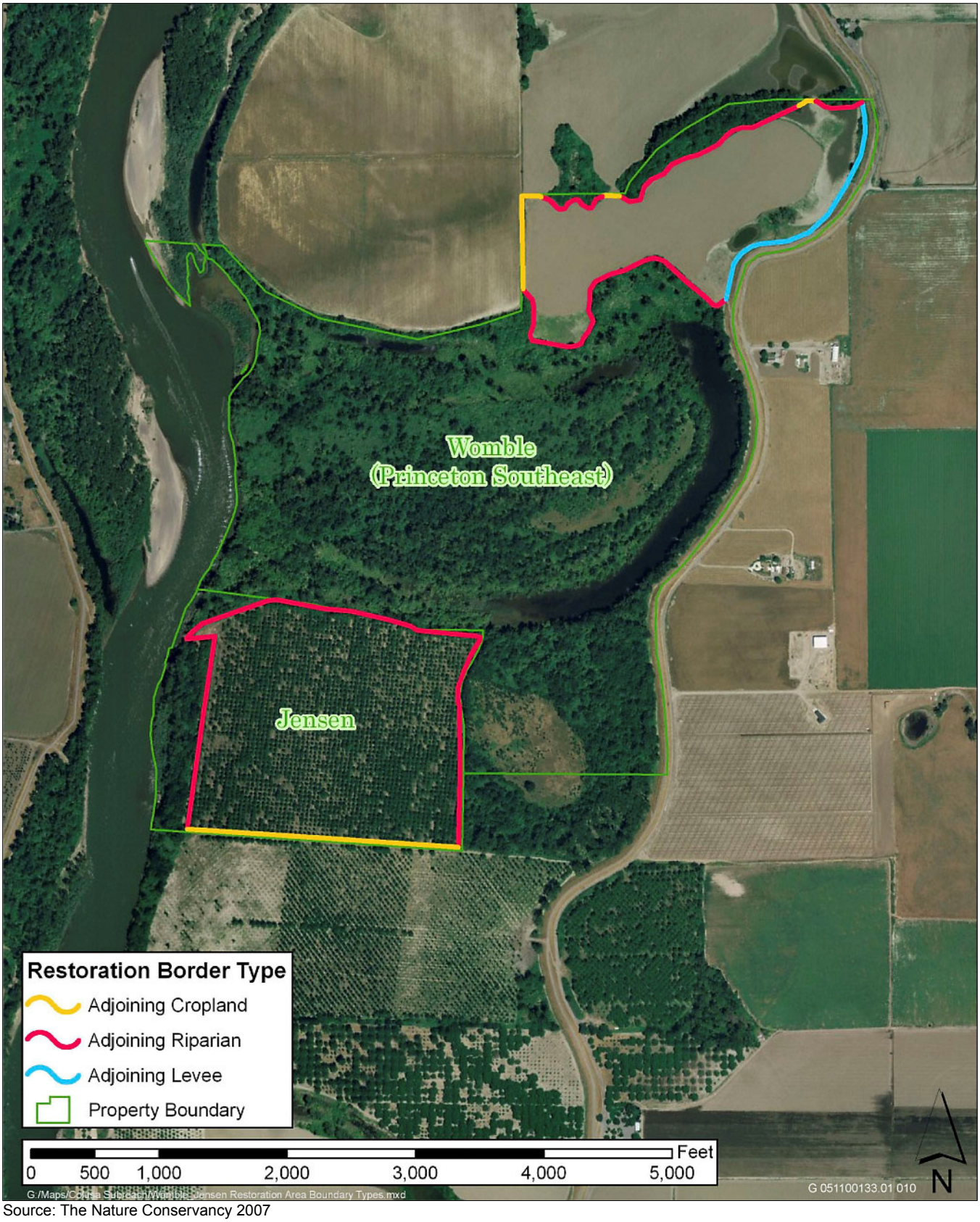
Cottonwood riparian forest is dominated by Fremont cottonwood and Goodding's black willow. Understory layers are often dense, with abundant recruitment of canopy dominants. Wild grape is the most conspicuous vine. Scattered seedlings and saplings of shade-tolerant species such as box elder or Oregon ash may also be found.

VALLEY OAK RIPARIAN FOREST

Valley oak riparian forest is characterized by a single, moderately-tall canopy layer that is relatively open and dominated by valley oak. The valley oak riparian forest canopy sometimes has other tree species present which are often associated with mixed riparian forest, including box elder, Oregon ash, and invasive northern California black walnut hybrids. The shrub layer is generally sparse and includes poison oak, blue elderberry, wild rose, wild grape, and California pipevine (*Aristolochia californica*). The understory typically includes young valley oak and walnut seedlings. The ground layer, when present, includes a range of species, from those found in mixed riparian forest to species found in drier conditions.

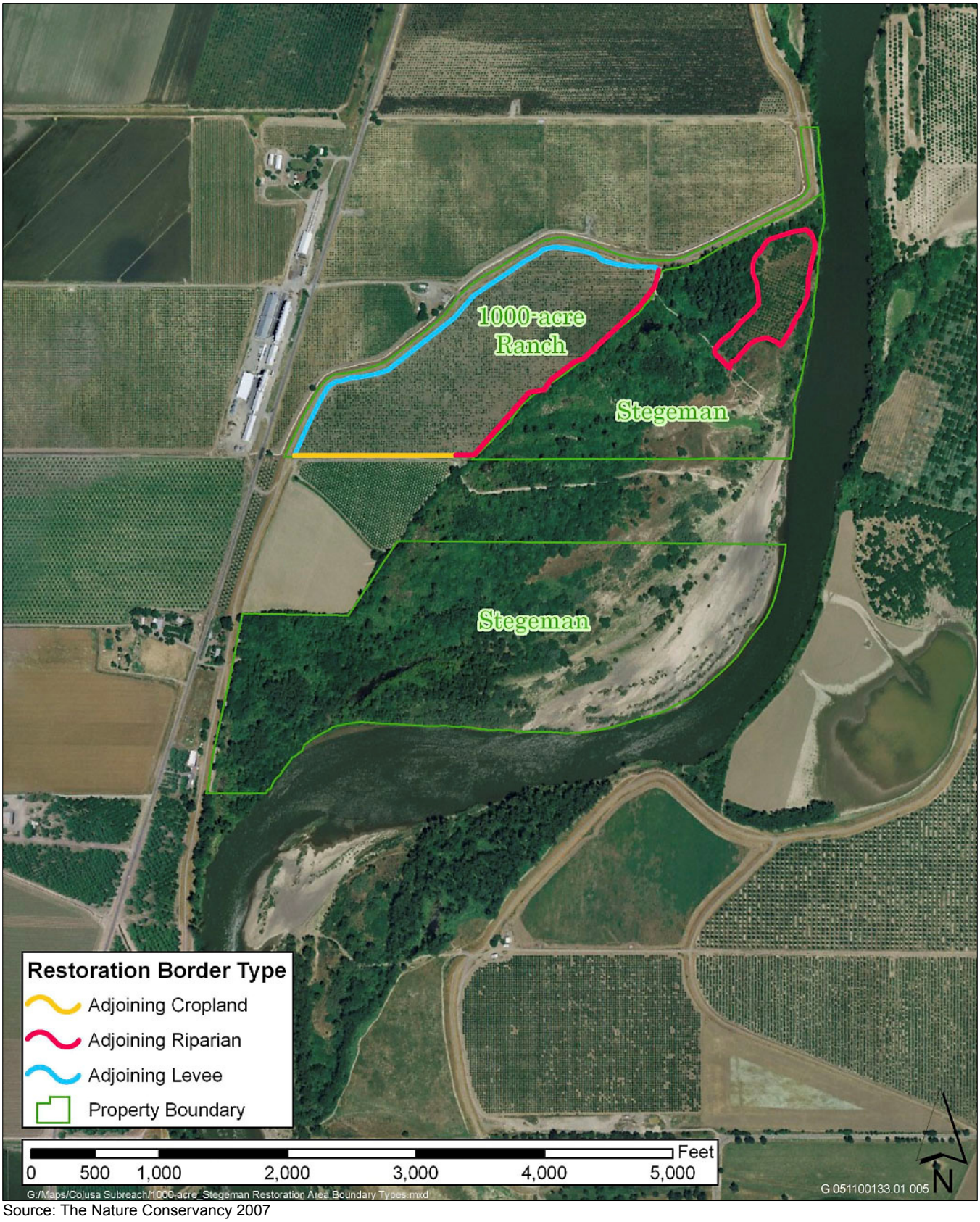
VALLEY OAK RIPARIAN FOREST/VALLEY NEEDLEGRASS GRASSLAND

This habitat type is a combination of valley oak riparian forest as described above with purple needlegrass (*Nassella pulchra*). The grassland component is a moderately tall grassland dominated by perennial, tussock-forming needlegrass with native and introduced annuals interspersed between the needlegrass.



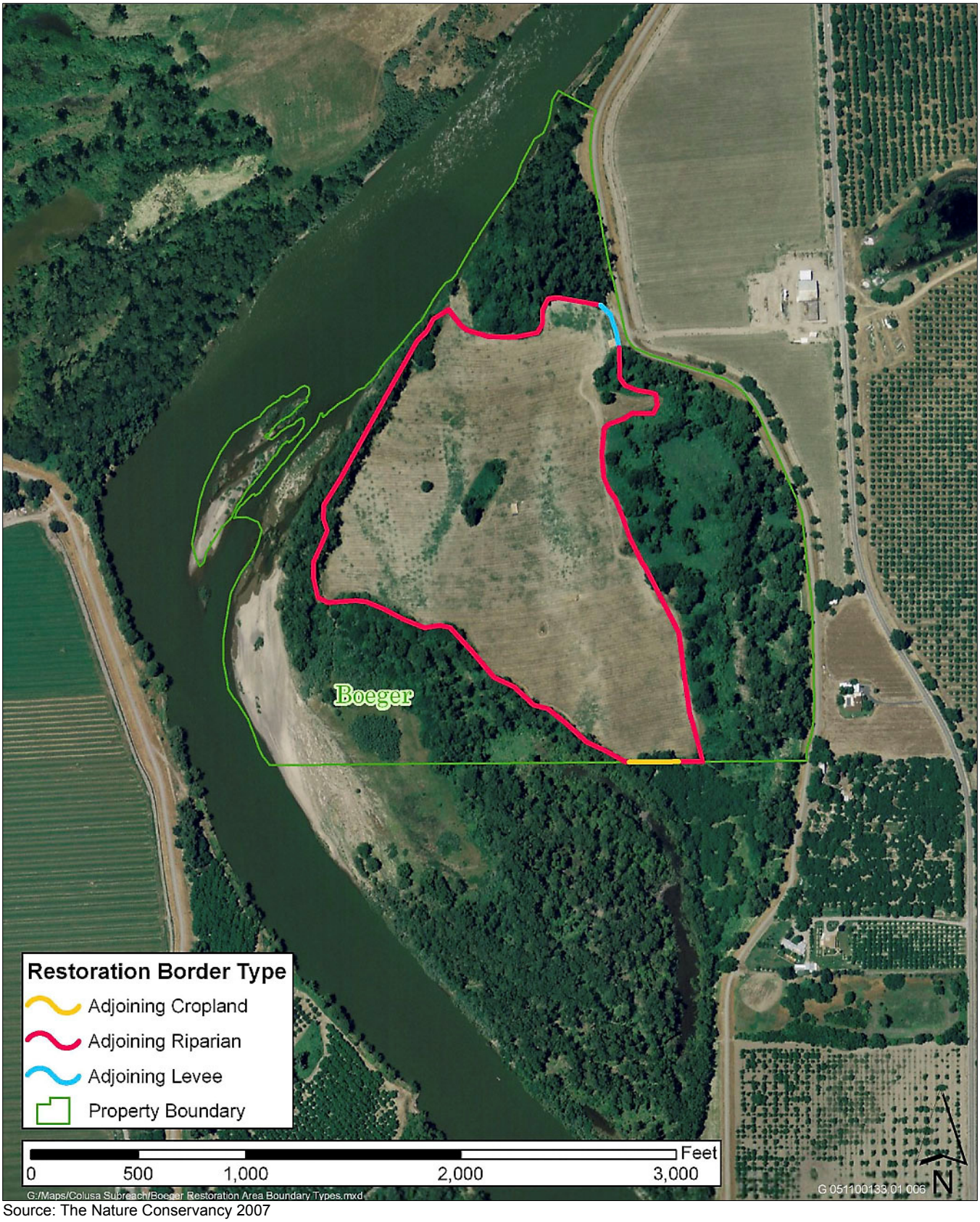
Source: The Nature Conservancy 2007

Princeton Southeast (Womble tract) and Jensen Restoration Area Boundary Types **Exhibit 1-3**



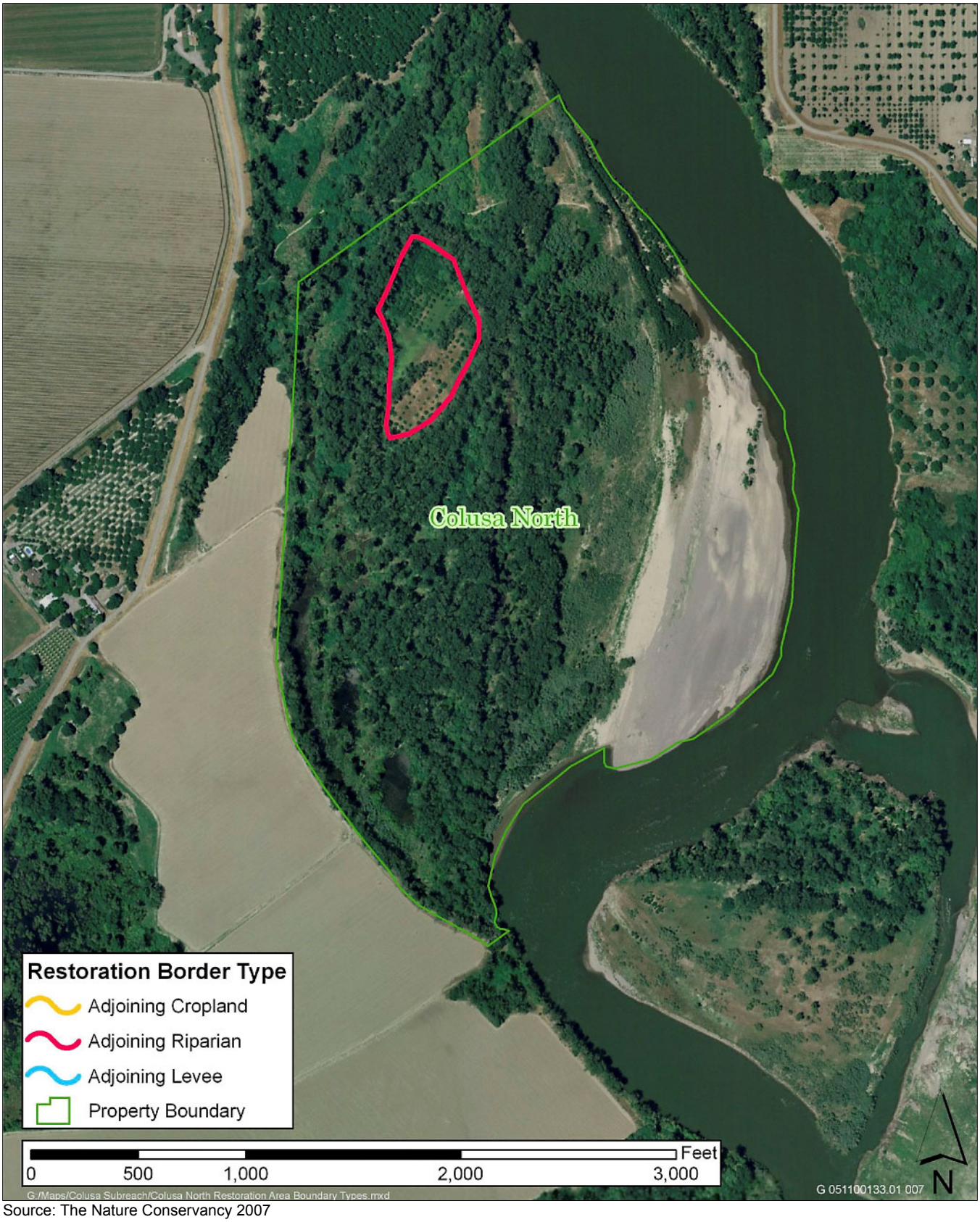
Source: The Nature Conservancy 2007

1,000-acre and Stegeman Restoration Area Boundary Types **Exhibit 1-4**



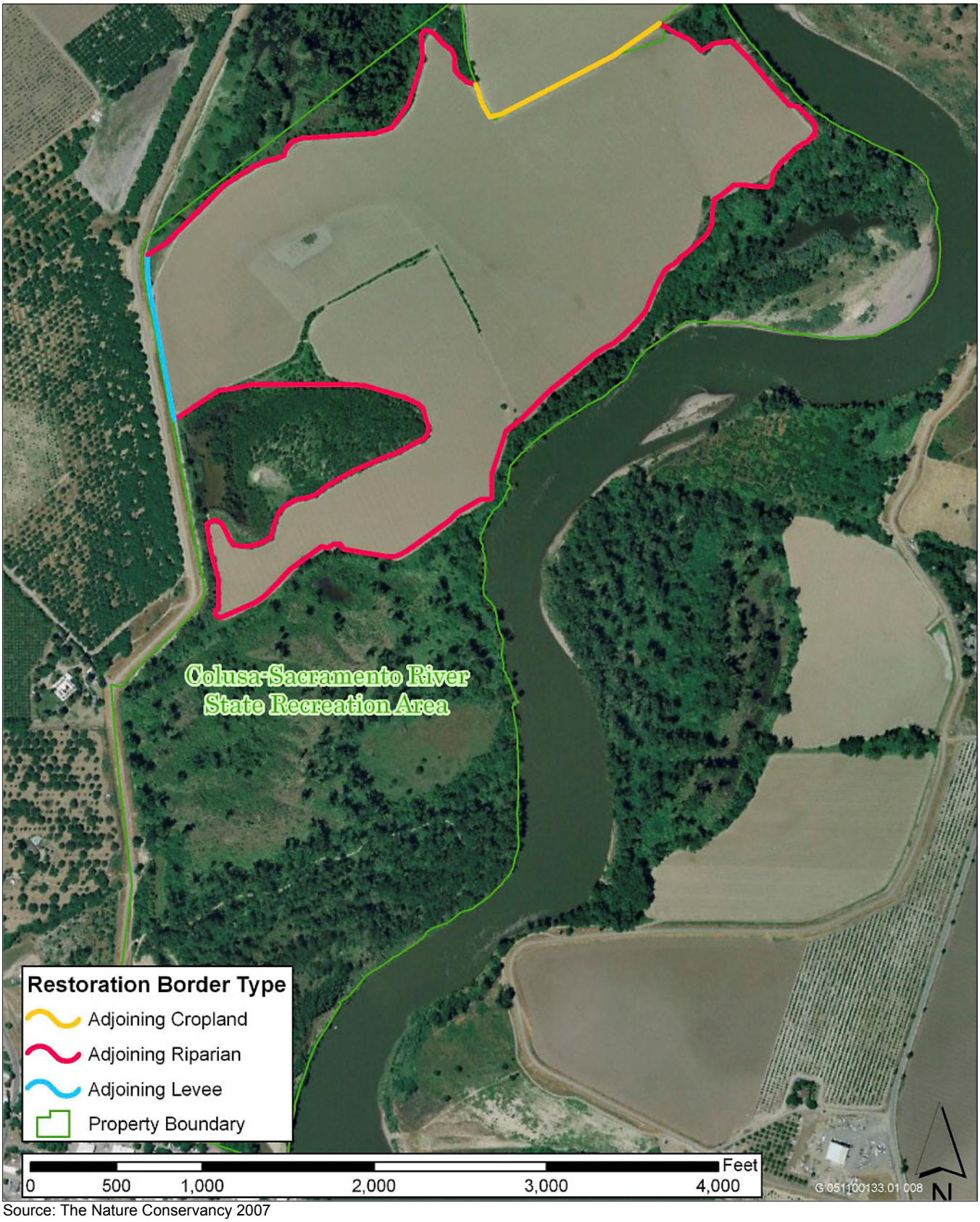
Source: The Nature Conservancy 2007

Boeger Restoration Area Boundary Types **Exhibit 1-5**



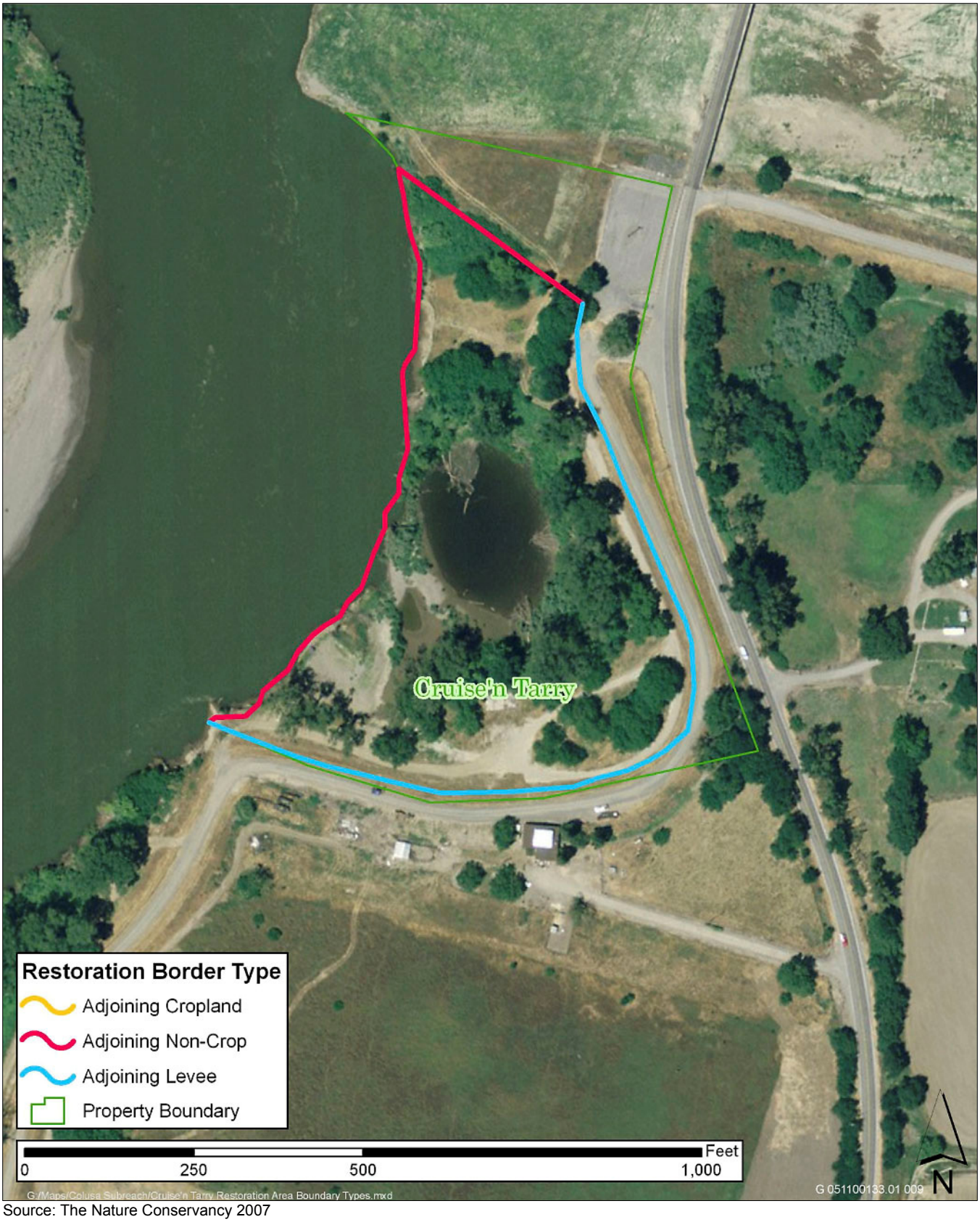
Source: The Nature Conservancy 2007

Colusa North Restoration Area Boundary Types **Exhibit 1-6**



Source: The Nature Conservancy 2007

Colusa-Sacramento River SRA (Ward Tract) Restoration Area Boundary Types **Exhibit 1-7**



Source: The Nature Conservancy 2007

Cruise'n Tarry Restoration Area Boundary Types **Exhibit 1-8**

WILLOW SCRUB

Willow scrub riparian habitat is an open to dense, broad-leafed, winter-deciduous shrubby streamside thicket dominated by any of several willow (*Salix*) species. Dense stands usually have little understory or herbaceous component. More open stands have a grassy herbaceous layer, usually dominated by nonnative species.

WILLOW SCRUB/VALLEY WILDRYE GRASSLAND

This habitat type is a combination of willow scrub, as described above, plus valley wildrye grassland. The grassland component is dominated by creeping wildrye (*Leymus triticoides*).

ROSE/BACCHARIS SCRUB

Rose/Baccharis scrub riparian habitat is similar to willow scrub with the exception that it is dominated by a mix of rose mallow (*Hibiscus californica*), California rose (*Rosa californica*) and *Baccharis* species such as coyote brush (*Baccharis pilularis*) and mule fat (*Baccharis salicifolia*).

ROSE/BACCHARIS SCRUB/VALLEY WILDRYE GRASSLAND

This habitat type is a combination of California rose/Baccharis scrub, as described above, plus valley wildrye grassland. The grassland component is dominated by creeping wildrye.

BLACKBERRY SCRUB

Blackberry scrub habitat is similar to the other scrub habitats described above with the exception that it is dominated by California blackberry (*Rubus ursinus*) as a co-dominant species. Invasive Himalayan blackberry will not be planted in the restored habitat.

MULE FAT SCRUB/VALLEY WILDRYE GRASSLAND

Mule fat scrub habitat is similar to the other scrub habitats described above with the exception that it is dominated by mule fat.

MULE FAT SCRUB/VALLEY WILDRYE GRASSLAND

Mule fat scrub habitat is similar to the other scrub habitats described above with the exception that it is dominated by mule fat as a co-dominant species interspersed with valley wildrye grassland. The grassland component is dominated by creeping wildrye.

ELDERBERRY SAVANNAH/VALLEY WILDRYE GRASSLAND MIX

This habitat type is characterized by blue elderberry (*Sambucus mexicana*) as the primary shrub component with creeping wildrye as the grassland dominant. Other species may be interspersed such as California mugwort, stinging nettle (*Urtica dioica*) and other herbaceous species.

VALLEY OAK ELDERBERRY SAVANNAH/VALLEY WILDRYE GRASSLAND MIX

This habitat type is similar to elderberry savannah/valley wildrye grassland but includes valley oak trees.

GRASSLAND

This habitat type is characterized by perennial and annual grasses and forbs of various heights stratified horizontally over the community type. Species in this community may include purple needlegrass, blue wildrye, creeping wildrye, California meadow barley (*Hordeum brachyantherum*), gum plant (*Grindelia* spp.), clover (*Trifolium* spp.), and other forbs.

SAVANNAH

This habitat type is similar to elderberry savanna but it not dominated by elderberry bush. Shrubs such as coyote brush, California rose and poison oak dominate the scrub layer while perennial and annual grass species such as purple needlegrass, blue wildrye, creeping wildrye and forbs such as mugwort dominate the understory.

1.1.5 EXISTING RIPARIAN AND CROPLAND HABITAT RELATIONSHIP AND RESTORATION OBJECTIVE

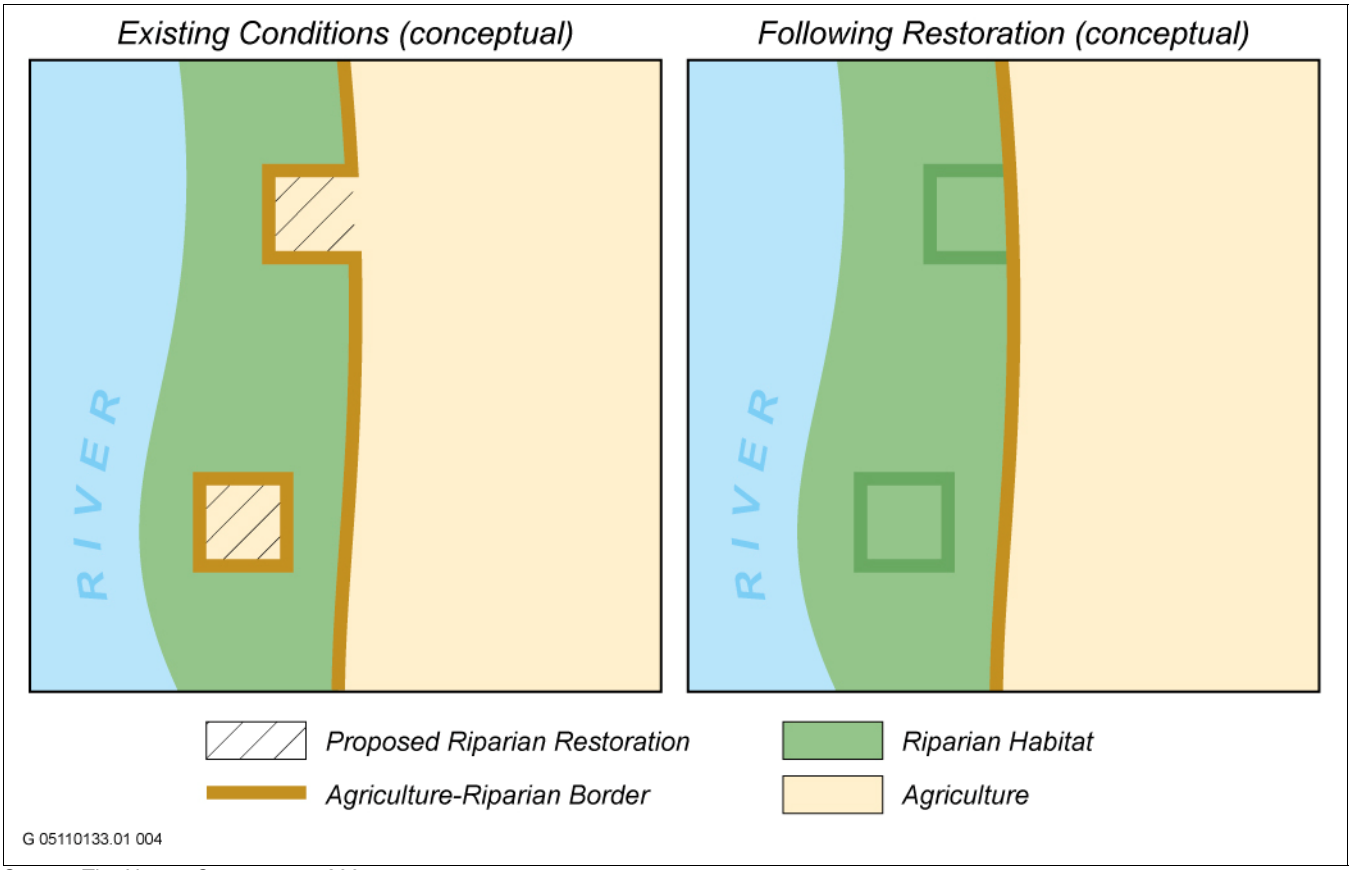
The approximately 55% of the land within the Colusa Subreach that is riparian habitat is dispersed throughout the Subreach and intermixed with cropland. Almost all of the land that is used for crops currently adjoins riparian habitat. As a result, most of the cropland areas are currently influenced by the plants and animals that populate riparian habitat.

A principal objective of riparian habitat restoration along the Sacramento River is the filling of gaps within areas of remnant riparian habitat. This results in larger, more connected areas of habitat that can better support viable populations of native species. Given this objective, areas that are selected for restoration tend to be adjacent to existing habitat and have a limited interface with cropland areas (Exhibits 1-3 to 1-8, Exhibit 1-9). This selection factor is particularly apparent in the Colusa Subreach where the eight proposed restoration areas are primarily adjacent to remnant riparian habitat and levees. Only about 11 percent of the perimeters of the eight restoration tracts are directly adjacent to cropland. Conceptually, the total extent of the borders between riparian habitat and agriculture land in the Subreach will be reduced following restoration (Exhibit 1-9). Table 1-4 provides details regarding the location of the proposed restoration areas relative to existing cropland.

Table 1-4
Proposed Restoration Tract Sizes and Adjoining Land Use Types

Restoration Tract	Total Area (ac)	Restoration Area (ac)	Restoration Area Perimeter				Restoration Area Distance from River (feet)
			Adjoining Cropland (feet)	Adjoining Levee (feet)	Adjoining Riparian (feet)	Percent Adjoining Cropland	
Princeton SE (Womble)	307	58	1,161	2,095	5,226	13.7%	2,300 to 5,100
Jensen	105	83	2,117	0	5,819	26.7%	200 to 2,400
Stegeman	69	10	0	0	3,044	0	50 to 600
1,000-acre Ranch	60	50	1,255	3,561	2,234	17.8%	1,200 to 3,800
Boeger	129	55	221	231	6,558	3.2%	50 to 2,000
Colusa North	118	5	0	0	2,256	0	800 to 1,300
Colusa Sacramento River SRA (Ward)	238	139	1,338	974	12,774	8.9%	20 to 2,400
Cruise n'Tarry	10	3	0	538	2,173	0	20 to 500
Totals	**1,036**	**403**	**6,092**	**7,399**	**40,084**	**11.4%**	**20 to 5,100**

Source: The Nature Conservancy 2007



Source: The Nature Conservancy 2007

Conceptual Reduction in Subreach Agriculture-Riparian Border Length Following Restoration **Exhibit 1-9**

There are only six cropland properties that adjoin the eight proposed restoration areas. These six areas include approximately 374 acres of crops, about 16% of the cropland in the Subreach. Each of these cropland areas is currently adjacent to riparian habitat along a substantial portion of its perimeter. The portion of the perimeters of these cropland areas that adjoins riparian habitat varies from 27% to 80% of the perimeters. Taken as a whole, 60% of the perimeter of these cropland areas is directly adjacent to existing riparian habitat at this time and the percentage would increase to 84% with the proposed riparian habitat restoration. Each of these adjacent cropland areas already is subjected to riparian habitat influences to a substantial degree. As a result, it is expected that the proposed restoration will not introduce completely new influences on the existing cropland.

1.2 STUDY OBJECTIVES AND DESIGN

1.2.1 STUDY OBJECTIVES

The goal of this study is to provide objective and comprehensive scientific and regulatory information on stakeholder concerns that cover two major areas: environmental regulations and pest damage to crops. More specifically, this study:

- identifies environmental regulations that apply to agricultural lands and evaluates the applicability of those constraints to the species, habitats, and agricultural practices in the Colusa Subreach;

- characterizes changes in regulatory constraints on agriculture, if any, that are likely to result from the proposed restoration projects in the Colusa Subreach;
- identifies solutions, regulatory agreements, and/or restoration strategies that may be implemented to reduce regulatory constraints on agriculture, without unduly impacting the likelihood of established programs achieving stated ecosystem recovery goals;
- summarizes and evaluates the existing information on wildlife-caused crop damage and pest wildlife populations in the Colusa Subreach;
- identifies differences in crop damage or pest wildlife populations, if any, on agricultural lands that adjoin riparian habitats vs. those that adjoin other agricultural lands;
- characterizes changes in wildlife-caused crop damage, if any, that may result from the proposed restoration projects in the Colusa Subreach;
- identifies solutions, pest management activities, or restoration strategies that may be implemented to reduce wildlife damage to crops, without unduly impacting the likelihood of established programs achieving stated ecosystem recovery goals; and
- provides research recommendations to fill knowledge gaps that currently limit our ability to anticipate impacts or predict responses to proposed solutions.

1.2.2 STUDY DESIGN

To ensure that stakeholder concerns would be adequately addressed by this study, EDAW facilitated meetings on May 30, 2006 and October 15, 2007 with the Advisory Workgroup, meetings on May 3, 2006 and May 11, 2007 with the External Experts Group, and a meeting on September 12, 2006 with six landowners with property adjoining the proposed restoration sites. Discussions with these stakeholders framed the initial design of this study and the priorities for analysis and provided important information that is included in this study's results. Stakeholders also reviewed a Draft Study Design document and approved a Final Study Design document, which incorporated their suggestions. No field research was conducted by EDAW for this study. The analysis for this study was based on a thorough review of the scientific literature, databases, unpublished field research currently in progress, and laws and regulations. Key information was also obtained through one-on-one interviews with key stakeholders, experts, and agency personnel.

2 REGULATORY CONSTRAINTS

The first part of this chapter, Section 2.1, includes an assessment of whether environmental laws and regulations have potential to increase constraints to agricultural practices on land adjacent to proposed riparian habitat restoration in the Colusa Subreach. The second part of this chapter, Section 2.2, discusses sensitive biological resources in the subreach and evaluates the potential for species-specific regulatory constraints. Analyses from both sections are summarized in Section 2.3, which concludes that the only potential increase in environmental regulatory constraints to agricultural practices would be a limitation of certain activities within 100 feet of elderberry shrubs with stems 1 inch or greater in diameter at ground level. These practices are not limited, however, adjacent to smaller elderberry shrubs, and such shrubs may be removed before they reach the protected 1 inch diameter size. A variety of practical solutions available to prevent limitations surrounding larger elderberry shrubs are discussed in Chapter 3, Regulatory Solutions. Riparian habitat restoration is not expected to increase agricultural regulatory constraints associated with the other 14 regulations, 14 protected species, and 6 protected habitats analyzed in this study.

The agricultural practices considered in this report were identified by Colusa Subreach farmers and stakeholders in the Advisory Workgroup and External Experts Group, and are listed below.

- Disking, grading, deep ripping, and plowing
- Mowing and maintenance of ditches and agricultural borders
- Irrigation and water transfers
- Planting, pruning, and harvesting
- Application of fertilizers and pesticides
- Additional pest control methods
- Tree removal

2.1 ENVIRONMENTAL LAWS AND REGULATIONS RELEVANT TO AGRICULTURE AND HABITAT RESTORATION IN THE STUDY AREA

This section summarizes 15 relevant environmental and natural resource laws and regulations, evaluates the applicability of these laws and regulations to specific agricultural practices and riparian habitat in the study area, and determines whether the proposed riparian habitat restoration is likely to increase constraints to neighboring agriculture related to these laws and regulations. More information on applicable environmental regulations may be found in the web-based permitting guide for projects in the Sacramento River watershed, located at http://www.sacriver.org/watershed/permitguide (SRWP 2007). This information-rich website is intended to be a guide for restoration project proponents and stakeholders to help them comply with regulatory requirements for ecological restoration projects in the Sacramento River watershed, but is also useful for understanding regulations that apply to agricultural activities in the area. Additional websites where readers may access further information are listed in Appendix C.

2.1.1 ENVIRONMENTAL LAWS

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) (42 USC 4321 et seq.) was written to ensure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that has potential to significantly affect the environment. NEPA requirements are invoked only in relation to federal projects and projects that require the approval of federal agencies. As such, NEPA regulations are typically not applicable to agriculture or restoration activities when such activities are conducted by private or state organizations or individuals on private or state lands using private or state funds and requiring no federal agency approvals.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) (Public Resources Code [PRC] Sections 21000 et. seq.) was enacted to protect the environment on a broad scale, including biological and agricultural resources, air and water quality, soils and mineral resources, aesthetics, cultural and historical resources, population and housing, public services and infrastructure, and recreation. CEQA applies to actions by state or local government agencies and projects requiring the approval of these public agencies that may involve significant adverse effects to the environment. CEQA requires that these projects be evaluated for adverse impacts to the environment, and requires the adoption of feasible mitigation measures for significant environmental impacts as a part of the agency approval process. Because routine agricultural operations practiced by private growers on their farms are not considered "projects" under CEQA and typically do not require public agency approval, this law does not generally apply to these agricultural practices. In addition, when CEQA compliance is required on neighboring restoration sites, environmental analysis and mitigation would not involve any restrictions to neighboring landowners or any need for surveyors to access neighboring private lands. The analyses of affected areas would be limited to the restoration sites themselves.

2.1.2 SENSITIVE SPECIES LAWS AND REGULATIONS

FEDERAL ENDANGERED SPECIES ACT

The goal of the federal Endangered Species Act (ESA) (16 United States Code [USC] 460 et seq.) is to conserve threatened and endangered plants and animals and the habitats upon which they depend. The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have authority over actions that may affect the continued existence of a federally listed species. Section 9 of the ESA prohibits the take of federally listed species; "take" is defined, in part, as killing, harming, or harassment. Under federal regulations, take is further defined to include habitat modification or degradation where it results in death or injury to wildlife by significantly impairing essential breeding, feeding, or sheltering activities.

The ESA provides several mechanisms by which take of federally-listed species may be permitted, with mitigation, by USFWS on a case-by-case basis. The permit mechanisms differ if the party responsible for the take is a federal, state or local agency; private citizen; or private organization. State, local, or private projects that are permitted by, funded by, or otherwise involve federal agencies (for example, levee improvement projects requiring certification by U.S. Army Corps of Engineers [USACE]) are said to have a "federal nexus" and are treated as federal projects under the ESA. Federal agencies are governed by Section 7 of the ESA, which outlines procedures for federal interagency cooperation to conserve federally-listed species and designated critical habitat. Section 7(a)(2) requires federal agencies to consult with USFWS to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species. For federal projects which may result in take of listed species, the agency responsible for the project must enter into a Section 7 consultation with USFWS, in which measures to avoid, minimize, and/or mitigate the take will be negotiated. If the agreed-upon measures are deemed adequate mitigation for the expected take and the project is not expected to jeopardize the continued existence of the species, USFWS may issue a Biological Opinion (BO) which permits take under specified conditions.

For projects where federal action is not involved but take of a listed species may occur, Section 7 does not apply and a USFWS BO is not required. Instead, non-federal (i.e., state, local or private) project proponents may seek to obtain incidental take under Section 10(a) of ESA. Section 10(a) of ESA allows the USFWS to permit the incidental take of listed species by state and local governments, private organizations and individuals if such take is accompanied by a Habitat Conservation Plan (HCP) that includes components to minimize and mitigate impacts associated with the take. Because agricultural and maintenance activities on private farms are not considered to have a "federal nexus," Section 10 rather than Section 7 applies to any ESA issues in the Colusa Subreach addressed in this study.

Section 2.2 of this report discusses the ESA-listed species with potential to occur in the Study area, the potential for agricultural operations to result in take of these species, and the potential for riparian habitat restoration to influence the likelihood of take on neighboring agricultural lands.

CALIFORNIA ENDANGERED SPECIES ACT

Similar to the federal ESA, the California Endangered Species Act (CESA) prohibits take of state-listed threatened or endangered species. CESA is outlined in Sections 2050–2100 of the California Fish and Game Code. State-protected species are listed by the California Department of Fish and Game (DFG), and often differ from the federally protected species listed by the USFWS and NMFS under the ESA. This difference reflects differing levels of species endangerment across the United States.

Under CESA, "take" is defined as any activity that would directly or indirectly kill an individual of a listed species. The CESA definition of "take" does not include "harm" or "harass," as the federal ESA does, and is thus less restrictive than the ESA. Also unlike the federal ESA, CESA does not explicitly include protection of endangered species habitat, except in the case of projects requiring state agency approval. Habitat protections for state-endangered species would thus not typically apply to routine agricultural operations on private land, unless alteration of the habitat could directly or indirectly kill an individual, thus resulting in take.

Section 2.2 of this report discusses the CESA-listed species with potential to occur in the Study area, the potential for agricultural operations to result in take of these species, and the potential for riparian habitat restoration to influence the likelihood of take on neighboring agricultural lands.

BALD AND GOLDEN EAGLE PROTECTION ACT OF 1940

This law provides for the protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession, and commerce of such birds. The 1972 amendments increased penalties for violating provisions of the Act or regulations and strengthened other enforcement measures. Section 2.2 of this report discusses the potential for bald and golden eagles to occur in the study area, the potential for agricultural operations to result in take of these species, and the potential for riparian habitat restoration to affect the potential for agriculture-related take.

MIGRATORY BIRD TREATY ACT

The federal Migratory Bird Treaty Act (MBTA), first enacted in 1918, implements domestically a series of treaties between the United States and Great Britain (on behalf of Canada), Mexico, Japan, and the former U.S.S.R., which provide for international migratory bird protection, and authorizes the U.S. Secretary of the Interior to regulate the taking of migratory birds. The MBTA establishes that it is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird" (16 USC 703). The current list of species protected by MBTA can be found in the August 24, 2006 Federal Register (71 FR 50194). The list includes a large proportion of the birds native to the United States. Nonnative species such as house sparrows, European starlings, ring-necked pheasants, and rock doves are not protected by this statute, nor are native, non-migratory upland game birds such as quail. Section 3513 of the California Fish and Game Code provides for state adoption of the MBTA's provisions and is discussed in the next section.

Riparian habitat restoration has been found to result in increased local abundance and distribution of riparian-associated migratory birds in the study area (Gardali et al. 2006), some of which may also occur on nearby agricultural parcels. Incidental take of migratory birds may occur during agricultural operations, such as: removal of nest trees; mowing of agricultural borders or ditch maintenance activities which remove herbaceous vegetation housing nests; or plowing, other earthmoving activities, or driving tractors in the presence of ground nests. However, migratory bird species associated with non-riparian habitats are currently present on Colusa Subreach farms. Therefore, the MBTA already applies to all farms in the Subreach, regardless of whether riparian habitat

restoration is implemented. While it is unknown how much of an increase may occur in the local abundance of riparian-associated migratory birds as a result of restoration, the relative increase in population on farms within the subreach is not expected to be large due to the tendency of most migratory bird species in the subreach to primarily utilize riparian habitat and due to the relatively small proportionate increase in riparian habitat to that presently occurring in the subreach. The proposed restoration is therefore considered unlikely to increase existing regulatory constraints on agriculture related to the MBTA.

Incidental take of migratory birds could also occur as a result of chemical pesticide application on farms. However, the existence of specific pesticide use regulations absolves pesticide applicators from regulatory responsibility for take of protected species, provided that the pesticides were used in accordance with their associated regulations (see Section 2.1.3 for more details on pesticide regulations). The November 15, 1989 Federal Register also grants an exception to the MBTA to allow the take of certain species including yellow-headed, red-winged, rusty, and Brewer's blackbirds; brown-headed cowbirds; and all grackles, crows, and magpies when they are found damaging crops "or about to" do so (54 FR 47525). Due to the population declines and conservation concern surrounding yellow billed magpies, however, it is recommended that take of this California endemic species be avoided.

CALIFORNIA FISH AND GAME CODE

The California Fish and Game Code regulates the take of game and nongame species of fish and wildlife. For game species, this code limits allowable take to open hunting and fishing seasons and possession limits (i.e., numbers of animals taken) established by DFG for licensed persons. For nongame species, the Fish and Game Code outlines species and groups of species for which take is prohibited, allowed when accompanied by a DFG permit, or allowed without a permit. In this law, "take" is defined as hunting, capturing, killing, or attempting to hunt, capture, or kill an animal. In the case of birds, "take" also includes destroying their nests or eggs. Habitat modification is not included in the Fish and Game Code's definition of take, with the exception of the individual trees or vegetation in which active nests are located. Also, similar to CESA, harassment is not included in the code's definition of take, except in the case where disturbance of a pair of nesting birds causes nest abandonment and/or reproductive failure.

Thirty-nine fish and wildlife species have been designated with fully protected status in Fish and Game Code Sections 3511, 4700, 5050, and 5515. These statutes prohibit take or possession of fully protected species at any time. DFG is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by those species. DFG has informed non-federal agencies and private parties that they must avoid take of any fully protected species when carrying out projects. Section 2.2 of this report discusses the Fish and Game Code's listed fully-protected species with potential to occur in the study area, the potential for agricultural operations to result in take of these species, and the potential for riparian habitat restoration to increase the likelihood for agriculture-related take from the existing condition (i.e., prior to restoration).

Birds also receive special protection under the Fish and Game Code. Section 3503 states that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically prohibits the take, possession, or destruction of raptors (i.e., eagles, hawks, owls, and falcons), including their nests or eggs. Section 3513 provides for adoption of the MBTA's provisions, and states that it is unlawful to take or possess any migratory nongame bird protected by the MBTA. These state codes offer no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of raptors, migratory nongame birds, or bird nests.

Riparian habitat restoration would likely result in increased local abundance and distribution of riparian-associated raptors and migratory birds in the study area, such as black-headed grosbeak, yellow-breasted chat, warbling vireo, yellow warbler, and Cooper's hawk. However, other migratory birds and raptors are known to presently nest on farms in the Colusa Subreach, including barn swallow, house finch, red-winged blackbird, and northern harrier. Therefore, as with the MBTA, farms in the subreach are already subject to the Fish and Game Code requirements, regardless of whether riparian habitat restoration is implemented. While it is unknown how

much of an increase may occur in the local abundance of riparian-obligate raptors and migratory birds as a result of restoration, the increase in populations on farms within the subreach is not expected to be large due to the tendency of most migratory bird species in the subreach to primarily utilize riparian habitat, the relatively small proportionate increase in riparian habitat to that presently occurring in the subreach and, especially in the case of raptors, the small population sizes typical for these species. The proposed restoration is therefore considered unlikely to increase existing regulatory constraints on agriculture related to the California Fish and Game Code.

The Fish and Game Code also includes specific allowances for take of animals on private lands and during agricultural activities. For example, Section 2014(d) asserts that the state may not engage in civil action against persons or local agencies responsible for irrigation canals, works, or drainages in which take of fish occur, or those responsible for take while engaged in legal methods of agricultural pest control.

Sections 4181 and 4181.5 allow landowners and tenants to apply to DFG for permits to take game species out of season when they are damaging or in danger of damaging crops or other property. These allowances include the take of deer, beaver, wild pig, wild turkeys, and gray squirrels. Similarly, Section 4152 asserts that nongame mammals and black-tailed jackrabbits, muskrats, and red fox squirrels that are found to be injuring growing crops or other property may be taken without a permit at any time and in any manner, except with certain kinds of leghold steel-jawed traps, which are regulated under Section 4004. Section 4186 authorizes landowners and tenants to take cottontail and brush rabbits during any time of the year when damage to crops or forage occurs.

Section 3801.5 similarly states that nongame birds not protected by the MBTA may be taken without a permit when they are found to be injuring growing crops or property. Brewer's blackbirds and American crows, which have been identified as agricultural pests in the study area, are protected by the MBTA and are thus not included in this Fish and Game Code exemption. However, the November 15, 1989 Federal Register grants an exception to take blackbirds and crows when found damaging crops "or about to" do so (54 FR 47525). Ring-necked pheasants, which have also been identified as agricultural pests in the study area, are considered game birds and are similarly not included in this Fish and Game Code exemption. As discussed in Chapter 4, however, the proposed habitat restoration is not expected to increase populations of blackbirds, crows, or pheasants in the study area.

Section 1602 of the California Fish and Game Code provides additional protections for streams and their associated riparian habitats; this section is discussed below in Section 2.1.4, Water Quality Regulations.

2.1.3 PESTICIDE LAWS AND REGULATIONS

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 USC 136 et seq.) is administered by the federal Environmental Protection Agency (EPA), in cooperation with state agricultural agencies. The majority of this law applies to pesticide manufacturers and distributors. The sections of this law which apply to pesticide users require applicators to:

- complete a certification process and any state-required training programs,
- maintain use records of any restricted pesticides used, if applicable, and
- use registered pesticides only in manners that are consistent with product labeling or, if applicable, an experimental use permit.

Habitat restoration may affect FIFRA requirements related to agricultural practices only through potential effects on use restrictions posted on product labeling. These potential effects are discussed below.

PESTICIDE LABEL RESTRICTIONS

To obtain a list of registered pesticides used in the study area, EDAW queried a Pesticide Use Report (PUR) from the California Pesticide Information Portal (CalPIP) online database administered by the California Department of Pesticide Regulation (DPR) (CalPIP 2004). This query included each of the 14 crops identified for analysis in this report and all sections within the study area. The results identified 120 pesticide products used in the study area in 2004; pesticide use data from 2005 or 2006 were not yet available for the study area at the time of this report. The full list of pesticide products used in 2004 is included in Appendix D.

Carolyn Pickel, Integrated Pest Management Farm Advisor for the University of California Cooperative Extension, identified Captan, Diazinon, DuPont Asana, Lorsban, Manex, Mustang, Omite, Roundup, and variations of these products as the most important pesticides from the list of those used in the study area (Pickel, pers. comm., 2006). EDAW analyzed the label restrictions for these pesticides in September 2006 and found that all environmental restrictions in the product labeling referred only to aquatic habitats such as rivers, lakes, and marshes, and did not refer to riparian or terrestrial habitats or species (EPA 2006a). The proposed restoration of riparian habitats and associated species is not expected to result in increased restrictions for these pesticides based on their current labels.

Conversely, restoration of riparian habitats could provide benefits when located between river banks and agricultural lands, by providing vegetated buffers between pesticide application areas and waterways. The planting of vegetated buffers has been shown to be an effective means of sequestering agricultural toxins. This is discussed further in the next section.

INTERIM SPECIES PROTECTION MEASURES FOR PESTICIDE USE (PRESCRIBE PROGRAM)

In addition to use limitations that are listed in pesticide labeling, Colusa Subreach stakeholders have expressed concerns regarding pesticide use limitations associated with threatened and endangered species. Under Section 7(a)(2) of the ESA, the EPA must ensure that the use of pesticides it registers will not result in harm to threatened or endangered species, or to habitat critical to those species' survival. As such, compliance with EPA-approved pesticide use guidelines and product labeling satisfies all legal requirements regarding pesticides and endangered species protection (Marovich 2000a, b). Pesticide use guidelines for endangered species protection in Colusa and Glenn counties are included in Appendices E and F. No additional restrictions to pesticide use apply for use adjacent to riparian habitat.

At the present time, the EPA's pesticide use restrictions are limited to the requirements specified on pesticide product labeling. However, the EPA and DPR, in consultation with USFWS and USDA, are in the process of developing an Endangered Species Protection Program that may carry additional regulatory restrictions in the future (Marovich, pers. comm., 2006). This proposed program has been developed in consultation with farmers, landowners, and agricultural commissioners, and has been endorsed by the California Agricultural Commissioners Association. The proposed guidelines, or "use limitations," are based primarily on existing best management practices (BMPs). An interim, non-regulatory version of this program has been published as proposed pesticide use guidelines in DPR County Bulletins (e.g., Marovich 2000a, b). These interim measures are also available online through a searchable DPR database called Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine (PRESCRIBE) (PRESCRIBE Online Database Application 2004). Guidelines pertaining to riparian habitat and protected species are discussed below.

The primary author of the PRESCRIBE pesticide use guidelines has summarized DPR's intent as follows: "Treat native habitat the way you would treat your neighbor's crop if that crop had different chemical tolerances than your own" (Marovich, pers. comm., 2006). No additional guidelines are included to restrict use near riparian habitat. The PRESCRIBE guidelines were designed to benefit protected wildlife in two ways: by reducing potential pesticide impacts and by enabling native habitats to be planted without additional regulatory restrictions (Marovich, pers. comm., 2006). For example, in Use Limitation 17, riparian vegetation is specifically listed as an

appropriate buffer between pesticide use and nearby habitat, to reduce pesticide drift in windy conditions (PRESCRIBE Online Database Application 2004). DPR's interpretation of this guideline is that even if protected species occupy a patch of riparian habitat, the edges of this habitat provide an adequate buffer to the interior (Marovich, pers. comm., 2006). Use Limitation 15 provides the following guidance to reduce runoff: "Provide a 20 foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur…" This buffer may consist of agricultural, riparian, or other vegetation (Marovich, pers. comm. 2006). Both of these interim measures are supported by DPR, DFG, California Department of Food and Agriculture (CDFA), and the Agriculture Commissioners Association (Rich Marovich, pers. comm. 2007; PRESCRIBE Online Database Application 2004).

The remaining guidelines applicable to the study area are neutral with regard to neighboring riparian habitat; they refer instead to irrigation waters and pesticide applications that are applied directly to habitat. As such, if the voluntary PRESCRIBE pesticide use limitations are implemented in a future regulatory program, they would not result in increased study area restrictions to agricultural practices if riparian habitat was restored there.

CALIFORNIA FOOD AND AGRICULTURAL CODE

The California Food and Agricultural Code authorizes a variety of programs to protect the state's natural resources while promoting a vibrant agricultural economy. The natural resource programs authorized by the code are largely voluntary in nature, with the exception of the code's pesticide regulations and requirements for compliance with existing federal regulations. The Food and Agricultural Code's pesticide regulations are implemented by DPR and county agricultural commissioners. Like FIFRA, the California Food and Agricultural Code regulates the registration of pesticides that may be used in the state. Code regulations also include Section 12972, which mandates that pesticides be used only in accordance with product labeling and "in such a manner as to prevent substantial drift to nontarget areas." This provision applies to all nontarget areas, whether the pesticide is applied next to habitat or agricultural land. Sections 14004.5 and 14102 also require the state Secretary of Food and Agriculture to restrict the use of environmentally harmful materials. The list of restricted materials is maintained by DPR, and includes general categories of pesticides as well as specific active ingredients. This list is codified in the California Code of Regulations (3 CCR 6400–6489, 6800–6960), which outlines the conditions under which they may be used. These environmental use requirements are limited to protecting water quality and air quality, and do not include additional protections for riparian or terrestrial habitats or species.

Pursuant to the Food and Agricultural Code, persons wishing to use a pesticide included in DPR's restricted materials list must also receive a permit from the applicable county agricultural commissioner, unless the pesticide is also included in a separate DPR list of materials exempt from permit requirements, listed in Section 6402 of the California Code of Regulations.

Restricted and exempt pesticides used in the study area are listed in Appendix D. Permit applications are evaluated on a case by case basis, depending on the active ingredients to be used, the formulation of the pesticide product (e.g., granular or water-based), the target pests and crops, the seasonal timing of the application, as well as adjacent land uses and sensitive resources. When granting use permits for restricted materials, county commissioners typically require BMPs to reduce runoff and chemical drift outside of the application area. Required BMPs may include limiting pesticide applications to periods when winds are light or blowing away from sensitive areas, avoiding overspraying into drains that carry runoff to sensitive areas, or requiring ground-based applications rather than aerial ones. Because the pesticide registration and labeling requirements outlined in FIFRA and the California Food and Agricultural Code reduce the risk of environmental damage associated with proper pesticide use and BMPs, increased proximity of riparian habitat is not expected to reduce the likelihood that applicants will receive county use permits (Richter, pers. comm., 2006).

Colusa County permits for restricted pesticide use adjacent to riparian habitat are likely to require BMPs to further reduce this risk, just as permit conditions are set for pesticide applications adjacent to waterways, apiaries,

livestock, or sensitive crops other than the target crops (Richter, pers. comm., 2006). Thus, although it is possible for adjacent riparian habitat to affect requirements for individual permits in some cases, riparian habitat restoration is unlikely to cause substantial changes in county permit requirements for agricultural pesticide use.

2.1.4 WATER QUALITY LAWS AND REGULATIONS

CLEAN WATER ACT

The federal Clean Water Act protects "waters of the United States," which are defined as interstate waters and intrastate waters used in interstate or foreign commerce or are subject to the ebb and flow of the tide (navigable waters), and their associated wetlands and tributaries. Irrigation and flood control channels are typically considered waters of the United States if they carry water for at least three months of the year and are tributaries (including distributaries) to traditional navigable waters. Wetlands are similarly considered waters of the United States if they are adjacent to navigable waters or abut tributaries to navigable waters. In other cases where the subject waters do not flow for at least three months of the year or wetlands are adjacent to such waters, USACE would make a case-by-case determination of jurisdiction. For regulatory purposes under this law, wetlands are defined as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Riparian habitats and portions of agricultural fields may be considered wetlands if they meet specific soil, hydrology, and vegetation criteria. Specifically, if a site supports hydric soils, wetland hydrology and hydrophytic vegetation, then the site would likely be considered a wetland subject to USACE jurisdiction under Section 404 of the Clean Water Act. It is unknown whether the proposed restoration areas currently support jurisdictional wetlands. A formal USACE-approved wetland delineation would be required to officially determine a site's status as a jurisdictional wetland under Section 404 of the Clean Water Act.

Any modifications to jurisdictional wetlands would require a permit from the USACE. This requirement would affect the landowner or agencies mandated to maintain the property. However, restoration of riparian habitat would not be expected to change any determination the USACE would make in a wetland delineation for the existing conditions at restoration sites or adjoining properties. Therefore, restoration of riparian habitat is unlikely to result in more restrictive requirements than currently exist for adjacent landowners conducting standard agricultural practices.

For waters of the United States, such as the Sacramento River and its associated irrigation canals, the Clean Water Act includes a variety of measures to protect water quality; these measures differ for each type of pollutant and each pollution source. Sources of water pollution are categorized under the act as point sources, which discharge relatively large concentrations of effluent from discrete conveyances (e.g., discharge pipes/ditches from industrial factories or concentrated animal feeding operations), and non-point sources, which are more dispersed on a landscape scale (e.g., runoff from irrigated agriculture or urban streets). The majority of the Clean Water Act's restrictions deal with point sources of pollution; non-point source regulatory sections are described below.

Clean Water Act Section 303(d): Water Quality Standards and Implementation Plans

Section 303(d) of the Clean Water Act mandates that states identify waters of the United States in their jurisdiction that are significantly affected by non-point source pollution, and for which water quality standards cannot be maintained through the Clean Water Act's point source pollution controls alone. For these waterways, states must establish "total maximum daily load" (TMDL) limits for the discharge of non-point source pollutants in order to improve water quality and meet established standards. The Sacramento River is included in California's list of waterways subject to TMDLs. These state regulations are discussed below, under the Porter-Cologne Water Quality Control Act (Porter-Cologne) and Regional Water Quality Control Board Irrigated Lands

Waiver (Irrigated Lands Waiver). Clean Water Act provisions for agricultural runoff require federal approval of state-established regulations but do not contain additional measures for the protection of riparian habitat. The restoration of riparian habitat thus would not increase water quality restrictions associated with Section 303(d).

Clean Water Act Section 404: Permits for Dredged or Fill Material

Section 404 of the Clean Water Act regulates the discharge of dredged or fill materials. Fill is defined as any material that replaces a portion of a water of the United States with dry land or changes the bottom elevation of any portion of a water of the United States. The sediment that runs off from individual farms during agricultural practices such as disking, grading, deep ripping, and plowing are not considered fill and are not regulated by Section 404.

Clean Water Act Section 402: National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) permit program was established under the Clean Water Act to reduce water pollution by regulating point sources that discharge pollutants into protected waters of the United States. The State Water Resources Control Board (State Water Board) has authority to issue NPDES permits in California and generally delegates this responsibility to the nine Regional Water Quality Control Boards (regional water boards).

Water transfers have been specifically excluded from NPDES permit requirements, as per the June 7, 2006 Federal Register Notice (71 FR 32887). This notice defines water transfers as any activity that conveys federally protected waters of the United States to other federally protected waters of the United States without first subjecting the water to intervening industrial, municipal, or commercial use. Agricultural transfers of irrigation water are included in this definition.

Four agricultural operations are subject to NPDES requirements: concentrated animal feeding operations, concentrated aquatic animal production facilities, aquaculture, and silviculture. These four operations are not practiced in the study area. Runoff from irrigated agriculture and agricultural stormwater is considered non-point source pollution and thus does not require an NPDES permit (EPA 2006b). Pesticide runoff from terrestrial applications, however, has historically been regulated less stringently than aquatic pesticide applications, discussed below. These aquatic pesticide regulations are relevant to the maintenance of irrigation ditches.

Applications of pesticides directly to water or below the ordinary high water line were excluded from NPDES permit requirements through an EPA ruling in the Federal Register on November 27, 2006 (71 FR 68483[1]). This issue, however, has been the subject of litigation for several years, and may continue to be litigated. It is reasonable to conclude, therefore, that NPDES permits for aquatically applied pesticides could again be required at some time in the future. Further, because the State Water Board and regional water boards have authority to issue NPDES permits and to establish other water quality regulations, it is unclear at the time of writing this report whether new state or regional regulations will replace the former federal permit requirements. We discuss the former NPDES aquatic pesticide requirements below for these reasons. (Mechanical and other forms of ditch maintenance do not require NPDES permits and are not included in the aquatic pesticide controversy. Permits for mechanical ditch maintenance are unlikely to be required in the future.)

Ten herbicides are currently authorized for aquatic use in California. Before the November 27, 2006 EPA ruling, the State Water Board had issued a statewide general NPDES permit for this use, to which farmers, irrigation districts, and other entities could apply for coverage. This permit was amended by the State Water Board on June 7, 2006. The basic requirements of this general permit included compliance with pesticide labeling and

[1] This ruling specifically exempts 1) the application of pesticides directly to waters of the United States for the purpose of controlling aquatic pests, and 2) the application of pesticides at the water's edge in certain explicitly-described cases where incidental deposition of the pesticide into the water is unavoidable.

regulations, monitoring and reporting requirements, use of a licensed pesticide applicator, and compliance with effluent and receiving water limitations outlined in the general permit.

Effluent and receiving water limitations for some permitted herbicides included numerical limits on the amount of herbicide used (e.g., copper), while limitations for other permitted herbicides were more qualitative and consisted simply of monitoring and reporting (e.g., Imazapyr). These limitations were developed by the State Water Board to protect a variety of "beneficial uses" of waters of the state, including safe drinking water, high-quality irrigation water, and healthy populations of fish and wildlife. Where more than one beneficial use was applicable, the general permit required compliance with the most protective of these criteria. With one exception not applicable to the study area, the limitations required to protect municipal drinking water and aquatic invertebrate organisms are the most protective criteria (State Water Resources Control Board 2006) and are more stringent than those that would be required to protect riparian habitat and its associated wildlife (Mustain, pers. comm., 2006). The restoration of riparian habitat thus would not increase NPDES restrictions for irrigation ditches in the study area, even if the NPDES aquatic pesticide permit requirements are reinstated in the future.

Clean Water Act Section 401: State Water Quality Certification

Section 401 of the Clean Water Act requires that before federal agencies authorize discharge permits through Section 404 or NPDES, they must receive certification from the applicable state agency stating that the discharge is consistent with state water quality standards and regulations. These state regulations are discussed below.

PORTER-COLOGNE WATER QUALITY CONTROL ACT

The Porter-Cologne (California Water Code section 13000 *et seq*.) is California's state clean water act, protecting "waters of the state." Waters of the state are defined more broadly than waters of the United States, and include any surface water or groundwater within the boundaries of the state. Irrigation ditches and constructed agricultural drains are specifically included in waters of the state (Central Valley Regional Water Quality Control Board 2006). Porter-Cologne's restrictions are also defined more broadly than those of the federal Clean Water Act. Porter-Cologne regulates the discharge of any waste or "material resulting from human activity" into waters of the state. This includes the runoff of sediments, fertilizers, and pesticides from agricultural activities.

Under Porter-Cologne, the State Water Board delegates water quality jurisdiction and planning authority to nine Regional Water Quality Control Boards. The Central Valley Regional Water Quality Control Board's jurisdiction includes the study area. Each regional water board must prepare and periodically update a basin plan for water quality control in accordance with Porter-Cologne. Each basin plan sets forth water quality standards for surface water and groundwater, as well as actions to control non-point and point sources of pollution to achieve and maintain these standards. The TMDLs mandated by the federal Clean Water Act are included in these basin plans.

The Central Valley Regional Water Quality Control Board is updating its basin plan at the time of writing this report. At this time, two TMDLs have been established that are relevant to irrigated agriculture along the Sacramento River (including the study area): Central Valley Pesticide TMDL, and Sacramento and Feather Rivers Diazinon TMDL. The first two of these include the Colusa Subreach study area. These TMDLs were established with many water quality objectives in mind, including high-quality irrigation water, safe water for river recreation, and protection of sensitive fish, wildlife, and invertebrates. Although TMDL pollutant limits are based in part on the sensitivity of animal species to pollutant loads, aquatic organisms in the water column and benthic sediment are typically much more sensitive to pollutant runoff than terrestrial wildlife. Riparian-associated wildlife and riparian habitat in general are thus not explicitly regulated by the TMDLs, which focus on the more sensitive aquatic life.

The Pesticide TMDL Unit Chief of the Central Valley Regional Water Quality Control Board has confirmed that TMDL regulations for agricultural runoff are not more restrictive for runoff that passes through riparian habitat before entering surface water than for runoff which enters the water after passing through other land uses

(Karkoski, pers. comm., 2006). Similarly, when riparian habitat is flooded, no additional restrictions apply beyond those protecting the water itself. Riparian habitat may also provide a benefit by buffering adjacent waterways, reducing runoff into the water column and improving water quality. In addition, once the proposed restoration sites are restored, they will no longer contribute to TMDLs, thus helping to achieve Sacramento River TMDL goals. Riparian habitat would provide vegetated buffers and sequestration of potential pollutants in runoff. Vegetated buffers, which may include riparian habitat, are included among the BMP options encouraged by the TMDL program (Karkoski, pers. comm., 2006).

REGIONAL WATER QUALITY CONTROL BOARD IRRIGATED LANDS WAIVER

To maintain water quality standards, and as part of the TMDL program, any party proposing to discharge waste that could affect waters of the state must file a report of waste discharge with the appropriate regional water board. The regional water board will then respond by issuing waste discharge requirements specific to that proposed discharge, or by waiving waste discharge requirements (with or without conditions) for that proposed discharge. Waste discharge requirements for agricultural discharges have been conditionally waived by the Central Valley regional water board's Irrigated Lands Waiver.

Waste specifically regulated by the Irrigated Lands Waiver includes organic and inorganic materials that may run off from farms, such as soils, rocks, minerals, fertilizers, and pesticides, that enter or have the potential to enter to waters of the state. Other types of discharge, such as hazardous waste, are not covered by the Irrigated Lands Waiver. Growers may receive regional water board approval to discharge under this waiver either as individuals or as members of a coalition group. To receive this approval, either the individual or the coalition group must submit a Notice of Intent to the regional water board, and receive a permit called a Notice of Applicability.

The California Water Code Section 13269 limits all conditional waivers to 5-year terms, after which the responsible regional water board must renew, revise, or rescind the waiver. The initial Irrigated Lands Waiver program expired on December 31, 2005, and was temporarily renewed by the Central Valley Regional Water Quality Control Board for an additional 6 months. On June 22, 2006, the Central Valley Regional Water Quality Control Board adopted the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands, which took effect on July 1, 2006. This waiver will remain effective until June 30, 2011, after which it may again be renewed, rescinded, or revised.

The previous and current Irrigated Lands Waivers incorporate the regional water board's TMDL regulations. As such, the Irrigated Lands Waiver program is focused specifically on surface water quality, and no additional restrictions are associated with riparian habitat under the waiver (Karkoski, pers. comm., 2006). Importantly, as noted in the preceding section, riparian habitat may buffer adjacent waterways, reducing the agricultural runoff that enters the water column and improving water quality, and vegetated buffers, including riparian habitat, are encouraged by the TMDL and Irrigated Lands Waiver programs.

SECTION 1602 OF THE CALIFORNIA FISH AND GAME CODE

All diversions, obstructions, or changes to the natural flow, bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG under Section 1602 of the California Fish and Game Code. Under Section 1602, it is unlawful to 1) substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake; 2) use any material from the bed, channel, or bank; or 3) deposit or dispose of debris or waste where it may pass into any river, stream, or lake without first notifying DFG of such activity and obtaining written authorization for such activity.

In this law, the regulatory definition of a stream is a body of water that flows at least periodically or intermittently through a bed or channel and supports wildlife, fish, or other aquatic life. This includes watercourses having a surface or subsurface flow that support or have supported riparian vegetation. Although only surface and ground waters are included in Porter-Cologne's definition of waters of the state (Karkoski, pers. comm., 2006), Section

1602 of the California Fish and Game Code specifically includes riparian habitat, intermittent drainage swales, wet meadows, and other intermittently flooded and moist-soil habitats as falling under DFG's jurisdiction, because of the value of those habitats to wildlife. DFG also has jurisdiction within altered or artificial waterways (including irrigation ditches) where those waterways support habitat for fish or wildlife.

DFG authorization for activities regulated by Section 1602 may take the form of a permit called a Streambed Alteration Agreement for activities expected to have substantial adverse effects on wildlife resources, or a written notice from DFG stating that the proposed activities are not expected to have substantial adverse effects. Streambed Alteration Agreement requirements for activities relevant to agriculture are handled by DFG on a case-by-case basis. For example, DFG need not be notified for the continuation of existing water transfer programs for irrigation, but notification and/or a Streambed Alteration Agreement may be required for new water transfers or increases in the volume of existing water transfers. Permit requirements in this case would depend on whether DFG determined that the volume, timing, and nature of the transfer would "substantially divert the natural flow" of the source waters (in this case, the Sacramento River). Similarly for irrigation ditch maintenance, aquatic pesticide use, and runoff of agricultural fertilizers, pesticides, and sediment, DFG has in some cases required a Streambed Alteration Agreement (DFG 2005a) and in other cases determined that no significant impacts were expected and no DFG permits were required (Holmes, pers. comm., 2006). Factors affecting these DFG decisions typically include ecological characteristics of the affected watercourses, the nature and severity of the potential impacts, and BMPs proposed for impact avoidance.

Although irrigation ditch maintenance involving the removal or degradation of riparian habitat may require a Streambed Alteration Agreement in some cases, the proposed riparian habitat restoration is not expected to increase Section 1602 permit requirements and regulatory constraints to neighboring agriculture because the proposed restoration areas do not include irrigation ditches that drain to neighboring agricultural parcels (Golet, pers. comm., 2006). Further, any potentially adverse environmental effects of water transfers and runoff would have a stronger effect on the Sacramento River's water quality and sensitive aquatic life than the adjoining riparian habitat and its associated wildlife. Thus, any DFG permit requirements associated with water transfers and runoff would be based on the larger aquatic impacts to the river and would not be more or less stringent if additional riparian habitat were nearby.

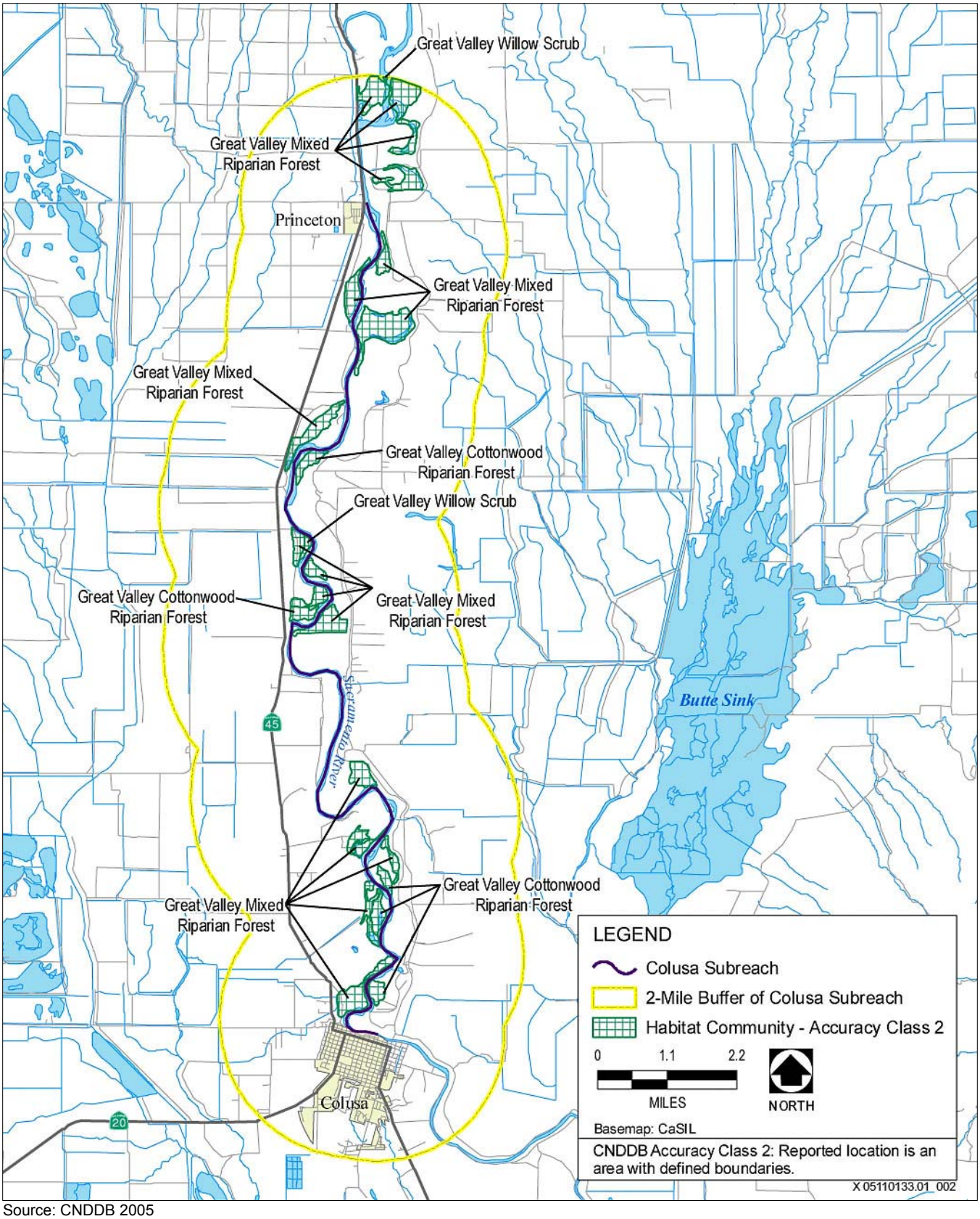
2.2 SENSITIVE BIOLOGICAL RESOURCES IN THE STUDY AREA

This section includes an assessment of the potential for proposed riparian habitat restoration in the Colusa Subreach to result in changes in the level of constraints posed to agriculture by sensitive habitats and sensitive species known to use or having potential to occur in the Colusa Subreach.

2.2.1 SENSITIVE HABITATS

Sensitive habitats include those that are of special concern to resource agencies or that are afforded specific consideration in state or federal environmental regulations such as CEQA, ESA critical habitat designations, the Clean Water Act, Porter-Cologne, Section 1602 of the California Fish and Game Code, and the Magnuson-Stevens Fishery Conservation and Management Act. Sensitive habitats are also referred to in regulatory documents as "sensitive natural communities." Sensitive habitats may be of special concern to regulatory agencies for a variety of reasons, including their locally or regionally declining status, or because they provide important habitat to common and special-status species. Sensitive habitats also provide other important ecological functions, such as enhancing flood and erosion control and maintaining water quality. Many sensitive natural communities are tracked in DFG's California Natural Diversity Database (CNDDB), a statewide inventory of the locations of some of the state's rarest plant and animal species and vegetation communities.

Sensitive natural communities documented in the study area by CNDDB include Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, and Great Valley willow scrub (Exhibit 2-1). Three additional



Source: CNDDB 2005

Habitat Communities within Two Miles of Colusa Subreach **Exhibit 2-1**

sensitive habitats are known to occur in the 7.5-minute quadrangles which contain the study area: Great Valley valley oak riparian forest, elderberry savannah, and valley freshwater marsh.

The Sacramento River, including the Colusa Subreach, has also been designated as Essential Fish Habitat (EFH) for chinook salmon, under the Magnuson-Stevens Fishery Conservation and Management Act, as amended (also known as the Sustainable Fisheries Act), and the Pacific Salmon Fisheries Management Plan (Pacific Fishery Management Council 2003). The River is designated as critical habitat for winter and spring-run chinook salmon and steelhead under the ESA.

Sensitive habitats proposed for restoration in the study area include Great Valley valley oak riparian forest, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, Great Valley willow scrub, and elderberry savannah. The proposed restoration would not include valley freshwater marsh.

The proposed riparian habitat restoration is not likely to increase sensitive habitat-related regulatory constraints on agricultural operations. The reasons for this are discussed in individual report sections for each of the environmental laws protecting sensitive habitats: Section 2.1, for CEQA, NEPA, the Clean Water Act, Porter-Cologne, and Section 1602 of the Fish and Game Code; and the fisheries sections below for ESA critical habitat and EFH as designated under the Magnuson-Stevens Fishery Conservation and Management Act.

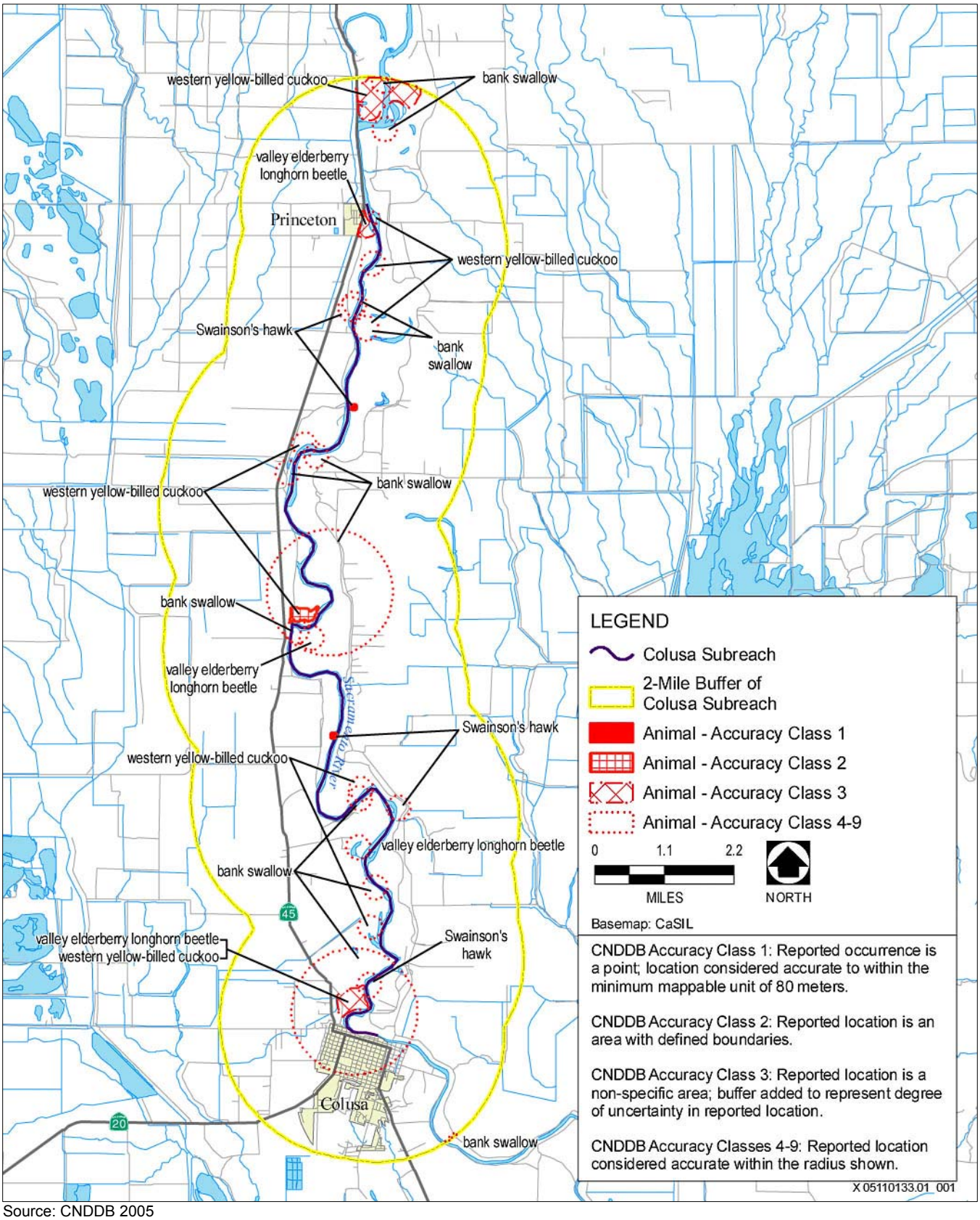
2.2.2 SENSITIVE SPECIES

Nine endangered, threatened, and fully protected fish and wildlife species are known to occur in the study area (Table 2-1), four of which have been partially mapped by the CNDDB (Exhibit 2-2), and five of which are known to occur throughout their respective habitats in the study area. Six additional endangered, threatened, and fully protected wildlife species that have not been documented in the study area have potential to occur because suitable habitat for them is present (Table 2-1). No threatened or endangered plants have potential to occur in the study area's riparian habitats. The protected plant species with potential to occur in the study area are limited to vernal pool and marsh species, which would not be affected by riparian habitat restoration on agricultural lands.

Although many "species of special concern" also occur in the study area and may benefit from the proposed restoration projects, this report is focused on endangered, threatened, and fully protected species. Legal protection for species of special concern is not associated with restrictions to routine agricultural operations. Because species of special concern are not protected by the ESA, CESA, or California Fish and Game Code and are covered only by CEQA and NEPA, constraints and mitigation for species of special concern are limited to the potential case of new public agency projects (e.g., Department of Water Resources levee improvements) which invoke these laws.

For each endangered, threatened, or fully protected fish and wildlife species with potential to occur in the study area, the following describes the species' habitat requirements, local and regional distribution, seasonality of occurrence in the study area, potential to specifically use riparian and agricultural lands in the study area, distance the species is likely to travel from riparian habitat into agricultural lands if applicable, regulatory constraints pertaining to the species, the potential for the proposed restoration projects to increase the species' abundance and distribution in the study area's riparian habitats and agricultural lands, and the potential for routine agricultural operations to result in take of the species.

In the text below, the four species for which regulatory constraints on agriculture *could* increase with restoration are discussed first. These include valley elderberry longhorn beetles, white-tailed kites, Swainson's hawks, and yellow-billed cuckoos. For these four species, potential regulatory constraints on agriculture that may be affected by the proposed restoration include, for valley elderberry longhorn beetles, activities within 100 feet of elderberry shrubs with stem diameters 1.0 inches or greater at ground level; and, for Swainson's hawks, white-tailed kites, and yellow-billed cuckoos, the removal of nest trees while eggs or chicks are present.



Source: CNDDB 2005

Threatened and Endangered Wildlife within Two Miles of Colusa Subreach **Exhibit 2-2**

Table 2-1
Endangered, Threatened, and Fully Protected Species with Potential to Occur in the Study Area

Species	Legal Status[1]		Habitat	Potential for Occurrence
	USFWS	DFG		
Invertebrates				
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	--	Elderberry shrubs, primarily in riparian woodlands.	Known to occur year-round.
Reptiles				
Giant garter snake *Thamnophis gigas*	T	T	Inhabits slow-moving streams, sloughs, ponds, marshes, inundated floodplains, rice fields, and irrigation and drainage ditches with mud substrate, emergent vegetation, and access to upland hibernaculae above the high water line.	May occur year-round; active April–October, inactive October–March.
Birds				
White-tailed kite *Elanus leucurus*	--	FP	Forages in grasslands and agricultural fields; nests in woodlands and isolated trees.	Known to occur year-round, but most abundant in winter
Southern bald eagle *Haliaeetus leucocephalus leucocephalus*	T	E, FP	Nonbreeding visitor to the Central Valley floor. Forages primarily from perches along rivers and other water bodies with abundant fish; less frequently hunts mammals in open habitats.	May occur in small numbers year-round, but more commonly outside of breeding season.
Swainson's hawk *Buteo swainsoni*	--	T	Nests in riparian woodlands and scattered trees; forages in grasslands and agricultural fields.	Known to occur in spring and summer.
Golden eagle *Aquila chrysaetos*	--	FP	Rare nonbreeding visitor to the Central Valley floor. Forages in large open areas of foothill shrub-steppe habitat and, less frequently, grassland and cropland.	Unlikely to occur except rarely in passage between more suitable habitat areas.
American peregrine falcon *Falco peregrinus anatum*	--	E, FP	Nonbreeding visitor to the Central Valley. Forages in a variety of habitats, but is most common near water, where shorebirds and waterfowl are abundant.	May occur in small numbers year-round, but more commonly outside of breeding season.
Greater sandhill crane *Grus canadensis tabida*	--	T, FP	Nonbreeding visitor to the Central Valley. Forages primarily in moist croplands with rice or corn stubble; also frequents grasslands and emergent wetlands. Prefers relatively treeless plains.	Unlikely to occur; most common where corn and rice fields are more dominant in the landscape. Sandhill cranes are known to occur north of the Subreach in Llano Seco, however, they are most common south of the study area.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	C	E	Nests and forages in riparian woodlands and riparian willow scrub; also forages in orchards adjacent to riparian habitat.	Known to occur in spring and summer.

Table 2-1
Endangered, Threatened, and Fully Protected Species with Potential to Occur in the Study Area

Species	Legal Status[1]		Habitat	Potential for Occurrence
	USFWS	DFG		
Little willow flycatcher *Empidonax traillii brewsteri*	--	E	Migrates through the Central Valley during spring and fall; forages in riparian willow scrub.	May occur in spring and fall.
Bank swallow *Riparia riparia*	--	T	Nests colonially typically in unforested, vertical river banks with friable soils; forages in a variety of habitats near the nesting colonies.	Known to occur in spring and summer.
Fish				
Sacramento winter-run chinook salmon *Oncorhyncus tshawytscha*	E	E	Spawns in cold, freshwater, gravel-bottomed streams; rears in rivers, tributaries, seasonally inundated floodplains, and Delta.	Known to occur during upstream, migration (adults) and during outmigration (juveniles)
Central Valley spring-run chinook salmon *Oncorhyncus tshawytscha*	T	T	Spawns in cold, freshwater, gravel-bottomed streams; rears in rivers, tributaries, seasonally inundated floodplains, and Delta.	Known to occur during upstream, migration (adults) and during outmigration (juveniles)
Central Valley steelhead *Oncorhyncus mykiss*	T	--	Spawns in cold, freshwater, gravel-bottomed streams; rears in rivers, tributaries, seasonally inundated floodplains, and Delta.	Known to occur during upstream, migration (adults) and during outmigration (juveniles)
Green sturgeon *Acipenser medirostris*	T	--	Spawns in cold, freshwater, gravel-bottomed streams; rears in rivers, tributaries, seasonally inundated floodplains, and Delta.	Known to occur during upstream, migration (adults) and during outmigration (juveniles)

1 Legal Status Definitions
Federal Listing Categories
E Endangered
T Threatened
C Formal candidate for listing as threatened or endangered
State Listing Categories
E Endangered
T Threatened
FP Fully Protected
Source: Data compiled by EDAW in 2006.

Species for which regulatory constraints on agriculture are *not* expected to increase with restoration are discussed next, and include giant garter snakes, southern bald eagles, golden eagles, American peregrine falcons, greater sandhill cranes, little willow flycatchers, bank swallows, chinook salmon, Central Valley steelhead, and green sturgeon. Following the species-specific analyses, these results are summarized by agricultural activity, for the agricultural operations prioritized by Colusa Subreach stakeholders in the Advisory Workgroup and External Experts Group. Potential solutions to regulatory constraints are discussed in Chapter 3, Regulatory Solutions.

VALLEY ELDERBERRY LONGHORN BEETLE

Ecology and Habitat

Valley elderberry longhorn beetles are patchily distributed throughout riparian forests of the Central Valley, and are absent from much of their historical range due to habitat loss, fragmentation, and degradation (USFWS 1984).

The beetles are dependent on elderberry shrubs for reproduction and survival and are known to occur in the study area's existing riparian habitats. Elderberry shrubs occur primarily in open riparian habitats (e.g., savannah); however, isolated shrubs and small patches of elderberries may also occur near irrigation ditches or in other agricultural areas where adequate water is available. Individual valley elderberry longhorn beetles rely on the same elderberry plant (or cluster of plants) throughout their life cycle (Barr 1991). Adults feed on the leaves and flowers, eggs are laid on the stem or leaves, and the larval and pupal stages develop within the pith of large stems, typically 1 inch or greater in diameter when measured at ground level. The majority of the valley elderberry longhorn beetle life cycle is spent within elderberry stems; the emergent adult stage lasts for less than 1 month of the beetle's 1-to-2-year life cycle. Dispersal of valley elderberry longhorn beetles is extremely limited. Some adults live their entire lives on their original host plants and do not disperse at all. Dispersing individuals typically limit travel to connected habitat within their home drainages, and colonization of disconnected unoccupied shrubs in fragmented habitat is uncommon (Collinge et al. 2001, Talley 2007).

Potential Effects of Restoration on the Species' Local Abundance and Distribution

The proposed restoration of riparian habitat would create up to 390 acres of habitat in which suitable elderberry shrubs could become established and could be colonized by valley elderberry longhorn beetles, potentially increasing the abundance and distribution of this species in the study area. Past riparian restoration projects along the Sacramento River have shown that as restoration sites age, the percent of elderberry shrubs with exit holes indicating valley elderberry longhorn beetle presence increases (River Partners 2003). The proposed restoration would also increase the quality of existing riparian habitat for this species. Because the proposed restoration sites are located adjacent to existing riparian habitat, the restored sites would increase the connectivity of existing beetle habitat in the study area, thus increasing the potential for dispersal between existing habitat patches and promoting a greater exchange of genetic diversity throughout the study area's population. Overall, however, no substantial increases in habitat for the beetle are anticipated, due to the small amount of restoration that is proposed, the relatively small amount of riparian-agriculture border area that would be affected, and the very small amount of potential habitat of this type that the proposed restoration sites could support. The open canopy types of riparian habitat (e.g., savannah) most suitable to the growth of elderberry shrubs constitute a small percentage of the proposed restoration, most of which is proposed for closed canopy riparian forest types in which elderberry shrubs are likely to be few (see Section 1.1.4, and Table 1-3). This limits the population size of elderberry shrubs that may result from the proposed restoration. Further, because a relatively small percentage of the proposed restoration perimeter borders agricultural land, the expected effect of elderberry shrubs on adjacent agricultural parcels is expected to be small (see Section 1.1.5)

Due to the limited dispersal capabilities of valley elderberry longhorn beetles (Collinge et al. 2001), this species is unlikely to colonize isolated elderberry shrubs on agricultural lands outside of core riparian habitat. However, mature elderberry shrubs are protected as potential hosts for valley elderberry longhorn beetles regardless of whether they are known to harbor beetle larvae. Elderberry shrubs may disperse more than a mile from their parent plants, as their seeds are carried by birds and mammals that eat the fruit (NRCS 2006). On unmanaged land, elderberry seeds may germinate and grow in areas containing appropriate hydrology, such as that found between the flood control levees of the Colusa Subreach. However, although elderberry shrub establishment may occur on agricultural fields and managed field borders, this establishment is uncommon because the species is easy to control with the standard weed control measures routinely practiced in these areas. Further, elderberry shrub growth is highly variable. In areas that are particularly good for elderberry growth (i.e., moist, sunny) they can grow relatively fast and reach a 1-inch diameter stem size within 1–2 years. However, in areas with particularly poor conditions, such as mitigation sites that do not receive much water, stem diameters may only reach 0.4 inches after 5 years. More commonly, elderberry shrubs tend to reach a 1-inch diameter stem size within 2–3 years (Holyoak and Talley, pers. comm., 2007) and typically begin to flower and bear fruit one year earlier, advertising their presence (USDA 2006). There are thus numerous opportunities to remove any shrubs before they reach the size at which they can be occupied by beetles, after which current law prevents them from being cut.

Species-specific Regulatory Constraints

Valley elderberry longhorn beetles are federally listed as threatened and are protected by the ESA. The ESA requires that USFWS conduct a review of listed species at least once every five years to determine whether any species should be reclassified or removed from the list. USFWS released its 5-year status review for the valley elderberry longhorn beetle on October 2, 2006 (USFWS 2006). In this review, USFWS reported an increase in known beetle locations from 10 at the time of listing in 1980 to 190 in 2006. Because of this observed population increase and the concurrent protection and restoration of several thousand acres of riparian habitat suitable for valley elderberry longhorn beetles, the USFWS status review determined that this species is no longer in danger of extinction, and recommended that the species be delisted and removed from ESA protection.

This recommendation is not a guarantee that the species will be delisted, however, because formal changes in the classification of listed species require a separate USFWS rulemaking process distinct from the 5-year review. If valley elderberry longhorn beetles are removed from the ESA list, it will likely be more than a year before this takes place. We have thus included the current regulatory constraints related to this species, below.

Because valley elderberry longhorn beetles are difficult to directly observe while inside elderberry stems, regulations designed to protect this federally threatened species are focused on their elderberry host plants. According to the USFWS conservation guidelines for the beetle, elderberry stems measuring 1.0 inch or greater in diameter when measured at ground level are protected as potential host stems for larval valley elderberry longhorn beetles, whether or not larvae are known to be present within the stems (USFWS 1999a). Adverse effects to these stems are generally prohibited by the ESA unless expressly permitted by USFWS through a Section 7 consultation and biological opinion, Habitat Conservation Plan, or Safe Harbor Agreement. These permits are discussed in detail in Chapter 3, Regulatory Solutions. Elderberry shrubs that have not yet grown to 1.0 inch or greater in diameter at ground level, however, are regarded as too small to support valley elderberry longhorn beetle larvae (USFWS 1999a). Therefore, ESA restrictions do not apply to these shrubs. As discussed above, elderberry shrubs typically grow for a few years (1 to 3 or more, depending on conditions) before reaching this size, and may be removed at any time prior to this without violating the ESA, because they would not be occupied by the beetles that are protected by the ESA.

According to the USFWS recovery plan for the valley elderberry longhorn beetle, the greatest threats to the persistence of this species are the loss and fragmentation of riparian habitat due to urban, industrial, and agricultural development; and impacts to existing habitat through flood management activities (e.g., levee construction and channel maintenance) (USFWS 1984). Activities which may impact individual elderberry stems include any action that may be detrimental to the health of the plant, such as insecticide or herbicide application, trimming, dewatering, flooding, or the use of heavy machinery resulting in root damage or erosion near the shrub (Collinge et al. 2001). Routine agricultural operations which use chemicals or heavy machinery and may impact shrubs if practiced in close proximity include disking, grading, deep ripping, plowing, ditch maintenance, planting, harvesting, tree removal, mowing and management of agricultural borders, and application of fertilizers and pesticides.

According to USFWS conservation guidelines for valley elderberry longhorn beetles, complete avoidance of adverse effects to beetles and their host plants may be assumed when a 100-foot or wider buffer is established and maintained from the dripline of each shrub with one or more stems 1.0 inch or greater in diameter at ground level (USFWS 1999a). In some cases, the required buffer width may be reduced to 20 feet or less through consultation with USFWS. No insecticides, herbicides, fertilizers, or other chemicals that may harm the beetles or their host plants are allowed within this buffer area without first receiving a permit from USFWS. Elderberry shrub removal, trimming or pruning, or construction activities within the applicable buffer area would similarly require a USFWS permit. Mowing of grasses and ground cover is allowed from July through April as close as 5 feet from elderberry stems.

In cases where the avoidance of impacts within the buffer area is not possible and it is determined that the shrubs should be removed from the affected area, USFWS guidelines require that the shrubs be transplanted to a conservation area for mitigation (USFWS 1999a). A specified number of additional plants must also be planted in this area, with planting ratios depending on the affected shrub's original location as riparian or non-riparian, the presence or absence of exit holes on the shrub which indicate beetle presence, and the number of affected stems in each of several size classes. The conservation area must be must be protected in perpetuity with a conservation easement or deed restrictions, and funds must be provided for habitat management in perpetuity and 10–15 years of monitoring.

SWAINSON'S HAWK AND WHITE-TAILED KITE

Ecology and Habitat

Swainson's hawks are known to occur in the study area during their spring and summer breeding season, and migrate to Central and South America for the winter. White-tailed kites are known to reside in the study area throughout the year, but are more common in winter. These two species nest in large trees, frequently but not exclusively in riparian habitats. They forage in open habitats for rodents, other small mammals, and occasionally small birds, reptiles, and large insects such as grasshoppers. Although their historical foraging habitat consisted primarily of native grassland and oak savannah, today Swainson's hawks and white-tailed kites commonly forage in row crop and rangeland habitats. These raptors are particularly abundant in row crop fields when discing, mowing, and irrigation activities increase the accessibility of their prey. Swainson's hawks and white-tailed kites inhabit large home ranges, and Swainson's hawks have been recorded foraging up to 18.6 miles from active nests (Estep 1989).

Potential Effects of Restoration on the Species' Local Abundance and Distribution

The proposed restoration projects could increase the number of suitable nest trees for Swainson's hawks and white-tailed kites by planting up to 390 acres, some of which may contain suitable foraging and nesting habitat. However, the proposed projects would also remove about 245 acres of row crop foraging habitat (Table 1-2). Because riparian nesting habitat is much less common in Glenn and Colusa counties than agricultural row crop habitat, these two species may be expected to increase slightly in abundance as a result of the proposed restoration. However, the abundance and distribution of foraging Swainson's hawks and white-tailed kites would be unlikely to change substantially because their populations are relatively small and unlikely to exhibit substantial population growth in response to a small increase in nesting habitat.

Species-specific Regulatory Constraints

Swainson's hawks are state-listed as threatened and are protected by CESA; it is estimated that the 700 to 1,000 breeding pairs currently present in California represent less than 10% of the state's historical population (Bloom 1980, DFG 1988). White-tailed kites are listed as a fully protected species in the California Fish and Game Code. Both species are also covered by the California Fish and Game Code's protections for raptors and migratory birds, as well as the federal MBTA.

Agricultural operations with potential to result in take of Swainson's hawks and white-tailed kites include pesticide use, nest tree removal, and disturbance of nesting pairs. Additional agricultural practices such as disking, grading, deep ripping, plowing, and mowing have potential to benefit Swainson's hawks and white-tailed kites by exposing their small mammal and insect prey.

No additional regulatory constraints would be imposed on agriculture as a result of any potential pesticide-related take of these species. The existence of specific pesticide use regulations absolves pesticide applicators from regulatory responsibility for take of protected species, provided that the pesticides were used in accordance with their associated regulations, as discussed in Section 2.1.3.

Trees in which Swainson's hawks and white-tailed kites are actively nesting may not be removed while eggs or chicks are in the nest. The incubation and nestling period in which nest trees may not be removed is a maximum of 76–79 days for Swainson's hawks and 60–67 days for white-tailed kites (NatureServe 2006). The probability of a Swainson's hawk or white-tailed kite pair nesting in an orchard tree that farmers must remove during this time period is very remote.

Nest disturbance is defined as any activity conducted near an active nest which disrupts the behavior of the nesting pair. Nest disturbance has the potential to cause nest abandonment or the loss of eggs or chicks due to reduced parental care. Under CESA, the California Fish and Game Code, and the MBTA, disturbance leading to nest abandonment or reproductive failure would constitute prohibited take of protected bird species. Bird responses to nest disturbance vary with each nesting pair and the time, regularity, and nature of the disturbance. Although some researchers have described disturbed nest sites which successfully fledge young (Estep 1989, England et al. 1995), others have recorded nest abandonment in response to human activity, especially during nest building and incubation (Bent 1937, Stahlecker 1975). Tree-nesting raptors such as Swainson's hawks and white-tailed kites are typically very tolerant of the low levels of disturbance caused by agricultural operations, with no adverse effects resulting at the nests. Also, as mentioned previously, agricultural ground disturbance such as disking or plowing may actually benefit these species by exposing their prey. As a result, agricultural operations are not expected to be constrained by regulations concerning nest disturbance of these species.

WESTERN YELLOW-BILLED CUCKOO

Ecology and Habitat

Western yellow-billed cuckoos were historically common in riparian habitats throughout western North America (Gaines and Laymon 1984). Due to extensive habitat loss, however, western cuckoos have been extirpated from the majority of their historical range. It is estimated that of the historical California population of more than 15,000 pairs (Hughes 1999), less than a few hundred individuals currently remain (Laymon 1998). The Sacramento River between Red Bluff and Colusa currently supports between one-half to two-thirds of remaining breeding population in California, and is one of two primary breeding locations for this subspecies (the second being the South Fork of the Kern River) (Laymon 1998). This subspecies is known to breed in the study area (CNDDB 2005). Cuckoos are a migratory species; they breed in North America during spring and summer and migrate to Central and South America for the autumn and winter.

Western yellow-billed cuckoos require large tracts (greater than 25 acres, often greater than 100 acres) of riparian forest vegetation for nesting (Gaines 1974, 1977, Laymon et al. 1997). Complex habitat structure is preferred, as western cuckoos forage predominantly in cottonwoods but nest primarily in willows, and occur most commonly in areas which also support dense understory vegetation. In addition to complex vegetative structure, western yellow-billed cuckoos occur primarily within 300 feet of surface water (Gaines 1974), and humidity may also be important for this subspecies (Hughes 1999). Western yellow-billed cuckoos are considered riparian obligates because they occur only in and adjacent to riparian habitats during their breeding season. In the Sacramento Valley, however, they are known to occasionally forage in walnut, prune, peach, and possibly other orchards located adjacent to riparian forest (DFG 2005b, Gaines and Laymon 1984), and at least one western yellow-billed cuckoo has been documented nesting in a walnut orchard (Laymon 1998). Breeding territories of western yellow-billed cuckoos range in size from 20–100 acres (Laymon and Halterman 1985), the majority if not all of which encompasses riparian habitat. Because cuckoo territories that include orchards as well as riparian habitat are rare, average and maximum distances traveled into orchards have not been quantified and published. Cuckoos prey predominantly upon large insects such as caterpillars, cicadas, and grasshoppers; however, they also prey upon frogs and lizards, and occasionally feed on fruit (Bent 1940, Preble 1957).

Potential Effects of Restoration on the Species' Local Abundance and Distribution

The proposed restoration could create up to 390 acres of riparian foraging and breeding habitat for western yellow-billed cuckoos. A past Kern River riparian restoration project, for example, resulted in cuckoo foraging activity in the second year after replanting and nesting in the third year after replanting, where cottonwood growth averaged 10 feet/year (Anderson and Laymon 1989). A second Kern River restoration project experienced cuckoo foraging activity within one year of replanting (Laymon et al. 1997). Statistical analysis associated with this second restoration project revealed that approximately half of the variation in cuckoo numbers (51.3%) across three areas and five years was explained by the amount of available habitat. Cuckoos have bred on Sacramento River restoration sites as well (Golet et al. *in press-a*). Cuckoos in the Colusa Subreach study area would thus be likely to increase in both abundance and local distribution as a result of the proposed restoration.

Species-specific Regulatory Constraints

Western yellow-billed cuckoos are state-listed as endangered, federally listed as a candidate species, and are protected by both state and federal endangered species acts. This species is also protected by the federal MBTA and the California Fish and Game Code's protections for migratory birds. Agricultural operations with potential to result in take of yellow-billed cuckoos include pesticide use, nest tree removal, and disturbance of nesting pairs.

Western yellow-billed cuckoos are known to have been poisoned in the past by DDT and Zolone (Phosalone), pesticide products no longer in use in the United States (Laymon 1980). No known cases of take of yellow-billed cuckoos exist with the pesticides currently used in the study area. Further, no additional regulatory constraints would be imposed as a result of any potential pesticide-related take, because the existence of specific pesticide use regulations absolves pesticide applicators from regulatory responsibility for take of protected species, provided the pesticides are used in accordance with their associated regulations, as discussed in Section 2.1.3.

Like Swainson's hawks and white-tailed kites, trees in which western yellow-billed cuckoos are actively nesting may not be removed while eggs or chicks are in the nest. Western yellow-billed cuckoo nests which successfully fledge young are typically occupied by eggs or chicks for only 15-20 days (NatureServe 2006). The probability of a pair of yellow-billed cuckoos nesting in an orchard tree that farmers must remove during this time period is very remote.

Nest disturbance also has the potential to cause take of yellow-billed cuckoos due to nest abandonment or the loss of eggs or chicks due to reduced parental care. Nest disturbance is defined as any activity conducted near an active nest which disrupts the behavior of the nesting pair. Under CESA, the California Fish and Game Code, and the MBTA disturbance leading to nest abandonment or reproductive failure would constitute prohibited take of protected bird species. Bird responses to nest disturbance vary with each species, individual nesting pair, and the time, regularity, and nature of the disturbance. To date, no information has been published on the sensitivity of yellow-billed cuckoos to varying levels and types of agricultural nest disturbance. However, based on the ecology of the species and the magnitude of disturbance expected from the agricultural activities considered in this study (e.g., planting, irrigation, harvesting), it is unlikely that nest disturbance caused by agricultural activities would result in take of yellow-billed cuckoos.

GIANT GARTER SNAKE

Ecology and Habitat

Giant garter snakes are endemic to California's Central Valley. They have been documented as far north in the Sacramento Valley as Chico, and south into the southern San Joaquin Valley. However, giant garter snakes have not been directly observed in the study area. This species has potential to occur there, however, where suitable habitat is present. Eleven giant garter snake occurrences have been documented by CNDDB in the Butte City, Colusa, and Moulton Weir 7.5' quadrangles, and are presumed to be extant in this region (CNDDB 2005).

Although the precise locations of these occurrences have been labeled sensitive and are thus suppressed by CNDDB, their presence within these quadrangles indicates that they are no more than 5 miles from the Sacramento River and no more than 3 miles from the study area. This distance could be traveled by giant garter snakes if they are not currently present in the study area, and if a suitable habitat corridor is available. Individual giant garter snakes have been recorded traveling over one mile, and may move as much as two miles in a day (Hansen and Brode 1993). Home ranges of individual giant garter snakes have been recorded from 5–2,070 acres in size (Wylie and Casazza 2000). The largest of these home ranges includes more than 3 square miles and was recorded near the study area, in the Colusa National Wildlife Refuge.

Giant garter snakes breed and forage in a variety of aquatic habitats, and use adjacent upland habitats for basking, refugia, and winter aestivation. Preferred aquatic habitats for this species include marshes, sloughs, ponds, flooded rice fields, irrigation canals and drainage ditches, low-gradient streams. They are typically absent from large or swift-moving rivers and from wetlands with sand, gravel, or rock substrates (USFWS 1999b). This species forages primarily at the interface between open water and emergent aquatic vegetation, and is most often found in habitats with slow flowing or standing water, permanent summer water, mud bottoms, earthen banks, and an abundance of prey such as small fish, frogs, and tadpoles. Giant garter snakes do not lay eggs and instead give birth to live young, which are reared in aquatic habitats containing abundant emergent vegetation for cover.

Giant garter snakes also use upland habitats adjacent to aquatic habitats for thermoregulation, warming themselves by basking and cooling themselves in the shade of soil/rock crevices or burrows made by other animals. Crevices and burrows are also used as nighttime refugia, daytime escape cover from predators, and winter aestivation sites. Giant garter snakes typically use upland habitats with grassy or shrubby banks and avoid dense wooded cover. Although summer basking sites are often just above the water's edge, winter aestivation sites for this species must be high enough in elevation to function as refuges from flood waters during the snakes' inactive season (October to March).

Giant garter snakes typically emerge from winter retreats from late March to early April and can remain active through October. The timing of their annual activities is subject to varying seasonal weather conditions. Cool winter months are spent in dormancy or periods of reduced activity. While this species is strongly associated with aquatic habitats, individuals have been noted using burrows as far as 165 feet from marsh edges during the active season (Wylie et al. 1997) and retreats more than 800 feet from the edge of wetland habitats while overwintering (Hansen 1988). Giant garter snake presence at these distances is rare, however, and has been recorded only when these distances match the high-water line.

Within the study area, the Sacramento River, riparian forest habitat, orchards, and row crop fields do not provide suitable habitat for giant garter snakes. These snakes are also unlikely to occur in any habitat between the flood control levees, due to the high flows in winter (Hansen, pers. comm., 2006). Because they depend on year-round habitat suitability, these snakes generally do not occupy otherwise suitable habitat that is located within flood control levees, even during their summer active season when flows are lower. This trend has been observed throughout the Central Valley (Hansen, pers. comm., 2006).

Suitable habitat for giant garter snakes during their active season occurs outside of the flood control levees and includes marshes, sloughs, irrigation ditches, flooded rice fields, and grass- or shrub-covered upland banks bordering these aquatic habitats. During the snake's dormant season, suitable aestivation habitat would be limited to grass- or shrub-covered upland habitats near water that are outside of the flood control levees, as well as the upper portion of the levees themselves, above the high water line.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

If giant garter snakes are present in the study area, they would be unlikely to use the parcels proposed for restoration, all of which are located in the active floodplain. Further, the riparian forest and willow scrub habitats that comprise the majority of the proposed restoration do not provide suitable habitat for this species, which

avoids habitats with dense wooded cover. The proposed restoration is thus unlikely to affect the local abundance or distribution of giant garter snakes in the study area.

Species-specific Regulatory Constraints

Giant garter snakes are state and federally listed as threatened and are protected by both state and federal endangered species acts. Agricultural operations with potential to result in take of giant garter snakes, if present in the study area, include pesticide use, ditch maintenance, and any ground-disturbing activities (e.g., disking, mowing, plowing) within 200 feet of aquatic habitats suitable for the snakes. However, the proposed habitat restoration would be unlikely to affect the local abundance or distribution of giant garter snakes in the study area. Therefore, it is unlikely that the proposed restoration would change the potential for agricultural take of this species. Riparian habitat restoration is thus not expected to affect regulatory constraints on agriculture related to this species.

BANK SWALLOW

Ecology and Habitat

Historically, bank swallows nested on coastal bluffs in southern California and in tall, vertical riverbanks throughout the Central Valley and northern California. This species' range has declined considerably in recent decades. Approximately seventy-five percent of the remaining bank swallow colonies in California are located along the banks of the Sacramento and Feather rivers and the major tributaries to the north of their confluence (Garrison 1998), and colony locations are known to occur along the Colusa Subreach. Banks colonized by bank swallows are composed of friable, alluvial soils, and are relatively devoid of dense woody vegetation.
The geographic range of this species in California has contracted significantly in recent decades. Bank swallows forage for insect prey in a variety of habitats including open water, riparian habitats, agricultural areas, wetlands, grasslands, shrublands, and occasionally upland woodlands. Nesting pairs of bank swallows typically forage within one-half mile from their nesting colonies (Stoner and Stoner 1941); however, migrating swallows may be found throughout the Central Valley before and after the spring and summer nesting season. This species migrates to Central and South America for the winter.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

Bank swallow nesting habitat is created and maintained by natural conditions where riparian vegetation communities and bank edges are periodically scoured away by fast-flowing water. Under this "natural dynamic equilibrium" condition, mature forest and woodlands often persist above tall river banks until removed by an active meander bend progressively moving downstream, or by an avulsion cut-off event in which a new channel is carved through existing floodplain habitat.

Restoration of riparian habitat in the Colusa Subreach is unlikely to affect bank swallow populations primarily because most of the proposed restoration sites are not directly adjacent to the river, and are thus not expected to affect the suitability of river banks for nesting. Restoration is also not expected to affect bank swallow foraging success, because this species may hunt flying insects in both riparian and agricultural habitats.

Species-specific Regulatory Constraints

Bank swallows are state-listed as threatened and are protected by CESA. This species is also protected by the MBTA and the California Fish and Game Code's protections for migratory birds. However, because riparian habitat restoration would not clearly affect the likelihood of bank swallows occurring on or near the study area's agricultural lands, regulatory constraints on agriculture related to this species would be unlikely to be affected by riparian habitat restoration. Further, the only agricultural operation with potential for take of this species would be aerial pesticide application. No additional regulatory constraints would be imposed as a result of any potential pesticide-related take, however, because the existence of specific pesticide use regulations absolves pesticide

applicators from regulatory responsibility for take of protected species, provided that the pesticides were used in accordance with their associated regulations, as discussed in Section 2.1.3.

SOUTHERN BALD EAGLE

Ecology and Habitat

"Southern" bald eagle is the subspecies of our national bird that nests south of Alaska; this subspecies has experienced greater population declines than the Alaskan subspecies and receives unique regulatory protections. Southern bald eagles rarely nest in the Central Valley, yet there have been a few reports of nesting in riparian habitat on the Sacramento River north of the Colusa Subreach (Golet, pers. comm., 2006). The bald eagle has not been documented in the study area. Wintering and non-breeding individuals are known to occur elsewhere along the Sacramento River, however, and could occur in the study area at any time of year. This species is primarily a fish-eater, and forages most commonly from tall riparian trees over open water. Less commonly, bald eagles also prey on small mammals and upland game birds in row crop fields, grasslands, and other open habitats.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

Because the study area is outside of the primary range of this species, any changes to the study area's habitats would not significantly affect the abundance or distribution of bald eagles in the region. If an individual wintering or other non-breeding eagle were to visit the study area, restoration of tall riparian trees could provide potential hunting perches for this species closer to some farms than currently exist. However, the chance of a traveling bald eagle perching in these specific trees is very slight, given the number of existing trees and the rarity of eagles in the area.

Species-specific Regulatory Constraints

This species is state-listed as endangered and is protected by CESA. Southern bald eagles are listed as a fully protected species under the California Fish and Game Code. They are also covered by the federal Bald and Golden Eagle Protection Act of 1940, federal MBTA, and the California Fish and Game Code's protections for raptors and migratory birds. However, because riparian habitat restoration would not substantially increase the likelihood of bald eagle occurrence on or near the study area's agricultural lands, regulatory constraints on agriculture related to this species would similarly not be affected by riparian habitat restoration.

GOLDEN EAGLE

Ecology and Habitat

Golden eagles are rare breeders in the foothill fringes of the Central Valley, and are rare winter and non-breeding visitors to the Central Valley floor. This species has the potential to forage in the study area during winter or migration. Optimal habitat for this species includes foothill and shrub-steppe habitats, where the eagles prey upon jackrabbits, other mid-sized mammals, and upland game birds. Golden eagles also forage in other open habitats such as row crop fields and grasslands. Golden eagles commonly hunt from perches in tall trees at the forested edges of open foraging habitats. Typically they do not forage directly in riparian woodlands, preferring instead to perch in isolated trees that provide a broad field of view.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

Because the study area is outside of the primary range of this species, any changes to the study area's habitats would not significantly affect the abundance or distribution of golden eagles in the region. If an individual golden eagle were to visit the study area, the restoration of riparian habitat on parcels currently in row crop agriculture could reduce the potential foraging habitat area, but only where open agricultural areas (e.g., crops or grasslands, not orchards) are restored to closed canopy riparian woodland or forested habitat types. This reduction would

have a minimal effect on the species, however, because agricultural row crop habitat is of marginal quality for this species and is relatively common in Glenn and Colusa counties. The restoration of tall riparian trees in the study area could also provide additional hunting perches for traveling golden eagles, but the chance of an eagle perching in these specific trees is very slight, given the number of existing trees and the rarity of eagles in the area.

Species-specific Regulatory Constraints

Golden eagles are listed as fully protected species under the California Fish and Game Code. They are also covered by the federal Bald and Golden Eagle Protection Act of 1940, federal MBTA, and the California Fish and Game Code's protections for raptors and migratory birds. However, because riparian habitat restoration would not affect the likelihood of golden eagle occurrence on or near the study area's agricultural lands, regulatory constraints on agriculture related to this species would similarly not be affected by riparian habitat restoration.

AMERICAN PEREGRINE FALCON

Ecology and Habitat

American peregrine falcons do not breed in the Central Valley and are relatively uncommon visitors to the region. However, non-breeding peregrines may occur in the study area, and have been observed on Sacramento River restoration sites (Golet et al. *in press-a*). Peregrine falcons forage primarily on mudflats, shorelines and open water, where they prey upon waterfowl and shorebirds. Peregrines seldom forage in agricultural habitats as these areas lack their preferred prey; however, they occasionally feed on songbirds in these areas. When hunting, peregrines rely on open space to increase the speed of their aerial dives; they are thus not typically associated with densely forested habitats such as riparian forest, but could be found in open riparian habitat types (e.g., scrub-grassland). Peregrine falcons are also not particularly dependent upon trees as perches; they may use perches in riparian habitat if available, but also hunt successfully from river banks and beaches.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

Riparian habitat restoration is not expected to substantially increase the abundance or distribution of peregrine falcons in the study area, because this area is outside of the species' primary range and this species is not typically associated with riparian or agricultural habitats.

Species-specific Regulatory Constraints

American peregrine falcons are state-listed as endangered and are protected by CESA. They are also listed as a fully protected species in the California Fish and Game Code, and are covered by the MBTA and the California Fish and Game Code's protections for raptors and migratory birds. However, because riparian habitat restoration would not greatly increase the likelihood of peregrine falcon occurrence on or near the study area's agricultural lands, regulatory constraints on agriculture related to this species are not expected to be affected by riparian habitat restoration.

GREATER SANDHILL CRANE

Ecology and Habitat

Greater sandhill cranes do not breed in the Central Valley, but are winter visitors to the region. During winter they forage primarily in moist croplands with rice or corn stubble, as well as grasslands and emergent wetlands. Their diet is composed primarily of invertebrates. In winter, greater sandhill cranes are most densely concentrated in agricultural areas and large wildlife preserves that support vast, contiguous fields of flooded rice, corn, and grassland, such as those south of the study area in the Cosumnes River Preserve and those to the north at Llano Seco NWR. Sandhill cranes are unlikely to occur in the study area because it differs from their preferred habitat configuration, although cranes may occur casually in flooded row crop and marsh habitats during migration.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

The proposed restoration would not have a significant effect on the local abundance or distribution of this species. Sandhill cranes are currently unlikely to occur in the study area, and while they may forage in flooded row crop or open riparian habitats (e.g., scrub-grassland), neither the current nor the proposed habitat configuration is preferred by this species.

Species-specific Regulatory Constraints

Greater sandhill cranes are state-listed as threatened and are protected by CESA. They are also listed as a fully protected species in the California Fish and Game Code, and are covered by the MBTA and the California Fish and Game Code's protections for migratory birds. However, because riparian habitat restoration would not affect the likelihood of greater sandhill crane occurrence on or near the study area's agricultural lands, regulatory constraints on agriculture related to this species would similarly not be affected by riparian habitat restoration.

LITTLE WILLOW FLYCATCHER

Ecology and Habitat

Little willow flycatchers were formerly common in California and bred in willow thickets throughout most of the lowland and montane portions of the state. In recent decades, habitat destruction and cowbird parasitism have eliminated the Central Valley from the breeding range of this species. Breeding populations in northern California are now restricted to montane meadows in the Sierra Nevada. This species migrates through the Central Valley in spring and fall, however, and is known to occur along the Sacramento River on its way to and from its Central and South American wintering grounds. During migration, this species has potential to forage in the study area. Willow flycatchers are strongly associated with their namesake shrub, and occur primarily in riparian habitats during migration. On rare occasions, however, willow flycatchers have been documented in orchards near willow-dominated habitats (NatureServe 2006). They have not been documented in row crop areas.

Potential Effects of Restoration on the Species' Local Abundance and Distribution

Although the abundance of willow flycatchers migrating through the study area is largely dependent on factors on the breeding and wintering grounds, the distribution of flycatchers in the study area would be likely to increase as a result of riparian habitat restoration. The proposed restoration could create up to 390 acres of riparian migration habitat for this species. Willow flycatcher use of restored habitat parcels would increase the proximity of this species to adjacent agricultural lands during migration; however, flycatchers using this habitat would be unlikely to forage on adjacent farms. In addition to habitat acreage, the restoration would also increase the connectivity of riparian migration habitat in the study area, which could potentially increase the survival of migrating flycatchers by increasing foraging efficiency and decreasing predation risk.

Species-specific Regulatory Constraints

Little willow flycatchers are state-listed as endangered and are protected by CESA. They are also covered by the MBTA and the California Fish and Game Code's protections for migratory birds. Because this species does not nest in the study area, however, the only agricultural operation with potential for take of this species would be pesticide application during migration. No additional regulatory constraints would be imposed as a result of any potential pesticide-related take, however, because the existence of specific pesticide use regulations absolves pesticide applicators from regulatory responsibility for take of protected species, provided that the pesticides were used in accordance with their associated regulations, as discussed in Section 2.1.3.

SACRAMENTO RIVER WINTER-RUN AND CENTRAL VALLEY SPRING-RUN CHINOOK SALMON

Ecology and Habitat

Four runs of chinook salmon occur in the Sacramento River, including fall-, late fall-, winter-, and spring-run. Each of these runs is considered an evolutionary significant unit: a population (or group of populations) that is reproductively isolated from other populations of the same species and that contributes substantially to the ecological/genetic diversity of the species (Waples 1991). Different runs of the same salmon species are often considered separate evolutionary significant units because the populations are reproductively isolated due to different spawning times. The Sacramento River winter-run and Central Valley spring-run chinook salmon evolutionary significant units are protected by the state and federal endangered species acts. Central Valley fall- and late fall-run chinook salmon have not declined as dramatically as Sacramento River winter-run and Central Valley spring-run chinook salmon, and are not protected by the ESA or CESA.

All chinook salmon require cold, freshwater streams with suitable gravel for reproduction. Females deposit their eggs in nests, or "redds," which they excavate in the gravel bottom in areas of relatively swift water (Moyle 2002). After emerging, chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities (including backwater sloughs) and move to progressively deeper, faster water as they grow (DFG 1998). Juveniles typically rear in fresh water for up to 5 months before migrating to sea, although spring-run juveniles frequently reside in freshwater habitat for 12–16 months. Chinook salmon spend 2–4 years maturing in the ocean before returning to their natal streams to spawn. All adult chinook salmon die after spawning.

Winter-run chinook salmon typically migrate through the study area from December through July as adults, and from November through May as emigrating juveniles. Adult spring-run generally migrate through the study area from March to July, while juveniles and yearlings emigrate downstream from March to June and November to April, respectively. Adult fall-run chinook salmon enter and migrate through the Sacramento River system from July through December and spawn from October through December. Late fall-run chinook salmon enter the river from October to April and spawn from January to April (Vogel and Marine 1991). Juvenile fall- and late fall-run chinook emigration peaks in April and May, but can extend from late February through June.

Generally, fall-chinook salmon move out of the upper river 1–2 months after emergence and are hypothesized to rear in the lower river or in the Bay-Delta. Late-fall-run chinook salmon tend to reside 4–6 months in the upper river before moving into the Bay-Delta (USFWS 1992). A portion of winter-run migrate out of the upper river soon after emergence; however, the majority appear to rear in the upper river and tributaries (Maslin et al. 1997 and 1998). Spring-run fish display considerable variation in stream residence and migratory behavior including leaving their natal streams as fry soon after emergence or rearing for several months to a year before migrating as smolts or yearlings (Yoshiyama et al. 1998).

Potential Effects of Restoration on the Species' Abundance and Distribution

Restoration of agricultural lands to natural riparian areas would likely result in long-term beneficial effects to chinook salmon in the Sacramento River by increasing shaded riverine aquatic vegetation, complex floodplain habitat, and instream tree and shrub debris, which provide important fish habitat. Riparian habitat provides structure (through shaded riverine aquatic habitat) and food for fish species. Shade decreases water temperatures, while low overhanging branches can provide sources of food by attracting terrestrial insects. As riparian areas mature, the vegetation sloughs off into the rivers, creating structurally complex habitat consisting of large woody debris that furnishes refugia from predators, creates higher water velocities, and provides habitat for aquatic invertebrates. Growth rates of juvenile chinook salmon appear to be enhanced by the conditions found in floodplain habitat with natural riparian vegetation.

Restoration of riparian habitats in the study area provides clear long-term benefits to chinook salmon, and could contribute cumulatively to the overall recovery of this species if the restoration is implemented in conjunction

with sufficient additional projects across a large (e.g., entire reach) scale. Because of the migratory nature of these fish, however, which use and migrate through the river in response to a complex suite of variables, restoration at these sites is not likely to result in changes in local species abundance or distribution within the study area at a scale that is measurable or relevant to regulatory constraints.

Species-specific Regulatory Constraints

As described above, chinook salmon known to inhabit the Colusa Subreach of the Sacramento River are divided into four evolutionary significant units based on the regional locations and seasons in which they spawn. Each of these evolutionary significant units receives a different level of regulatory protection. The Sacramento River winter-run chinook have experienced the largest population declines, and have been listed as endangered by both federal and state endangered species acts. The Central Valley spring-run chinook are state and federally listed as threatened. The Central Valley fall/late-fall run chinook populations are more secure; therefore, the NMFS has determined that ESA listing is not warranted for these populations.

The portion of the Sacramento River within the project study area (along with other areas) is designated as critical habitat for Sacramento River winter-run and Central Valley spring-run chinook salmon, which includes increased regulatory protections. The Sacramento River, including the study area, has also been designated as Essential Fish Habitat by the Pacific Fisheries Management Council to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries. Essential Fish Habitat is defined as waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the Pacific Salmon Fisheries Management Plan (Pacific Fishery Management Council 2003), portions of the Sacramento River, including the section through the study area, have been designated as Essential Fish Habitat (EFH) for all four runs of chinook salmon (as amended – also know as the Sustainable Fisheries Act).

Adverse effects to aquatic habitat and/or chinook salmon that are likely to result in take of the species are prohibited by the ESA and CESA, and adverse effects to EFH are prohibited by Magnuson-Stevens Fishery Conservation and Management Act. These prohibitions are in effect unless expressly permitted by NMFS through a Section 7 consultation, Habitat Conservation Plan, Safe Harbor Agreement, or EFH assessment. These permits are discussed in detail in Section 2.1.2, Federal Endangered Species Act, and in Chapter 3, Regulatory Solutions. Agricultural activities that could result in adverse effects to aquatic habitat and/or chinook salmon include irrigation pump entrainment of juveniles and water quality impacts due to runoff of pesticides, fertilizers, and sediment. The potential for take due to irrigation pump entrainment is not expected to increase with the proposed riparian habitat restoration. Further, the existence of specific pesticide and water quality regulations absolves farmers from regulatory responsibility for pesticide-related or water quality-related take of fish, provided that agricultural activities were conducted in accordance with these regulations, as discussed in Section 2.1.3. Regulatory constraints associated with protected fish species would thus not be expected to increase as a result of the proposed restoration. However, riparian habitat restoration could lead to increased populations which, if conducted on a large scale or through several projects over time, could be substantial enough to lead to delisting and a relaxation of current regulatory constraints to agricultural operations related to this species.

CENTRAL VALLEY STEELHEAD

Ecology and Habitat

The Central Valley steelhead evolutionary significant unit includes all populations of steelhead in the Sacramento and San Joaquin rivers and their tributaries (USBR and DWR 2003). Steelhead have a complex life history, including the capability to be anadromous or resident (residents are called rainbow trout and are also present in the Sacramento River in the vicinity of the Colusa Subreach) (Moyle 2002). Anadromous steelhead spend 1–4 years in the ocean and then migrate back into freshwater to spawn. Steelhead use the Colusa Subreach portion of the Sacramento River within the project study area (along with other areas) as a migratory pathway for adults and as rearing habitat for emigrating juveniles. Historical records indicate that adult steelhead enter the mainstem

Sacramento River in July, reach peak abundance in the fall, and continue migrating through February or March (McEwan and Jackson 1996). Spawning begins in late December and peaks in February–March (Busby et al. 1996) in riverine habitat north of the study area with clear, cold, perennial streams with abundant gravel, riffles, and fast-flowing water (Bovee 1978). After steelhead fry emerge from spawning gravels, they continue to grow and mature in freshwater for 1–3 years before emigrating to the ocean (Moyle 2002).

Juvenile steelhead generally emigrate downstream to the ocean beginning in November and continuing through May (Schaffter 1980). In the Sacramento River, however, juvenile steelhead emigrate in spring and early summer. Sacramento River steelhead generally migrate as 1-year-olds (Barnhart 1986, Reynolds et al. 1993). Individual steelhead are capable of returning to spawn in multiple years, in contrast to chinook salmon which die after spawning.

Potential Effects of Restoration on the Species' Abundance and Distribution

As described for chinook salmon, restoration of agricultural lands to natural riparian areas would result in long-term beneficial effects to steelhead in the Sacramento River by increasing complexity of the aquatic environment and providing cover, food, and other habitat components (e.g., increasing beneficial shaded riverine aquatic habitat and improving seasonally inundated floodplain habitat). However, due to the migratory nature of this species which uses the entire Sacramento River, these benefits would only be likely to result in changes in overall species abundance and/or distribution if in conjunction with sufficient additional projects on a large (e.g., entire reach) scale. The proposed restoration projects alone are unlikely to result in changes in local species abundance or distribution within the study area at a scale that is measurable or relevant to regulatory constraints.

Species-specific Regulatory Constraints

Central Valley steelhead are federally listed as threatened and are protected by the ESA. The portion of the Sacramento River within the project study area (along with other areas) is designated as critical habitat for Central Valley steelhead, which includes increased regulatory protections. Adverse effects to aquatic habitat and/or steelhead that are likely to result in take of the species are prohibited by the ESA unless expressly permitted by the NMFS through a Section 7 consultation, Habitat Conservation Plan, or Safe Harbor Agreement. These permits are discussed in detail in Section 2.1.2, Federal Endangered Species Act, and in Chapter 3, Regulatory Solutions. Agricultural activities that could result in adverse effects to aquatic habitat and/or chinook salmon include irrigation pump entrainment of juveniles and water quality impacts due to runoff of pesticides, fertilizers, and sediment. The potential for take due to irrigation pump entrainment is not expected to increase with the proposed restoration. Further, the existence of specific pesticide and water quality regulations absolves farmers from regulatory responsibility for pesticide-related or water quality-related take of fish, provided that agricultural activities were conducted in accordance with these regulations, discussed in Section 2.1.3. Regulatory constraints associated with protected fish species would thus not be expected to increase as a result of the proposed restoration.

GREEN STURGEON

Ecology and Habitat

Green sturgeon adults and juveniles occur throughout the Sacramento River, including the Colusa Subreach. Individual green sturgeon are thought to spawn in the upper Sacramento River every 3–5 years (Tracy 1990). Their spawning period is March to July, with a peak in mid-April to mid-June (Moyle et al. 1992). Green sturgeon spawning occurs in deep pools or holes in large, turbulent river mainstems (Moyle et al. 1992). Specific spawning habitat preferences are unclear, but are likely large cobbles, and can range from clean sand to bedrock. Eggs are likely broadcast over the large cobble substrate where they settle into the space between the cobbles.

Green sturgeon spawning has only been documented in the Klamath, Sacramento (Moyle et al. 1992, DFG 2002) and Rogue (Erickson et al. 2002, Rien et al. 2002) rivers during recent times. In the Sacramento River, green sturgeon spawn in late spring and early summer above Hamilton City (upstream of the Colusa Subreach), and perhaps as far upstream as Keswick Dam (DFG 2002). Green sturgeon occur in the upper river, particularly around the Red Bluff Diversion Dam, and the opening of the Red Bluff Diversion Dam gates to improve winter-run Chinook passage is believed to have provided substantial increases in green sturgeon spawning habitat (NMFS 2005).

Juveniles appear to spend one to three years in freshwater before they enter the ocean (Nakamoto et al. 1995), and may be present in the Colusa Subreach at any time of year. Little is known about green sturgeon feeding other than general information. Adults captured in the Delta are benthic feeders on invertebrates including shrimp, mollusks, amphipods, and even small fish (Houston 1988, Moyle et al. 1992). Juveniles inhabit the San Francisco Bay estuary until they are approximately 4–6 years old, when they migrate to the ocean (Kohlhorst et al. 1991).

Potential Effects of Restoration on the Species' Abundance and Distribution

As described for chinook salmon and steelhead, restoration of agricultural lands to natural riparian areas would result in long-term beneficial effects to sturgeon in the Sacramento River by increasing complexity of the aquatic environment and providing cover, food, and other habitat components (e.g., increasing beneficial shaded riverine aquatic habitat and improving seasonally inundated floodplain habitat). However, due to the migratory nature of this species which migrates upstream of the Colusa Subreach to access other Sacramento River habitats, these benefits would only be likely to result in changes in overall species abundance and/or distribution if in conjunction with sufficient additional projects on a large (e.g., entire reach) scale. The proposed restoration projects alone are unlikely to result in changes in local species abundance or distribution within the study area at a scale that is measurable or relevant to regulatory constraints.

Species-specific Regulatory Constraints

The southern distinct population segment (DPS) of the green sturgeon population spawns primarily in the Sacramento River and is listed as federally threatened under the ESA. Critical habitat has not been designated for this species. Adverse effects to aquatic habitat and/or green sturgeon that are likely to result in take of the species are prohibited by the ESA unless expressly permitted by the NMFS through a Section 7 consultation, Habitat Conservation Plan, or Safe Harbor Agreement. These permits are discussed in detail in Section 2.1.2, Federal Endangered Species Act, and in Chapter 3, Regulatory Solutions. Agricultural activities that could result in adverse effects to aquatic habitat and/or chinook salmon include irrigation pump entrainment of juveniles and water quality impacts due to runoff of pesticides, fertilizers, and sediment. The potential for take due to irrigation pump entrainment is not expected to increase with the proposed restoration. Further, the existence of specific pesticide and water quality regulations absolves farmers from regulatory responsibility for pesticide-related or water quality-related take of fish, provided that agricultural activities were conducted in accordance with these regulations, discussed in Section 2.1.3. Regulatory constraints associated with protected fish species would thus not be expected to increase as a result of the proposed restoration.

2.3 CONCLUSIONS

Of the seven federal laws and regulations analyzed in Section 2.1, four do not have potential to become more restrictive to agricultural operations as a result of riparian habitat restoration anywhere in the United States. These regulations include NEPA, MBTA, FIFRA, and the Bald and Golden Eagle Protection Act of 1940. (While these conclusions are geographically broad, they apply only to the restoration of riparian habitat and not to the restoration of wetlands or other habitat types.) The same is true in California for two of the eight state laws and regulations analyzed: CEQA, and Sections 1602 and 3503 of the California Fish and Game Code.

The potential for riparian habitat restoration to increase agricultural constraints associated with the remaining laws is dependent upon regional factors that vary across the state. The federal Clean Water Act would not become more restrictive to agricultural operations as a result of riparian habitat restoration in the Colusa Subreach. For Central Valley farms under the jurisdiction of the Central Valley Regional Water Quality Control Board (including the Colusa Subreach), the Regional Water Quality Control Board Irrigated Lands Waiver would not become more restrictive to agricultural operations as a result of riparian habitat restoration. This regulation does not apply to farms outside of the Central Valley board's jurisdiction, and the eight other Regional Water Quality Control Boards may have different regulations. Similarly, California's Porter-Cologne Water Quality Control Act is implemented by these nine regional boards, each of which is regulated with a different set of TMDLs. Riparian habitat restoration would not increase agricultural constraints related to the Central Valley board's TMDLs and the application of Porter-Cologne in the Central Valley. TMDLs set by other regional boards have not been analyzed in this study.

Two additional regulations and one voluntary program would not become more restrictive to agricultural operations as a result of riparian habitat restoration specifically in the Colusa Subreach: pesticide label restrictions, the voluntary PRESCRIBE program, and the California Food and Agricultural Code. These regulations and programs are applied variously depending on the pesticide products used, and only the pesticide products used in the Colusa Subreach were analyzed in this report.

Three laws do have potential to become more restrictive to agricultural operations as a result of riparian habitat restoration in the Colusa Subreach. These laws include the federal and state endangered species acts and the fully protected species provisions of the California Fish and Game Code. Restrictions to agriculture associated with these three laws vary according to the species being protected. Fourteen special-status species known or with potential to occur in the Colusa Subreach are examined in Section 2.2. Regulatory constraints to agriculture are unlikely to be affected by riparian habitat restoration for the following species: giant garter snakes, southern bald eagles, golden eagles, American peregrine falcons, greater sandhill cranes, little willow flycatchers, bank swallows, chinook salmon, Central Valley steelhead, and green sturgeon. Regulatory constraints could theoretically increase by a small amount related to Swainson's hawks, white-tailed kites, western yellow-billed cuckoos, and valley elderberry longhorn beetles, however the likelihood of this is low, as discussed below.

For the three bird species listed above, potential regulatory constraints on agriculture that may be affected by the proposed restoration are limited to activities involving removal of nest trees while eggs or chicks are present. However, because nest trees may legally be removed by farmers before eggs have been laid, after the chicks have fledged, or after the nests have failed, restrictions to the timing of nest tree removal are not considered a significant constraint to farm activities. The incubation and nestling period in which nest trees may not be removed is a maximum of 15–20 days for western yellow-billed cuckoos, 60–67 days for white-tailed kites, and 76–79 days for Swainson's hawks (NatureServe 2006). As these three species are more likely to nest in riparian trees than farm or orchard trees, the likelihood that a pair would nest in a farm or orchard tree that farmers must remove within this 15–79 day period is low. As a result, Chapter 3, Regulatory Solutions, does not discuss solutions for nest tree removal aside from indicating that they should be removed outside of the incubation and nestling period.

For the valley elderberry longhorn beetle, potential regulatory constraints to agriculture that may be affected by the proposed restoration are limited to activities within 100 feet of elderberry shrubs with stem diameters 1.0 inches or greater at ground level that could result in take of such shrubs. Agricultural activities that could be in conflict with the 100-foot buffer include earth-moving activities such as disking, grading, deep ripping, and plowing; planting and harvesting methods involving the use of heavy machinery; ditch maintenance activities; application of pesticides; and tree removal. It is possible that restrictions to these activities may be removed within the next several years, as the USFWS has proposed to delist the valley elderberry longhorn beetle (USFWS 2006). If delisted, constraints related to valley elderberry longhorn beetles and elderberry shrubs may be reduced or eliminated. However, this USFWS recommendation is not a guarantee that the species will be delisted, and the official decision may not be finalized for a number of years. Chapter 3, Regulatory Solutions, contains a variety of

restoration design components, local policies, and legal agreements that may reduce or eliminate agricultural constraints related to valley elderberry longhorn beetles in the Colusa Subreach for the remaining time in which the beetle is listed. In any case, even with the current listing status, farmers are free to engage in all the above-listed activities, and may even cut down elderberries, so long as this is done before stems grow to 1 inch in diameter.

The results from this chapter are summarized by agricultural activity below, for the agricultural operations prioritized by Colusa Subreach stakeholders in the Advisory Workgroup and External Experts Group. Potential solutions to these constraints are discussed in Chapter 3, Regulatory Solutions.

Table 2-2
Potential for Increased Agricultural Regulatory Constraints Associated with Endangered, Threatened, and Fully Protected Species and Riparian Habitat Restoration in the Study Area

Agricultural Operation	Potential for Increased Regulatory Constraints to Result from Restoration	Rationale [1]
Disking, grading, deep ripping, and plowing	Prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level.	Not regulated by environmental laws except in the case of species take or sediment runoff into protected wetlands and waterways. May cause take of valley elderberry longhorn beetles if conducted within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Not likely to affect other endangered, threatened, or fully protected species in the study area.
Ditch maintenance	Prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level.	Not regulated by environmental laws except in the case of species take or sediment runoff into protected wetlands and waterways. May cause take of valley elderberry longhorn beetles if conducted within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Not likely to affect other endangered, threatened, or fully protected species in the study area.
Irrigation and small-scale water transfers	None.	Not regulated by environmental laws except in the case of species take. May affect threatened and endangered fish species in the study area; however, the potential for this take is not likely to increase with restoration.
Planting	Mechanical methods prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level.	Not regulated by environmental laws except in the case of species take. May cause take of valley elderberry longhorn beetles if conducted mechanically and within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Not likely to affect other endangered, threatened, or fully protected species in the study area.
Orchard Pruning	None.	Not regulated by environmental laws except in the case of species take, and not likely to affect endangered, threatened, or fully protected species in the study area.
Application of pesticides	Prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Restricted within riparian habitat, but permitted adjacent to riparian habitat.	May cause take of valley elderberry longhorn beetles if conducted within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. This is the only endangered, threatened, or fully protected species in the study area for which pesticide use limitations have been imposed. Although pesticides may cause take of additional protected species in the study area, the existence of specific pesticide use regulations absolves pesticide applicators from

Table 2-2
Potential for Increased Agricultural Regulatory Constraints Associated with Endangered, Threatened, and Fully Protected Species and Riparian Habitat Restoration in the Study Area

Agricultural Operation	Potential for Increased Regulatory Constraints to Result from Restoration	Rationale [1]
		regulatory responsibility for take of other protected species, provided that the pesticides are used in accordance with their associated regulations. Other environmental restrictions to pesticide use are primarily focused on runoff into protected waters and aquatic habitats, rather than riparian or terrestrial habitats. Although pesticide use may be restricted within riparian habitat, depending on the pesticide, the regulatory agencies consider riparian edges to be adequate buffers for the protection of the interior habitat. Spraying is thus permitted on agricultural lands up to the riparian border.
Application of fertilizers	None.	Not regulated by environmental laws except in the case of species take or fertilizer runoff into protected waterways. Not likely to affect endangered, threatened, or fully protected species in the study area. Runoff into protected waterways may decrease with the restoration of riparian habitat, providing both ecological and regulatory benefits.
Additional pest control methods (e.g., shooting, trapping, or hazing)	None.	Not regulated by environmental laws except in the case of species take, and not likely to affect endangered, threatened, or fully protected species in the study area.
Harvesting	Mechanical methods prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level.	Not regulated by environmental laws except in the case of species take. May cause take of valley elderberry longhorn beetles if conducted mechanically and within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Not likely to affect other endangered, threatened, or fully protected species in the study area.
Tree removal	Prohibited for the rare trees supporting active nests of white-tailed kites, Swainson's hawks, or yellow-billed cuckoos. These trees may be removed, however, after the chicks have fledged or the nest has failed. Prohibited within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level.	Not regulated by environmental laws except in the case of species take. Would cause take of white-tailed kites, Swainson's hawks, or yellow-billed cuckoos in the rare event that an active nest containing eggs or chicks was present in the tree at the time of removal. May cause take of valley elderberry longhorn beetles if conducted within 100 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Not likely to affect other endangered, threatened, or fully protected species in the study area.
Mowing and management of agricultural borders	Mowing prohibited within 5 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level. Other mechanical activities and chemical applications prohibited within 100 feet of such shrubs.	May cause take of valley elderberry longhorn beetles if mowing occurs within 5 feet of elderberry shrubs with stems 1.0 or more inches in diameter at ground level, or if other mechanical activities or chemical applications occur within 100 feet of such shrubs.

[1] Sources for the rationale are provided in the regulatory and species analyses throughout this chapter.

Restoration of riparian habitat adjacent to agricultural lands may provide economic and other benefits to farmers. The resource protection regulatory agencies tend to support that land use configuration. For instance, vegetated buffers, which may include riparian habitat, are included among the BMP options encouraged by the TMDL program (Karkoski, pers. comm., 2006). Also, dense riparian vegetation provides a physical barrier (i.e., vegetated buffer zone) to the application of potential contaminants from agricultural operations, including spray drift, to other non-target resources. Physical barriers provide a higher standard of protection than traditional pesticide abatement measures (i.e., pesticide application buffer zones and wind direction constraints) and they avoid or reduce the economic impacts associated with buffer zones that displace crops when located on the perimeter of a farmed property. The width required by a physical barrier such as a riparian vegetation buffer zone to effectively prevent spray drift from reaching non-target areas is anticipated to be as small as a single tree row, based on the efficacy typically observed within orchards. The PRESCRIBE database interim measures for pesticide use restrictions related to sensitive resources includes, as Use Limitation 15, guidelines to reduce runoff by providing a 20 foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams and wetlands, or on the downhill side of fields where run-off could occur. Use Limitation 17 suggests providing riparian vegetation as an appropriate buffer between pesticide use and nearby habitat, to reduce pesticide drift in windy conditions. Both interim measures are supported by DPR, DFG, California Department of Food and Agriculture, and the Agriculture Commissioners Association (Rich Marovich, pers. comm. 2007).

3 REGULATORY SOLUTIONS

This chapter includes a description and analysis of potential solutions to address increased regulatory constraints that could result from the restoration of riparian habitat adjacent to or near agricultural land in the Colusa Subreach. As concluded in Chapter 2, Regulatory Constraints, the only potentially substantive increase in regulatory constraints is associated with ESA protections for the federally threatened valley elderberry longhorn beetle. Current USFWS guidelines for the beetle's protection under the ESA include restriction of activities within 100 feet of blue elderberry shrubs with stems 1.0 inch or greater in diameter at ground level.

Agricultural activities that could violate these guidelines if conducted within 100 feet of such shrubs include earth-moving activities such as disking, grading, deep ripping, and plowing; planting and harvesting methods involving the use of heavy machinery; ditch maintenance activities; application of pesticides; and tree removal. Nonetheless, the conduct of agricultural activities within 100 feet of blue elderberry shrubs is relatively common along the Sacramento River. It appears that the USFWS Guidelines are not actively enforced in regard to agriculture though this situation could potentially change in the future.

However, despite these regulations and the presence of elderberry shrubs within the study area, the likelihood of these agricultural activities becoming more restricted due to the proposed restoration is relatively low. No substantial increases in regulatory constraints would result from restoration whether or not the shrub is planted. And, if the valley elderberry longhorn beetle is delisted, as has been proposed, these regulatory constraints will be removed. The preliminary planting designs at the proposed restoration sites suggest that any increase in elderberry shrubs on agricultural land would be small. The open canopy types of riparian habitat (e.g., savannah) most suitable to the growth of elderberry shrubs constitute a small percentage of the proposed restoration, most of which is proposed for closed canopy riparian forest types (see Section 1.1.4) in which elderberry shrubs are planted in lower densities. The potential for elderberry shrub increases on adjacent agricultural land is further limited by the relatively small percentage of the proposed restoration perimeter that borders agricultural land (see Section 1.1.5).

Although the potential is low for the proposed restoration to increase regulatory constraints to agricultural activities, this study recognizes the goals of Colusa Subreach landowners for greater assurances of their continued ability to perform agricultural activities without potential for hindrance. This chapter thus discusses several potential solutions to increase these assurances and reduce or eliminate the potential for restoration to increase regulatory constraints related to valley elderberry longhorn beetles.

The chapter focuses on eight potential solutions to prevent restrictions to agricultural activities surrounding blue elderberry shrubs. These potential solutions are described in Sections 3.2 and 3.3 and are compared in Sections 3.4 and 3.5. Section 3.1 briefly discusses three additional solutions proposed during meetings with the Advisory Workgroup and External Experts Group that are useful in other regulatory contexts but that are not applicable to restrictions relating to valley elderberry longhorn beetles. These solutions have, therefore, been omitted from the remainder of this chapter.

Increased regulatory constraints from valley elderberry longhorn beetles and the ESA may be prevented through two main approaches: 1) restoration design solutions that prevent protected shrubs from being planted or naturally colonizing land within 100 feet of farm activities, or 2) agency policies and legal agreements that allow shrubs to be planted or colonize the area without constraining farm activities. Solutions considered under these two categories include:

Agency policy solutions
Delisting
Good Neighbor Policy
Habitat Conservation Plan
Memoranda of Agreement/Understanding
Programmatic Safe Harbor Agreement

Restoration design solutions
Habitat type configuration
Planting protocols
Buffer zones

Each potential regulatory solution is evaluated in terms of nine criteria to determine the relative benefits and detriments of the potential solution to address regulatory constraints on nearby or adjacent agricultural lands when riparian habitat is restored. Sections 3.4 and 3.5 include a summary and comparison of the evaluations for each potential solution. The following nine criteria were used in the evaluation, focused on each solution's likelihood for successfully addressing regulatory issues in the Colusa Subreach:

- ***Landowner assurances –*** Level of security with which neighboring farmers will be protected from increased regulatory constraints
- ***Ecological benefit –*** Level of benefit and protection for restored ecosystem and wildlife
- ***Restoration proponent responsibility –*** Financial and logistical responsibility for applicable fees, maintenance, and/or land use
- ***Neighboring landowner responsibility –*** Financial and logistical responsibility for applicable fees, maintenance, and/or land use
- ***Timeline to completion*** – Duration of required actions for implementation and maintenance
- ***Longevity*** – Duration of landowner protection from increased regulatory constraints
- ***Flexibility*** – Ease with which neighboring landowners and restoration proponents may adapt the solution to meet their shared objectives
- ***Logistical simplicity*** – Simplicity of implementation and maintenance
- ***Cost*** – Relative cost of implementation and maintenance

3.1 OMITTED REGULATORY SOLUTIONS

Two potential solutions considered in the Final Study Design for this study include Natural Community Conservation Plans (NCCP) and "programmatic and streamlined permitting". NCCPs are applicable only to California state-listed threatened and endangered species, not the valley elderberry longhorn beetle, which is federally listed. Programmatic and streamlined permits include a broad array of permit types, most of which are not applicable to this study, with the exception of programmatic safe harbor agreements. For the purposes of this study, programmatic and streamlined permitting is an informal term that refers to permitting solutions that cover large geographic areas (e.g., a reach of a river corridor) to enable repeatable project actions to be covered by a single permit rather than requiring new permits for each action. By doing so, overburdened resource agencies are relieved from reviewing multiple applications for the same type of activity and issues within a reach, and applicants can achieve their project actions efficiently by being able to spend more funds and time on project activities rather than applying for new permits covering the same type of activities and addressing the same sensitive resource issues. Programmatic and streamlined permits can include permits for state and federal regulations such as the federal Clean Water Act (i.e., Section 404 permit for fill of waters of the United States and Section 401 water quality certification) and Section 1602 (i.e., Streambed Alteration Agreement) of the California Fish and Game Code. As discussed in Chapter 2, riparian habitat restoration would not increase the restrictions or need for permits that these regulations pose to Colusa Subreach farmers. Programmatic and streamlined permitting may also apply to permits addressing the protection of state or federally listed species, such as incidental take permits (e.g., Biological Opinion from the USFWS or Section 2081 permit from DFG) and programmatic safe harbor agreements (PSHAs). The type of programmatic take permit applicable to the concerns of this study is the PSHA, discussed later in this chapter.

Similarly, “neighboring landowner agreements” are not explicitly addressed in this study because they are included in the text describing several other solutions. For example, neighboring landowner agreements form part of the decision-making process between restoration proponents and neighboring landowners regarding buffer strip management, good neighbor policies, and optional land survey access (or lack thereof) for a PSHA.

3.2 RESTORATION DESIGN SOLUTIONS

This section and Section 5.1.1 describe restoration design solutions (e.g., habitat type configuration, planting protocols, and buffer zones) that may be employed to limit the potential for increased conflicts due to riparian habitat restoration. However, unlike Section 5.1.1, this section focuses on design solutions that limit the potential for valley elderberry longhorn beetles and their habitat to occur in restored riparian areas and adjacent agricultural lands and to reduce the risk of trans-boundary regulatory conflicts between these two land uses.

3.2.1 HABITAT TYPE CONFIGURATION

It is likely that regulatory constraints that might otherwise occur to neighboring or nearby farms as a result of riparian habitat restoration would be reduced simply by configuring a restoration site design to avoid restoring certain habitat types adjacent to vulnerable farmland. However, this may not always be feasible or may not enable achievement of ecological objectives. Restoration proponents could configure their restoration plans so that riparian community types more likely to host blue elderberry shrubs (the host plant for valley elderberry longhorn beetle), such as open savanna, open woodland, and shrub-grassland are farthest away from neighboring or nearby agricultural land. Because blue elderberry shrubs are relatively intolerant of shade and are uncommonly found in dense, closed canopy forest, planting cottonwood, valley oak, and mixed riparian forest habitats closest to neighboring farms may reduce the likelihood of blue elderberry shrub dispersal from restored habitat to neighboring properties. Additional considerations for habitat placement may include the current abundance of blue elderberry shrubs in adjacent habitat (which increases the likelihood of shrub dispersal into the restoration sites from existing habitat), as well as the agricultural activities on adjacent farmlands. If mature elderberry shrubs (i.e., with stems greater than 1 inch in diameter at ground level) are within 100 feet of adjacent farmlands, agricultural activities could be constrained. To avoid this constraint, if there are many elderberry shrubs in adjacent existing riparian habitat, a more resistant closed canopy habitat type (e.g., cottonwood riparian forest) that tends to exclude elderberry shrub colonization might be planted where agricultural activities would otherwise be affected. The optimal restoration design for each site may be influenced by these factors, as well as compatibility with neighboring pest control goals and traditional restoration design concerns such as soils, hydrology, connectivity with adjacent habitat types, and target species.

Because habitat design configurations alone cannot guarantee that blue elderberry shrubs will not grow within 100 feet of adjacent agricultural land (due to natural recruitment), and because design configurations must meet ecological objectives, landowner assurances may be increased by combining habitat design configuration with actively maintained buffer zones (including removal of immature elderberry shrubs) or any of the other potential solutions presented in this chapter.

Habitat type configuration is evaluated as a solution in Table 3-1 below.

3.2.2 PLANTING PROTOCOLS

Blue elderberry shrubs are sometimes omitted from restoration planting protocols within floodways in order to avoid regulatory constraints related to their removal (California Reclamation Board 2006). Overall, an advantage of this approach is that it does not increase the cost of the restoration. A disadvantage is that it could reduce the success of the restoration project in meeting ecosystem recovery goals. Riparian habitats lacking blue elderberry shrubs provide extensive benefits to riparian wildlife and plants; however, they are not able to contribute to the recovery of valley elderberry longhorn beetles, and they lack the blue elderberry flowers, fruits, and vegetative structure that benefit many wildlife species. Additionally, not planting blue elderberry would not prevent existing

Table 3-1
Evaluation of Habitat Type Configuration as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	- ➔ +	No guarantee that blue elderberry shrubs from currently existing riparian habitat would not disperse to restoration sites or agricultural fields, unless this solution is combined with buffer zones or other regulatory solutions.
Ecological benefit	= ➔ -	No change to the achievement of overall ecosystem goals because elderberry shrub habitat configuration would be combined with traditional ecological considerations in developing the final restoration design. Potential reduction in the achievement of valley elderberry longhorn beetle recovery goals if the number of elderberry shrubs or the number of elderberry-supporting acres would be reduced; no change to these goals if only the location and not the number of shrubs or acres would be altered.
Restoration proponent responsibility	+	The restoration proponent would have no long-term maintenance responsibilities.
Neighboring landowner responsibility	+	None.
Timeline to completion	+	Configuration would be implemented as part of restoration with initial habitat construction.
Longevity	-	In the absence of site maintenance, blue elderberry shrubs may naturally colonize from native habitat parcels.
Flexibility	-	Restricts restoration proponent as to where certain (i.e., open and closed canopy) riparian community types may be restored.
Logistical simplicity	+	Relatively small adjustment to restoration protocols.
Cost	+	Minimal, unless this solution is combined with buffer zones or other regulatory solutions

[1] Explanation of symbols used in evaluation tables:

+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects

- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved

= : no net beneficial or detrimental effect on party listed in that particular criteria category

➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented

Source: EDAW 2007

elderberry shrubs from dispersing naturally to the restoration sites from nearby riparian habitat if blue elderberry shrubs are present there and the restored habitat includes an open canopy and has the right conditions to support the shrubs.

Although counter to the intent to speed the recovery of valley elderberry longhorn beetle populations, short-term monitoring by the project proponent to actively search for and remove all blue elderberry saplings with small stem diameters (< 1 inch) within 100 feet of the restoration site borders can meet the objective to reduce regulatory constraints on adjacent agricultural operations.

There are several different ways in which planting protocols may be implemented and two feasible options, or scenarios, are considered here. The first scenario would be to completely omit blue elderberry shrubs from the planting protocol for an entire restoration site. In addition, no maintenance would be performed on the restoration

site to remove shrubs that may naturally colonize from the remnant riparian habitat that currently exists. This is beneficial for landowners in the short-term, because no elderberry shrubs would be planted on or near their property by restoration proponents. However, there is no guarantee that blue elderberry shrubs would not later colonize from remnant habitat. The second scenario would involve omitting the planting of blue elderberry shrubs within 100 feet of the border between the proposed restoration site and the adjacent farm while still planting other native riparian species. This scenario enables some elderberry to be planted on site away from adjacent farmland to help meet valley elderberry longhorn beetle and ecosystem recovery goals. Similar to the first scenario, no maintenance would be performed, so blue elderberry shrubs may colonize from remnant riparian habitat. Long-term maintenance of border areas to remain free of blue elderberry shrubs is discussed in Section 3.2.3, Buffer Zones. The planting protocols described in this section may be combined with buffer zones and/or any of the other potential solutions presented in this chapter. Since the second scenario helps meet valley elderberry longhorn beetle and ecosystem recovery goals and the likelihood of constraints to agricultural practices from nearby elderberry plants is generally considered to be low, this scenario may be preferable over the first scenario.

The overall advantages and disadvantages as well as the variations in planting protocol scenarios, are included in Table 3-2 below.

Table 3-2
Evaluation of Planting Protocols as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	- ➔ +	No guarantee that blue elderberry shrubs from currently existing riparian habitat would not disperse to restoration sites or agricultural fields, unless this solution is combined with buffer zones or other regulatory solutions.
Ecological benefit	-	Lack of elderberry shrubs could reduce achievement of valley elderberry longhorn beetle and ecosystem recovery goals.
Restoration proponent responsibility	+	The restoration proponent would have no long-term maintenance responsibilities.
Neighboring landowner responsibility	+	None.
Timeline to completion	+	Protocol would be implemented as part of restoration with initial habitat construction.
Longevity	-	In the absence of site maintenance, blue elderberry shrubs may naturally colonize from remnant native parcels.
Flexibility	=	Restoration proponents and neighboring landowners may negotiate regarding the extent to which elderberry shrubs would be omitted from the planting protocols, which may vary according to site-specific landowner preferences and restoration goals.
Logistical simplicity	+	Relatively small adjustment to restoration protocols.
Cost	+	Low establishment and maintenance cost for initial planting of blue elderberry shrubs.

[1] Explanation of symbols used in evaluation tables:
+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects
- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved
= : no net beneficial or detrimental effect on party listed in that particular criteria category
➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented
Source: EDAW 2007

3.2.3 BUFFER ZONES

For the purposes of this study, a buffer zone is a 100-foot wide buffer area on the border between a restoration site and adjacent farmland. The buffer area may be other widths, however, 100 feet is the minimum width provided by the USFWS Conservation Guidelines for Valley Elderberry Longhorn Beetle (USFWS 1999a). Many options exist for the plants and structure that could characterize a buffer zone, and these are discussed in detail in Chapter 5, Pest Solutions. An advantage of this approach is that long-term maintenance of the buffer zone to exclude naturally dispersing blue elderberry shrubs is more likely to be feasible than similar maintenance of the entire restoration site. This approach would also allow the interior of the restoration site to more fully meet the ecosystem recovery goals to which blue elderberry shrubs may contribute. A disadvantage for the restoration proponent is that, if the buffer zone is located on the conservation land property, it reduces the area available for restoration. However, if this buffer is located on conservation land property and is planted with an income-generating crop maintained and harvested by the neighboring farmer, that could be an advantage for the neighboring farm landowner who, in addition to benefiting from assurances that elderberry shrubs would not be present, would benefit from potential increased cropland and income that could offset any potential losses on the primary farming area.

This approach could incur increased costs for long-term maintenance, although increased costs would not be expected during the initial planting of the buffer zone and restoration site. Long-term funding to maintain buffer zones is expected to be difficult to come by for DFG, the public agency slated to own the restoration sites under the current proposal, after the restoration would be completed. If this approach is implemented, an agreement would be desirable between the restoration proponents and neighboring landowners as to how the buffer would be maintained and who would hold the financial and logistical responsibility for its maintenance. This approach would successfully avoid valley elderberry longhorn beetle-related regulatory constraints to neighboring farms, including constraints related to both planted elderberry shrubs and shrubs that colonize naturally on the restoration site.

There are several ways in which buffer zones may be implemented. The first option, or scenario, would be to create a riparian habitat buffer zone including planting of native riparian species other than blue elderberry shrubs within 100 feet of the property boundary. The restoration proponent would maintain these 100 feet of habitat, removing any colonizing shrubs before they reached the protected 1.0 inch diameter stem size at ground level. In the second scenario, the buffer zone would be a 100-feet wide unvegetated (e.g., disced firebreak), vegetated (e.g., grassland), or primary or secondary crop (e.g., orchard, row crop, pasture) free of blue elderberry shrubs, and located within the restoration site, but not planted with riparian habitat at all. These solutions could benefit farmers in several ways. First, their responsibilities here would be of their own choosing, because the buffer zone maintenance would be provided by the restoration proponent unless there was an agreement to involve the adjacent farmers (e.g., to plant and maintain a crop, etc.). If an adjacent farmer decided to plant and maintain the buffer zone with a crop, the crop could bring in additional income. Because of the potential for mature (greater than 1 inch in diameter) elderberry shrubs in the restored habitat adjacent to the buffer zone, crops in the buffer zone would likely have to be maintained differently from the crops on the adjacent farmer-owned property. Buffer maintenance would have to be performed with techniques that are compliant with USFWS guidelines for conservation of valley elderberry longhorn beetles (e.g., no toxic pesticides unless expressly permitted through USFWS consultation).

The overall advantages and disadvantages as well as the variations in buffer zone scenarios are included in the evaluation in Table 3-3 below.

Table 3-3
Evaluation of Buffer Zones as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	+	Blue elderberry shrubs cannot disperse and grow to 1.0 inch diameter size in a buffer zone that is actively maintained to exclude them.
Ecological benefit	- ➔ =	Fewer acres would be available to restore riparian habitat if buffer zone is not riparian habitat. However, some sites may not be suitable for elderberries.
Restoration proponent responsibility	- ➔ =	If the project proponent decided to initially donate or make available buffer zone land on the conservation parcel to an adjacent farmer who would maintain it, the project proponent's overall responsibilities would be reduced. However, the project proponent's responsibilities would be substantially higher if they were responsible for maintaining the buffer zone. Long-term maintenance may or may not be financially feasible for the project proponents.
Neighboring landowner responsibility	= ➔ +	If the buffer zone is riparian habitat there would be no neighboring landowner responsibility for maintenance. If the buffer zone is a primary or secondary crop, maintenance responsibility would be balanced by benefits of using land for crops or reaping pest control benefits.
Timeline to completion	- ➔ +	Long-term maintenance effort would be equal to that otherwise associated with the buffer zone's land use (crops or pest control). May take a considerable amount of time to gain approvals for planting crops on state lands.
Longevity	+	Longevity of maintenance activities would be negotiated between restoration proponents and neighboring landowners. Buffer zone maintenance may continue in perpetuity or until the valley elderberry longhorn beetle is delisted.
Flexibility	+	No federal agencies are involved, simplifying negotiations between the project proponent and neighbors.
Logistical simplicity	+	Relatively small adjustment to restoration protocols.
Cost	- ➔ +	Similar to costs generally associated with the buffer zone's land use, although higher if maintenance activities are restricted by nearby elderberry shrubs. Maintenance costs would be higher for buffers planted with riparian vegetation and maintained to be free of elderberry shrubs. Alternatively, the potential for additional income exists if a crop is planted.

[1] Explanation of symbols used in evaluation tables:

+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects

- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved

= : no net beneficial or detrimental effect on party listed in that particular criteria category

➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented

Source: EDAW 2007

3.3 REGULATORY AGREEMENT SOLUTIONS

The following section summarizes the USFWS' consideration of delisting the valley elderberry longhorn beetle as a threatened species and describes agreements between restoration proponents and local landowners/stakeholders (e.g., Good Neighbor Policy, Programmatic Safe Harbor Agreement, Habitat Conservation Plans) that can be utilized to enable both restoration and neighboring landowner/stakeholder goals to be met until the beetle no longer poses regulatory constraints to agricultural operations adjacent to restoration sites.

3.3.1 DELISTING

USFWS released its 5-year status review for the valley elderberry longhorn beetle on October 2, 2006 (USFWS 2006). In this review, USFWS reported an increase in known beetle locations from 10 at the time of listing in 1980 to 190 in 2006. Because of this observed population increase and the concurrent protection and restoration of several thousand acres of riparian habitat suitable for valley elderberry longhorn beetles, the USFWS status review determined that this species is no longer in danger of extinction, and recommended that the species be delisted and removed from ESA protection.

This recommendation is not a guarantee that the species will be delisted, however, because formal changes in the classification of listed species require a separate USFWS rulemaking process distinct from the 5-year review. If valley elderberry longhorn beetles are officially proposed for removed from the ESA list, it will likely be more than a year before this decision is finalized. The official decision to delist or not to delist may in fact take several years, following extensive data review, public comment, and potential litigation. If this species is indeed delisted, habitat restoration would not cause regulatory restrictions to farmers related to valley elderberry longhorn beetles, with or without the potential solutions provided here.

We recommend that any regulatory agreements adopted in the Colusa Subreach include explicit provisions for how agreed-upon responsibilities may change following delisting, if it occurs. These provisions would be negotiated between the restoration proponents and adjacent landowners, and would likely be different for many of the potential solutions discussed in this chapter. Restrictions to habitat design configurations and planting protocols would likely be lifted following delisting, allowing the planting of elderberry shrubs in areas where they would have been omitted while the beetle remained listed. Buffer zones would no longer have to be maintained free of elderberry shrubs following delisting, and would likely be left to be naturally recolonized by the adjacent riparian vegetation. The restoration proponents' annual reporting requirements for federal permits (e.g., Habitat Conservation Plans, Programmatic Safe Harbor Agreements) would likely be lifted following delisting. Memoranda of Understanding/Agreement regarding responsibility for take of valley elderberry longhorn beetles would likely sunset following delisting, as they would no longer be needed. The SRCAF Good Neighbor Policy would likely remain unchanged following delisting (except for the recommendation to enter a Programmatic Safe Harbor Agreement), as this policy is a broad framework for interaction between landowners on a variety of land use issues beyond ESA constraints.

Delisting of the valley elderberry longhorn beetle is evaluated as a solution in Table 3-4 below.

Table 3-4
Evaluation of Delisting the Valley Elderberry Longhorn Beetle as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	+	If delisted, habitat restoration would not cause regulatory restrictions, and it is highly unlikely that valley elderberry longhorn beetle would be listed again if that decision is made.
Ecological benefit	- → +	Valley elderberry longhorn beetle may decline in population if delisting results in a loss of habitat and host species. Alternatively, with riparian habitat protected, if delisting occurs, there may be fewer constraints to planting elderberry shrubs in restoration sites, potentially leading to more elderberry planting and a possible increase in habitat.
Restoration proponent responsibility	+	No responsibility if and when a delisting decision is finalized.
Neighboring landowner responsibility	+	No responsibility if and when a delisting decision is finalized.

Table 3-4
Evaluation of Delisting the Valley Elderberry Longhorn Beetle as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Timeline to completion	-	May take many years for USFWS to reach a final decision.
Longevity	+	Long-term decision.
Flexibility	=	The new status will be as legally binding as the current listing status.
Logistical simplicity	= ➔ -	Time-consuming decision process with multiple parties involved. However, neither restoration proponents nor farmers need to play a role in making the delisting determination.
Cost	+	None to the restoration proponent or adjacent landowners.

[1] Explanation of symbols used in evaluation tables:
+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects
- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved
= : no net beneficial or detrimental effect on party listed in that particular criteria category
➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented
Source: EDAW 2007

3.3.2 GOOD NEIGHBOR POLICY

To address neighboring landowner concerns, the SRCAF drafted a Good Neighbor Policy (GNP) that applies to all SRCAF restoration projects in the Sacramento River Conservation Area (Conservation Area) from Red Bluff to Colusa, including the study area. This GNP provides a broad framework for cooperation between neighbors to identify and implement a variety of potential solutions to land use conflicts. The current adopted GNP is included in Appendix G. In this policy, the term "neighbor" pertains broadly to lands adjacent, nearby, or "in the vicinity" of SRCAF activities, and may apply to any landowner, farmer, land manager, private organization, or public agency in this report's study area.

The stated intent of the GNP is to "make every reasonable effort to prevent harm or loss to any person and public or private entity from activities prescribed in the SRCAF Handbook," including habitat restoration. The GNP would be most effective when used in conjunction with other potential regulatory constraint solutions (e.g., buffer zones) discussed in this chapter. The GNP supports the policy's intent to prevent harm or loss and other goals by:

- encouraging buffer zones where feasible,
- encouraging participation in a PSHA,
- encouraging neighboring landowner involvement in a variety of land use decisions,
- encouraging studies to address neighbor concerns,
- encouraging the consideration of a contingency fund for unforeseen impacts to neighbors,
- encouraging neighboring landowner agreements for a variety of issues beyond ESA compliance and pest control, and
- pledging to work with regulatory agencies so that neighbors may benefit from restoration in a variety of ways.

These efforts include SRCAF recommendations for project proponents to avoid or minimize conflicts with neighboring land uses, as well as SRCAF actions to resolve any conflicts which may arise.

The GNP includes several measures to prevent, address, and resolve conflicts between neighbors and restoration proponents. First, the SRCAF has pledged to provide a local, informal means of settling disputes that neighbors may choose before pursuing legal resolutions to conflicts. In this service, the SRCAF would offer to convene the parties involved, SRCAF Board members, and applicable technical experts to either resolve the issue or identify available financial or technical resources to help resolve the issue. Second, the SRCAF would assist entities whose projects within the Conservation Area may require permits pursuant to the ESA or CESA. This assistance includes education regarding permit requirements and processes, facilitation of projects in compliance with the ESA and CESA, and possibly mitigation banking or brokering landowner mitigation agreements if such agreements are approved by USFWS and DFG. Third, the SRCAF is also working with natural resource regulatory agencies, public works agencies, and private landowners to promote the concept of the Conservation Area as a "self-mitigating area," where environmental mitigation "credits" could be provided on a programmatic basis to neighboring landowners and public works agencies in exchange for resources or actions that support conservation activities.

Participation in a GNP would involve a high level of flexibility for all parties due to the fact that they can choose if and when to sign an agreement and customize it to their needs. A GNP agreement also would aim to relieve neighboring farmers of the responsibility for resolving regulatory conflicts once the agreement is signed. In most cases, the restoration or other project proponent would take responsibility to resolve project-related issues. However, if the GNP agreement only entails increased communication between involved parties, then pre-project assurances to landowners may be low. This is because, as stated in the adopted GNP, "The SRCAF is a non-governmental entity that does not have legislative nor regulatory authority over local, state and federal programs or funding mechanisms. The SRCAF policies apply and are binding only to its allowed actions as an advisory body." If the GNP is used in conjunction with a programmatic safe harbor agreement and/or buffer zone, then landowners would be assured protection through a higher regulatory authority and restoration proponent action. In the case of contingency funds, it may be difficult for a project proponent to quickly determine the cause of damages and who would therefore be responsible for paying for them. Another limitation of contingency funds is that they would only be available for a specified limited length of time after the project completion date.

The SRCAF Good Neighbor Policy is evaluated as a solution in Table 3-5 below.

Table 3-5
Evaluation of Good Neighbor Policy as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	- → +	If the GNP is used alone (i.e., communication only), then pre-project assurances may be low. If the GNP is used in conjunction with a PSHA and/or buffer zone, then landowners would be assured protection through a higher regulatory authority.
Ecological benefit	N/A	Not applicable.
Restoration proponent responsibility	-	Restoration proponents are financially and logistically responsible for a greater number of studies and actions to evaluate, reduce, and mitigate potential impacts to neighbors than is typically the case.
Neighboring landowner responsibility	+	None other than voluntary participation in the decision-making processes regarding neighboring land use.
Timeline to completion	+	The GNP itself has already been adopted. Related agreements for individual projects would take effect as soon as the involved parties complete the agreements.

Table 3-5
Evaluation of Good Neighbor Policy as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Longevity	=	The GNP as a framework has long-term applicability. Parties involved in related agreements for individual projects may choose the duration of the agreements.
Flexibility	+	Participation is voluntary, project agreements can be customized to landowner's and restoration proponent's particular situation, and landowners can choose to sign on at any time.
Logistical simplicity	- → +	Consensus for each project may be difficult to reach. No long-term habitat maintenance is required.
Cost	- → +	Cost for each project depends on the ease of reaching consensus.

[1] Explanation of symbols used in evaluation tables:
+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects
- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved
= : no net beneficial or detrimental effect on party listed in that particular criteria category
→ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented
Source: EDAW 2007

3.3.3 HABITAT CONSERVATION PLANS

The federal ESA discussion in Section 2.1.2 provides an overview of the mechanisms by which take of federally-listed species may be permitted, by USFWS on a case-by-case basis. Because agricultural and maintenance activities on private farms in the Colusa Subreach are not considered to have a "federal nexus," Section 10 rather than Section 7 applies to ESA issues addressed in this study, and a Habitat Conservation Plan (HCP) rather than a Biological Opinion would be an appropriate pathway with which to obtain an incidental take permit for valley elderberry longhorn beetles.

Section 10(a) of the ESA allows the USFWS to permit the incidental take of threatened and endangered species if such take is accompanied by a HCP that includes components to minimize and mitigate impacts associated with the take. HCPs for take of valley elderberry longhorn beetles typically involve riparian habitat restoration as mitigation for take of blue elderberry shrubs (i.e., valley elderberry longhorn beetle habitat), and blue elderberry shrubs are planted in the restored habitat at ratios defined in USFWS valley elderberry longhorn beetle guidelines (USFWS 1999a). With any valley elderberry longhorn beetle HCP, initial surveys of blue elderberry shrub locations are required for ESA compliance, as well as long-term monitoring and reporting of blue elderberry shrub survival on the restoration site.

Like a Programmatic Safe Harbor Agreement (PSHA, discussed in Section 3.3.5), an HCP may be developed on a programmatic, regional scale. However, there is no precedent with an HCP for restoration by one party to mitigate for another party's take of listed species (unless the second party pays into a conservation bank for this purpose and is considered financially responsible for the restoration). Thus the PSHA framework in which neighbors may sign on to receive protection from ESA constraints associated with another party's habitat restoration cannot apply to an HCP. A programmatic HCP also differs from a PSHA in that the agency or individual holding the incidental take permit must have regulatory authority over all individuals that sign on to the agreement, to ensure that permit conditions are met. For this reason, programmatic HCPs are typically applied in the arena of land development, where cities and counties hold the USFWS incidental take permits and require developers to meet the HCPs' terms and conditions before receiving city/county development permits. This framework is not

applicable to the farmers and restoration proponents in the Colusa Subreach. However, there is one way in which an HCP could be applied in this case.

The restoration proponents could apply for an HCP for incidental take of existing blue elderberry shrubs on restoration sites in the Subreach during their initial restoration activities. This take would be mitigated by blue elderberry shrub planting and by the long-term benefits that restoration would have on valley elderberry longhorn beetle populations. A provision could be added to extend the HCP beyond the restoration sites to the entire Subreach, and for the restoration proponents to annually survey and remove all juvenile blue elderberry shrubs from neighboring properties whose owners voluntarily sign an access agreement, to protect neighboring property owners from regulation before the shrubs develop 1.0 inch diameter stems. Removal of larger blue elderberry shrubs from neighboring properties could also potentially be covered under the HCP, and would be mitigated by the restoration projects following USFWS valley elderberry longhorn beetle guidelines (USFWS 1999a).

A major drawback of this approach is that because the restoration proponents would hold the take permit and do not have regulatory authority over neighboring farmers to ensure permit compliance, the restoration proponents would be required to be the responsible parties removing all shrubs covered under the HCP, even those present on neighboring farmlands. This arrangement is unlikely to be amenable to either the restoration proponents or the neighboring farmers. Additional drawbacks to the HCP approach are the high cost and lengthy timeframe typically associated with drafting and negotiating such agreements. A programmatic HCP is thus the least favored of the potential regulatory solutions discussed in this chapter.

Habitat Conservation Plans are evaluated as a solution in Table 3-6 below.

Table 3-6
Evaluation of an HCP as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	= ➔ +	If USFWS approves an HCP as described, neighbors would be absolved of responsibility for blue elderberry shrubs. However, USFWS approval of these terms is not guaranteed.
Ecological benefit	+	All of the proposed acreage would be restored to riparian habitat, and blue elderberry planting in the restoration acreage would not be limited.
Restoration proponent responsibility	-	Long-term surveying & shrub removal responsibility on neighboring properties.
Neighboring landowner responsibility	-	Long-term restoration proponent access to property.
Timeline to completion	-	More than 2 years for USFWS to approve HCP.
Longevity	=	Parties may choose duration; typically 5-50 years.
Flexibility	-	Legally binding.
Logistical simplicity	-	Time-consuming HCP approval process with multiple parties involved, plus long-term survey and shrub removal tasks.
Cost	-	Likely > $100,000 for HCP approval process, plus long-term survey and shrub removal costs.

[1] Explanation of symbols used in evaluation tables:
+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects
- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved
= : no net beneficial or detrimental effect on party listed in that particular criteria category
➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented
Source: EDAW 2007

3.3.4 MEMORANDA OF AGREEMENT/UNDERSTANDING

A Memoranda of Agreement (MOA) or Memoranda of Understanding (MOU) is a binding legal agreement between two or more entities. Two such agreements that may serve as models for the Colusa Subreach are the Turlock Irrigation District (TID)-Reclamation Board MOA for Tuolumne River Restoration Projects (full text in Appendix H) and the Department of Water Resources (DWR)-Department of Fish and Game (DFG) MOU for Flood Control Projects in the Sacramento and Feather River Wildlife Areas (full text in Appendix I).

Pursuant to the TID-Reclamation Board MOA, TID "protects and releases" the Reclamation Board from responsibility for any future impacts to valley elderberry longhorn beetles associated with TID's restoration efforts in the floodway. If future flood control activities performed by the Reclamation Board result in take of valley elderberry longhorn beetles, TID assumes full responsibility for USFWS consultation and mitigation that may be required. A similar agreement may be feasible in which Colusa Subreach landowners may voluntarily sign on to receive similar protections, with the restoration proponents assuming responsibility for any take of shrubs that may occur on or adjacent to the restoration sites.

Pursuant to the DWR-DFG MOU, DFG assumes responsibility for potential take of valley elderberry longhorn beetles from DWR activities. This MOU also provides additional flexibility for DWR to add or modify locations and descriptions of covered activities after the MOU is signed. This agreement is also associated with a USFWS biological opinion (BO) (see Section 2.1.2, Sensitive Species Regulations - Federal Endangered Species Act for more information on biological opinions). A BO is similar to a safe harbor agreement (described below), but is only applicable to projects with a federal nexus, such as those involving federal property, funding, or actions (including requirements for other federal permits such as a Section 404 permit from the U.S. Army Corps of Engineers [USACE] for adding fill or dredging of materials from "waters of the United States", such as the Sacramento River). The BO permits DWR to remove blue elderberry shrubs and return the area to the pre-project number of shrubs (130) in Sacramento and Feather River Wildlife Areas, if needed, and allows DWR the flexibility to choose which 130 shrubs would remain. They do not need to be the original pre-project shrubs.

A similar, legally binding MOA/MOU in the Colusa Subreach may be achievable in which the restoration proponent could "protect and release" neighbors from responsibility for any future impacts to valley elderberry longhorn beetles associated with restoration efforts. In this way, the restoration proponent could enable restored blue elderberry shrubs to be used to help maintain a pre-project number of shrubs. If future activities performed by neighbors result in take of blue elderberry shrubs, the restoration proponent could assume full responsibility for ESA compliance through USFWS consultation and mitigation. The agreement may be combined with a PSHA (described below). In this case, there would be two avenues for landowner protection from restrictions or responsibility for potential take of elderberry shrubs. Landowners who sign the PSHA would be protected in accordance with the PSHA's terms, such as an allowance for take of elderberry shrubs so long as a baseline pre-project number of shrubs was maintained within the region covered by the PSHA. Landowners choosing not to sign on to a PSHA could instead sign an MOA/MOU. In that case, the landowner would be protected by the restoration proponent responsible for the MOA/MOU and the possibility of take of an elderberry shrub by a landowner.

MOA/MOUs are advantageous to neighboring farmers in that the landowners are absolved from any legal responsibility for blue elderberry shrubs that result from the restoration. Another benefit to these agreements is that they have a relatively high level of flexibility; the MOU/MOA is voluntary and it enables necessary activities to occur, such as plowing and pesticide applications, that may result in some take of blue elderberry shrubs. However, an MOA/MOU consensus may be difficult to reach, and the level of legal responsibility for the restoration proponent would be very high.

MOA/MOUs are evaluated as a solution in Table 3-7 below.

Table 3-7
Evaluation of MOA/MOUs as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	+	The restoration proponent assumes legal responsibility for all blue elderberry shrubs that result from the restoration.
Ecological benefit	+	All of the proposed acreage would be restored to riparian habitat, and blue elderberry planting in the restoration acreage would not be limited.
Restoration proponent responsibility	-	The restoration proponent assumes legal responsibility for the actions of neighbors. This may be more difficult than in the example cases where all involved parties were public agencies.
Neighboring landowner responsibility	+	None other than signing the agreement.
Timeline to completion	=	More than one year to reach consensus on details of agreement. No long-term habitat maintenance required.
Longevity	+	Involved parties may choose the duration of the agreement.
Flexibility	+	Legally binding once signed. Flexible prior to signing, as no federal agencies are involved, simplifying negotiations between the restoration proponent and neighbors.
Logistical simplicity	=	Consensus may be difficult to reach. No long-term habitat maintenance required.
Cost	=	Cost depends on the ease of reaching consensus.

[1] Explanation of symbols used in evaluation tables:

+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects

- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved

= : no net beneficial or detrimental effect on party listed in that particular criteria category

➔ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented

Source: EDAW 2007

3.3.5 PROGRAMMATIC SAFE HARBOR AGREEMENTS

Programmatic Safe Harbor Agreements (PSHAs) are voluntary agreements that provide federal agency assurance that individuals will not be subject to additional ESA-related restrictions if habitat restoration in the region increases the abundance or distribution of protected species on their property. PSHAs differ from individual Safe Harbor Agreements in that they may be applied regionally, rather than on a project-specific or landowner-specific basis, and that individuals need not participate in the region's restoration activities in order to receive regulatory protection.

The SRCAF is currently pursuing a PSHA, and describes it as follows in the adopted GNP: a PSHA "would allow non-profits, agencies, or private landowners to do habitat restoration pursuant to an agreement that would allow 'take' of listed species which might occur 'incidental to, and not the purpose of, the carrying out of an otherwise lawful activity' provided that such incidental take does not reduce the local populations of the covered species below some pre-determined baseline."

"Any neighbors connected in some way to these restored properties would also be able to sign up under the PSHA and receive a permit allowing them to avoid Endangered Species Act liability for any incidental take associated with their 'otherwise lawful activities,' such as existing and routine farming activities. They could also be protected from any future restrictions associated with additional species or habitat on their land, and be able to return their lands to baseline levels in the future (notwithstanding requirements associated with funding received for the work)."

In this way, PSHAs can also help to reduce ESA constraints below the current level for Colusa Subreach farmers who choose to sign on. Under current conditions without restoration, blue elderberry shrubs may naturally disperse onto or within 100 feet of Colusa Subreach farms from the remnant riparian habitat that currently exists in the region. Without a PSHA, take of these shrubs after they have reached 1.0 inch in diameter at ground level could be considered a violation of the ESA. If restoration and development of a PSHA for the restoration are implemented, farmers who choose to sign on to the PSHA would be protected from restrictions relating to these remnant-dispersing elderberry shrubs as well as any elderberry shrubs directly related to the restoration sites.

The SRCAF GNP also states that "A Programmatic Safe Harbor Agreement, as opposed to an individual Safe Harbor Agreement, would have the SRCAF as the permit holder for covered activities within the Conservation Area, thereby allowing landowners to access the regulatory assurances without direct contact with agencies. The SRCAF would also function as an intermediary, assisting landowners who wish to sign on to the permit."

As discussed above under HCPs above, a USFWS Section 7 consultation would not be required to accompany the PSHA, as Section 7 applies to federal projects and a "federal nexus" does not apply to private agricultural practices. SRCAF is actively pursuing and negotiating a PSHA with USFWS and DFG, and would act as the agreement holder. A completed PSHA that may be used as a model for PSHAs within the Colusa Subreach is the recently approved (2006) Lower Mokelumne River Watershed PSHA (see Appendix J for entire document). This PSHA was initiated by farmers in San Joaquin County and is focused on valley elderberry longhorn beetles. The agreement holder, or program administrator, is the California Association of Resource Conservation Districts and USFWS is the service agency. This PSHA was one of the first PSHAs, in which farmers could enter into the agreement once the agreement had already been approved. It also extends assurances to landowners or neighbors who do not wish to participate in restoration. Like other SHAs, the Lower Mokelumne River Watershed PSHA allows incidental take to occur up to the point at which the take does not reduce the local populations of the covered species below some pre-determined baseline. The baseline in this PSHA is a map depicting individual biological units of blue elderberry shrubs in specific locations. SRCAF is investigating a different option for a PSHA within the Colusa Subreach in which the baseline account of blue elderberry shrubs would be based on the number of shrubs in any location within the covered area. This baseline based on a number of shrubs rather than mapped individual shrubs has a precedent in the USFWS-approved BO for DWR described in Section 3.3.4.

The main landowner concern about PSHAs in the Colusa Subreach is the apparent need to have agency or restoration proponent staff access private land of neighboring farms. Typically, a biologist from DFG or other organization (e.g., SRCAF staff or consultant) would conduct a survey on a participant's property in order to determine the baseline number of blue elderberry shrubs. This option, or scenario, is described in more detail below (Scenario 1). If landowners do not want their property to be surveyed, then surveys can be limited to the proposed restoration sites (Scenario 2). Yet another option would be to survey the property indirectly by means of detailed aerial photographs or maps (Scenario 3). Each landowner can sign on to a PSHA under Scenario 1, 2, 3, or not at all. Any of these 4 options can exist in the same regional PSHA. Several Sacramento River farmers have already expressed strong interest in PSHAs and view them in a positive way. These farmers have stated an interest in participating if/when the SRCAF agreement is approved by USFWS (Bev Anderson-Abbs, pers. comm. 2006).

SCENARIO 1 – SITE SURVEYS ON LANDOWNER PARTICIPANT LAND FOR BASELINE DETERMINATION

Initial surveys and follow-up monitoring by the restoration proponent would be required to document the number of blue elderberry shrubs present. If no 1.0-inch-diameter blue elderberry shrubs are present at the time of the initial survey, the landowner would receive complete freedom from ESA restrictions related to valley elderberry longhorn beetles on their property. If there are shrubs with 1.0 inch or greater diameter stems present, then the landowner remains responsible for the number of 1.0 inch diameter blue elderberry shrubs already on or within 100 feet of their property prior to the restoration and PSHA, but may take any additional shrubs that become established in the future with no recourse. Monitoring for up to three years, including overhead costs, would be paid for by SRCAF (Anderson-Abbs, pers. comm., 2007a).

SCENARIO 2 – SITE SURVEYS ONLY ON PROPOSED RESTORATION LAND FOR BASELINE DETERMINATION

This is essentially a PSHA "buffer zone." If neighboring farmers and landowners prefer that their property not be surveyed, surveys may be limited to the proposed restoration sites. The landowners would not receive protection from ESA regulations for blue elderberry shrubs on their property, but they would be freed from restrictions to activities within 100 feet of shrubs present in adjacent restoration sites.

SCENARIO 3 – AERIAL PHOTOGRAPH OR MAP SURVEYS FOR BASELINE DETERMINATION

This is essentially a combination of the benefits of legal protection described in Scenario 1 with the advantage of restricting access to landowner property described in Scenario 2. Instead of USFWS or restoration proponent staff accessing landowner property to determine baseline blue elderberry shrub surveys, property would be indirectly surveyed by means of detailed aerial photographs or maps (Anderson-Abbs, pers. comm., 2007b). The USFWS would still have a baseline level of blue elderberry shrubs and thus the landowner could take any additional shrubs that become established in the future with no recourse. The challenge with this scenario is ensuring the accuracy of the maps or photographs and the blue elderberry shrub identifications made on them.

Programmatic Safe Harbor Agreements are evaluated as a solution in Table 3-8.

Table 3-8
Evaluation of PSHAs under Various Scenarios as a Solution to Increased Regulatory Constraints in the Colusa Subreach

Evaluation Criteria	Score[1]	Rationale
Landowner assurances	= → +	Federal absolution of responsibility for take of any blue elderberry shrubs caused by the proposed restoration, unless landowners decide to use the PSHA "buffer zone" as described in scenario 2.
Ecological benefit	+	All of the proposed acreage would be restored to riparian habitat, and blue elderberry planting in the restoration acreage would not be limited.
Restoration proponent responsibility	=	Responsible for the PSHA preparation and negotiating during the USFWS approval process, along with surveying, monitoring, and reporting following PSHA approval.
Neighboring landowner responsibility	+	Land access is not required unless landowners desire the additional regulatory relief of Scenario 1.
Timeline to completion	-	More than two years for USFWS to approve PSHA due to process requirements for Federal Register announcements, public comment periods, etc.
Longevity	+	Parties to the initial negotiation may choose the duration of the agreement, often 30 years with options to renew.
Flexibility	+	Participation is voluntary, can be implemented in several ways, and landowners can choose to sign on at any time.
Logistical simplicity	=	PSHA approval process may be time consuming. In addition, there are initial surveys, follow-up monitoring, and reporting. No long-term habitat maintenance is required of any party.
Cost	=	Some non-profit and public agency groups can draft and negotiate PSHAs with staff time at minimal cost.

[1] Explanation of symbols used in evaluation tables:

+ : benefit to party listed in a particular criteria category or, if none listed, benefit is to the parties involved, with little to no detrimental effects

- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved

= : no net beneficial or detrimental effect on party listed in that particular criteria category

→ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented

Source: EDAW 2007

3.4 OVERALL EVALUATION OF POTENTIAL REGULATORY SOLUTIONS

This section includes, as Table 3-9, an evaluation and comparison of the potential regulatory solutions based on the nine criteria described in the introduction to this chapter, and summarizing results from the evaluation tables for each potential regulatory solution described in this chapter. The evaluations are based on knowledge of the ecology of valley elderberry longhorn beetles, the best available information from up-to-date regulations and local experts, and professional experience. They are most useful in making relative comparisons among the solution choices. A combination of solutions may also be beneficial, allowing different solutions to be applied at different sites. This combination approach may be advantageous because neighboring landowner preferences vary throughout the subreach, as do the crops grown and maintenance activities for which landowners seek regulatory protection.

3.5 REGULATORY SOLUTION CONCLUSIONS

No substantial increases in regulatory constraints from the valley elderberry longhorn beetle are anticipated following riparian habitat restoration due the relatively small amount of open canopy (e.g., savanna) habitat restoration that is proposed and the relatively small amount of riparian-agriculture border area that would be affected (see Sections 1.1.4 and 1.1.5). However, in recognition of stakeholder goals for greater assurances of their continued ability to perform agricultural activities without hindrance, several potential solutions to increase these assurances than and reduce or eliminate the potential for increased regulatory constraints were discussed.

Solutions to potential increased regulatory constraints include a combination of restoration design solutions that prevent protected elderberry shrubs from being planted or naturally colonizing land within 100 feet of farm activities, and agency policies and legal agreements that allow shrubs to be planted or colonize the area without constraining farm activities. Table 3-9 provides an evaluation and comparison of the regulatory constraint solutions in the Colusa Subreach.

Of the potential regulatory solutions considered, three appear to be the most promising solutions for the Colusa Subreach until/unless valley elderberry longhorn beetles are delisted and associated ESA restrictions are removed:

- maintained buffer zones,
- programmatic Safe Harbor Agreement (PSHA) as part of the SRCAF Good Neighbor Policy (GNP), and
- memoranda of Agreement/Memoranda of Understanding (MOA/MOU).

All three potential solutions offer high long-term landowner assurance for protection from increased restrictions related to the valley elderberry longhorn beetle, and flexibility for restoration proponents and neighboring landowners to collaborate in the decision-making process. In addition, a PSHA may reduce ESA constraints to farmers below the current level by offering protection from restrictions and responsibilities relating to new and existing blue elderberry shrubs in the Subreach, depending on the terms of the PSHA. The SRCAF GNP also includes recommendations for buffer zones and a PSHA, and offers a framework for public involvement in the decision-making process.

The most beneficial approach may be one that offers maximum flexibility to meet the needs of both neighboring landowners and restoration proponents by combining buffer zones, a PSHA, an MOA/MOU, and public outreach as recommended in the GNP. In this approach, landowners wishing to reduce their ESA constraints below the current level could choose to sign on to a PSHA under the various options, with Scenario 1 offering the highest level of protection (protection against constraints from elderberry shrubs on their own and neighboring restoration land), Scenario 2 offering protection against constraints related only to elderberry shrubs on neighboring restoration land (without any requirement for surveys on their own land), and Scenario 3 offering both (protection against constraints from shrubs on the landowner's land and neighboring restoration property without the need for on-site surveys). Landowners who do not wish to sign on to the PSHA would be under no obligation to do so.

Table 3-9
Evaluation and Comparison of Solutions to Increased Regulatory Constraints in the Colusa Subreach

Solution	Landowner Assurances[1]	Ecological Benefit[1]	Restoration Proponent Responsibility[1]	Neighboring Landowner Responsibility[1]	Timeline to Completion[1]	Longevity[1]	Flexibility[1]	Logistical Simplicity[1]	Cost[1]
Restoration Design Solutions									
Restoration Design: Habitat Type Configuration	- → +	=	+	+	+	-	-	+	+
Restoration Design: Planting Protocol	- → +	-	+	+	+	-	=	+	+
Restoration Design: Buffer Zones	+	- → +	- → =	= → +	+	+	+	+	= → +
Local Policy/Agreement Solutions									
Delisting of valley elderberry longhorn beetles	+	- → +	+	+	-	+	=	=	+
Good Neighbor Policy	- → +	**N/A**	-	+	+	=	+	- → +	- → +
Habitat Conservation Plan (HCP)	= → +	+	-	-	-	=	-	-	-
Memoranda of Agreement/Understanding (MOA/MOU)	= → +	+	-	+	=	+	+	=	=
Programmatic Safe Harbor Agreement (PSHA)	+	+	=	+	-	+	+	=	=

[1] Explanation of symbols used in evaluation tables:

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- : detrimental to party listed in a particular criteria category or, if none listed, detrimental to the parties involved

= : no net beneficial or detrimental effect on party listed in that particular criteria category

→ : range between the two values indicated, reflecting the fact that it depends on the context of the situation, such as site conditions or options implemented

Source: EDAW 2007

These landowners would have the option to instead sign an MOA/MOU which would not involve any federal agencies and in which the restoration proponents would "protect and release" their neighbors from responsibility for take of valley elderberry longhorn beetles, or they may choose to sign no agreement at all.

Restoration proponents could maintain 100-foot buffer zones on the restoration sites adjacent to properties of landowners who do not wish to sign a PSHA or MOA/MOU, to minimize potential that existing ESA constraints on these landowners would be increased by the restoration. On the other hand, for restoration sites adjacent to properties of landowners who do sign the PSHA, no buffer zones would be needed to reduce regulatory constraints. This would allow the additional ecological benefit of restoring the entire site to riparian habitat (if buffer zones are also not needed on those properties for pest control). If buffer zones are needed on a farm

property for pest control, the PSHA would enable greater flexibility in the buffer zone design and maintenance. Consideration of buffer zones for pest control is provided in Chapter 5, Pest Solutions.

3.6 REGULATORY SOLUTION RECOMMENDATIONS

Implementation of the following recommendations would help reduce potentially increased regulatory constraints to nearby or adjacent agricultural properties through appropriate riparian habitat restoration practices:

- continue to communicate regularly through collaborative public outreach;
- consider compatibility with potential regulatory (and pest) constraints to neighboring landowners when designing the configuration of riparian habitat types within proposed restoration sites, along with traditional restoration design considerations such as hydrology, soils, and target species;
- monitor future updates in laws and regulations applicable to land uses within the Colusa Subreach including but not limited to possible delisting of valley elderberry longhorn beetles from ESA restrictions; and
- engage in a combination of regulatory solutions that offers high landowner assurances, ecological benefit, longevity, and flexibility through the use of maintained buffer zones, a voluntary PSHA as part of the SRCAF Good Neighbor Policy, and an optional MOA/MOU.

4 AGRICULTURAL PEST EFFECTS AND CONVENTIONAL CONTROL MEASURES

This chapter is divided into three principal sections, focused on the Colusa Subreach:

- summary of existing crop damage conditions caused by various animal and fungal pest species; plant pests (weeds) are not discussed;
- analysis of each potential pest species, including:
    - habitat and ecology for each considered species;
    - analysis of expected changes to pest populations and damage to agricultural crops or operations as a result of riparian habitat restoration;
    - general information on conventional control measures; and
- conclusions and observations based on the results of the research.

This chapter focuses on pests that were identified as being of high and medium priority for study, as determined by the Advisory Workgroup and the External Experts Group, as described below. Due to scope limitations, low priority pests (Norway rat, ring-necked pheasant, mealy plum aphid, and leaf curl plum aphid) were not investigated. Due to the paucity of studies on the potential for riparian habitat restoration to influence pest species in agricultural habitats, some of the results and conclusions presented in this chapter are necessarily limited or speculative. However, sufficient information on species life histories and habitat requirements exists such that best professional judgments of the likely changes in pest effects can be made. The results and conclusions are based on the best available information as applied to the specific circumstances or conditions in the Colusa Subreach. Chapter 5 provides a discussion of solutions for substantive pest effects identified in this chapter.

4.1 PEST EFFECTS ON AGRICULTURE IN THE COLUSA SUBREACH

During the May 2006 Pest and Regulatory Effects study design meetings, the Advisory Workgroup and External Experts Group identified and prioritized key crops grown in the Colusa Subreach that should be considered in this study (Table 4-1). The crops are prioritized according to acreage, economic importance in the Subreach, location between or outside of the flood control levees, and proximity to the proposed restoration sites.

Table 4-1
Crops Grown in the Colusa Subreach: Priority for Analysis

High Priority	Medium Priority	Low Priority
Walnuts	Safflower	Rice (outside levee)
Prunes	Tomatoes	Cotton (outside levee; minimal acreage)
Almonds		Corn (outside levee)
Vine seeds		Rangeland for sheep (outside levee; minimal acreage)
Beans		Fallow
Alfalfa		
Winter wheat		

Source: Colusa Subreach Planning Advisory Workgroup, Pest and Regulatory Effects Study External Experts Group 2006

The Advisory Workgroup and External Experts Group also identified and prioritized the insect, bird, mammal, and fungal disease species of greatest concern to farmers in the Colusa Subreach.

A summary of potential pest effects on agriculture in the Colusa Subreach is included in Table 4-2, including pest species, priority level of concern in the Subreach, affected crops, and the mechanism for damage. Crop damage information was compiled by EDAW from several sources including the University of California Integrated Pest Management Program 2006, Salmon and Lickliter (1984), Advisory Workgroup and External Experts Group members at the May 2006 study design meeting, personal communications with several Colusa Subreach farmers, additional knowledgeable individuals, and the wildlife knowledge of EDAW staff.

Table 4-2
Potential Pest Effects on Agriculture in the Colusa Subreach

Pest	Affected Crop	Crop Priority[1]	Potential Damage Mechanism/Notes
Pest Species identified as being High Priority for Study			
California ground squirrel (*Spermophilus beecheyi*)	almond, prune, walnut, vine seed, tomato, beans, row crops	All	Row crops such as beans are taken at the seedling stage. Burrows weaken the ground above, making mowing and other mechanical maintenance activities more difficult. Burrows also weaken levees, leading to possible levee failure. Ground squirrels gnaw on tree roots and plastic irrigation infrastructure.
California vole (*Microtus californicus*)	almond, prune, walnut, vine seed, tomato, row crops	All	Feed on row crop seedlings, rangeland forage, tree roots, and bark. They girdle and kill trees by gnawing completely around the trunk or roots, disrupting nutrient and water flow. Trees not killed by girdling may exhibit reduced vigor and decreased yields.
Botta's pocket gopher (*Thomomys bottae*)	Row crops, tomato, vine seed, roots of small orchard trees	All	Burrows weaken the ground above, making mowing and other mechanical maintenance activities more difficult. Gophers also consume row crop roots and gnaw on plastic irrigation infrastructure. Extensive chewing on tree roots can kill young trees directly, or secondarily by making them susceptible to root rot.
Mule deer (*Odocoileus hemionus*)	Orchard fruits and trees, tomato, beans, vine seeds, row crops	All	Feed on row crops, orchard fruits, and tree twigs, buds, and bark. Males may also damage tree trunks and limbs when rubbing their antlers against the bark.
Walnut blight (*Xanthomonas campestris* pv. *juglandis*)	walnut	High	Bacterial disease causes lesions on nuts, catkins, shoots, and leaves.
Root and crown rot (*Phytophthora* spp.)	walnut, prune, almond, tomato	High, Medium	In orchard crops, this fungal disease causes reduction in tree growth, early leaf fall, and may kill trees between one season and several years following infection. In tomato, the fungus causes lesions on roots, which may girdle or rot off in severe cases. Infected tomato plants are slow growing and may wilt or die in hot weather. Tomato fruit in contact with the ground may also become infected.
Brown rot (*Monilinia* spp.)	prune, almond	High	Fungal disease causes destruction of flowers, leaf collapse, girdling of twigs, and fruit rot.

Table 4-2
Potential Pest Effects on Agriculture in the Colusa Subreach

Pest	Affected Crop	Crop Priority[1]	Potential Damage Mechanism/Notes
Walnut husk fly (*Rhagoletis completa*)	walnut	High	Larvae feed inside the husk, staining the shell and increasing the nut's susceptibility to mold growth.
Fruit-tree leafroller (*Archips argyrospila*)	prune, almond	High	Feeds on leaves, buds, fruits, and developing nuts. In prunes, may increase fruit susceptibility to brown rot infection. In almonds, the number of nuts attacked is usually small and rarely requires control measures.
Oblique-banded leafroller (*Choristoneura rosaceana*)	prune, almond	High	Larvae feed on developing nuts and fruits but generally cause limited damage. In prunes, economic damage is usually limited to fresh market prunes rather than prunes grown for the dried market. Larval damage may, however, increase fruit susceptibility to brown rot infection. In almonds, treatment is not usually needed for this pest unless populations are high.
Omnivorous leafroller (*Platynota stultana*)	cotton	Low	Larvae feed on leaves, small buds, and the surface of green seed cases, which may then open prematurely. However, injury caused by this species is sporadic, localized, and rarely of economic importance.
Peach twig borer (*Anarsia lineatella*)	prune, almond	High	Larvae feed on growing shoots, fruits, and nuts; increase fruit susceptibility to brown rot infection; and increase nut susceptibility to navel orangeworm infestation.
Lygus bug (*Lygus hesperus*)	tomato, cotton, beans	All	In beans, feeding causes bud and flower loss, resulting in reduced yields. Lygus bug also feeds on young, developing beans, causing pitting and blemishes on table market beans and reducing germination in seed beans. In tomato, lygus bug feeds on fruit, causing the feeding site to dry out and the fruit skin to crack. In cotton, lygus bug reduces yields by feeding on shoots and reproductive structures, reducing fertilization and causing buds to shrivel and drop from the plant; and by halting branch growth, seed development and lint maturation.
Codling moth (*Cydia pomonella*)	walnut, prune	High	The codling moth is a serious insect pest of primarily deciduous fruits (e.g., apples, pears, plums) and is highly adaptable to a variety of climates worldwide. Larvae feed on nuts and fruits, and increase nut susceptibility to navel orangeworm infestation. Feeding is more common on walnuts than prunes.
Navel orangeworm (*Amyelois transitella*)	walnut, almond	High	Like codling moth, this pest infests orchard tree nuts at the larval stage. It feeds on nuts and increases nut susceptibility to fungal infestation.
Pest Species identified as being Medium Priority for Study			
Black-tailed jackrabbit (*Lepus californicus*)	almond, blackberry, raspberry, tomato, beans	All	Feeds on a variety of row crops, rangeland forage, buds and twigs of sapling trees and, rarely, tree bark. Jackrabbits also girdle small trees, although rarely. Unlike pygmy rabbit and many European rabbits, jackrabbits do not dig burrows and usually take shelter under shrubs.

Table 4-2
Potential Pest Effects on Agriculture in the Colusa Subreach

Pest	Affected Crop	Crop Priority[1]	Potential Damage Mechanism/Notes
Audubon's cottontail (*Sylvilagus audubonii*)	almond, blackberry, raspberry, tomato, beans	All	Feeds on a variety of row crops, rangeland forage, buds and twigs of sapling trees and, rarely, tree bark. Cottontails also girdle small trees, although rarely. Although they may take shelter in burrows dug by other animals, cottontails do not dig their own burrows.
Western gray squirrel (*Sciurus griseus*)	walnut, almond, prune	High	Feeds on green and ripe nuts and fruits; strip bark and feed on tree cambium.
American beaver (*Castor canadensis*)	walnut, prune, almond, winter wheat, tomato, vineseed, safflower, beans	High Medium	Feeds on tree trunks and fells small trees; rarely feeds in orchards (Miller and Yarrow 1994). Burrows in levees may lead to levee failure. May cause problems with irrigation systems if they build dams or lodges in irrigation canals.
Northern river otter (*Lontra canadensis*)	none	none	Although they often take shelter in beaver lodges and burrows dug by other animals, river otters do not dig their own burrows or build their own lodges, and thus are not a direct cause of damage.
Common muskrat (*Ondatra zibethicus*)	rice, walnut, prune, almond, winter wheat, tomato, vineseed, safflower, beans	All	Burrowing causes damage to rice infrastructure, water impoundments, and irrigation canals.
Brewer's blackbird (*Euphagus cyanocephalus*)	alfalfa, fruit crops, tomato, corn	All	Insects (including pest species) are the primary food source. However, blackbirds also consume vegetables, nuts, fruits, and grains.
American crow (*Corvus brachyrhynchos*)	wheat, corn	High, medium	Feeds on fruits, nuts, vegetable crops, and grains. Also feeds on insects, birds, and small mammals, including pest species.
European starling (*Sturnus vulgaris*)	alfalfa, winter wheat, tomato, rice, sprouting seeds	All	Insects (including pest species) are the primary food source. However, starlings also consume vegetables, nuts, fruits, and grains.
Coyote (*Canis latrans*)	rangeland	Low	Digs dens for shelter which may damage crops and pose a hazard to farm machinery. However, coyote principally preys on many small mammal species that are considered agricultural pests.
Pest Species identified as being of Low Priority for Study			
Leaf curl plum aphid (*Brachycaudus helichrysi*)	prune	High	Adults feed on leaves and cause leaves to curl. When aphid populations are high, tree growth, fruit size, and fruit sugar content may be reduced.
Mealy plum aphid (*Hyalopterus pruni*)	prune	High	Adults feed on leaves and cause leaves to curl. When aphid populations are high, tree growth, fruit size, and fruit sugar content may be reduced.

Table 4-2
Potential Pest Effects on Agriculture in the Colusa Subreach

Pest	Affected Crop	Crop Priority[1]	Potential Damage Mechanism/Notes
Norway rat (*Rattus norvegicus*)	almond, walnut, prune, alfalfa, winter wheat, rice	High, low	Feeds on fruits, nuts, vegetable crops, and grains; gnaws on tree limbs. Norway rats also dig small burrows, but these rarely cause noticeable damage. Also feeds on insects. Rats do not typically cause major economic damage except in years of unusually high populations.
Black rat (*Rattus rattus*)	almond, walnut, prune, alfalfa, winter wheat, rice	High, low	Feeds on fruits, nuts, vegetable crops, and grains; gnaws on tree limbs. Black rats, also called roof rats, typically nest above ground and rarely dig burrows; they are primarily a tree-dwelling species. Also feeds on insects. Rats do not typically cause major economic damage except in years of unusually high populations/cyclic population booms.
Ring-necked pheasant (*Phasianus colchicus*)	winter wheat, safflower	High, medium	Feeds on waste grain, seedlings, and insects, including pest species.

[1] Crops in the Colusa Subreach were prioritized into categories composed of high, medium, and low crops based on their importance in the Subreach, which is detailed above in Table 4-1. A label of "All" indicates that crops of all priority levels are affected.

Sources: University of California Integrated Pest Management Program 2006, Salmon et al. 1987, Colusa Subreach Planning Advisory Workgroup, Pest and Regulatory Effects Study External Experts Group, Colusa Subreach farmers, EDAW staff. Data compiled by EDAW in 2006–2007.

4.2 POTENTIAL PEST EFFECT CHANGES FROM RIPARIAN HABITAT RESTORATION, AND CONVENTIONAL CONTROL MEASURES

This section includes an analysis of potential changes to the agricultural pest effects as a result of riparian habitat restoration. It is based on pest species habitat and ecology and the potential for pest populations to be affected by habitat restoration. Section 4.2.1 includes analyses of mainly high priority pest species for which transboundary issues have been studied. Section 4.2.2 includes analyses of mainly medium priority pest species for which this issue has not been specifically studied. Both sections include descriptions of the pest species habitat and ecology, the potential for restoration to affect pest populations, and general information on conventional control measures. Where applicable, a description of alternative hosts for certain insect pests is also provided and a summary of this is included in Table 4-3. Table 4-4 includes an analysis of the potential for riparian habitat restoration to affect high and medium priority pest populations and pest effects to crops and agricultural operations. The following is a summary of effects determined in this section.

With only 7 percent of the Subreach proposed for riparian habitat restoration, the anticipated change in pest populations and pest effects is unlikely to be substantial. Overall, there may be a decrease in pest effects. For the most part, riparian habitat does not support agricultural pests evaluated in this study, as discussed in this section. Pest effects that do occur, however, could shift to new farmlands that adjoin a few of the restoration sites. However, all of those farmlands already are bounded by at least some riparian habitat, and in some cases, they are substantially surrounded by riparian habitat. Only 11% of the perimeters of the eight restoration tracts are directly adjacent to cropland (Table 1.4, Exhibits 1-3 to 1-8). Of six cropland properties that adjoin proposed restoration areas, 60% of the perimeter of these cropland areas is directly adjacent to existing riparian habitat. Following restoration, the percentage would increase to 84%. Each of these adjacent cropland areas already is subjected to riparian habitat influences to a substantial degree. As a result, it is expected that the proposed restoration will not introduce completely new influences on the existing cropland (Exhibit 1-9).

Five pests (walnut husk fly; fruit-tree, oblique-banded, and omnivorous leafrollers; and lygus bug) are known to have host plants in riparian areas. Three other pests (coddling moth, navel orangeworm, and peach tree borer) may have host plants in riparian areas, but this is uncertain. It is generally unknown the extent to which riparian host plants may serve as sources for infestations of these pests to neighboring crops in comparison to crops that are replaced.

In general, the proposed restoration is unlikely to support pest populations at a higher rate than the existing agricultural habitat since the existing uses of the proposed restoration area is in active or fallow agricultural uses, including crops and orchards. The potential for crops to support pests depends, of course, on the crop planted. However, when agricultural areas are planted with a potential host (e.g., walnut orchards), there is a high density of host trees for walnut husk fly and other pests. In comparison, if host plant species exist within a riparian habitat, they are at a low density and mixed in with numerous non-host native plant species that do not provide habitat for agricultural pests. In addition, there may be predator-prey relationships that serve to control pests in a multi-species riparian community in comparison to a single crop environment.

In general, insufficient information is available to make a clear determination of the extent to which pests will use riparian areas and infest adjacent agricultural crops, including comparisons between riparian habitat and farmland as sources for infestations to other agricultural land. More research on pests in riparian habitats and adjacent farmland would be helpful to get a clearer understanding of the issues and to determine effective ways to resolve them.

4.2.1 ANALYSIS OF PEST SPECIES WITH EMPIRICAL EVIDENCE FROM RESTORATION STUDIES

For five of the pest species listed in Section 4.1 - California ground squirrel, Botta's pocket gopher, California vole, codling moth, and navel orangeworm - scientific studies have been conducted to compare pest abundance between riparian and agricultural habitats, and pest abundance and/or crop damage between farms near riparian habitat and farms surrounded by other farms. In this section, the potential for restoration to affect pest species populations was analyzed based on two factors: 1) the studies' indications of the pest species uses of riparian communities of various ages, and factors influencing the species' home and dispersal ranges (i.e., distances that different pest species may travel from their homes [i.e., nests, burrows, dens, etc.] to forage or to begin a new colony), and 2) the attractiveness of existing habitat compared to the attractiveness of the proposed riparian habitat. Effects of restoration on these species' populations are discussed below, along with their conventional control measures.

CALIFORNIA GROUND SQUIRREL

Habitat and Ecology

The California ground squirrel is a burrowing rodent with a primarily herbivorous diet. It generally prefers open space (e.g., grasslands, fallow fields), but is highly adaptable to disturbed environments and will infest earthen dams, levees, irrigation ditch banks, railroad rights-of-way, and road embankments, and will readily burrow beneath buildings in rural areas (Hygnstrom et al. 1994). Ground squirrels tend to avoid moderate to heavily forested areas or habitat with dense brush (Salmon and Gorenzel 2002). Preferred habitat tends to be near physical structures such as stumps, rocks, or fence posts (Loredo-Prendeville et al. 1994). When ground squirrels are observed in riparian habitats, such as along the American River Parkway in Sacramento (Talley et al. 2006), they are usually seen along the edges of the riparian forest adjacent to open or disturbed fields. California ground squirrels are not likely to use restored riparian habitats, but they may colonize restoration sites during the establishment phase following initial planting when the habitat is open and tree and shrub plantings are small.

Ground squirrels live in a burrow system where they rest, rear young, store food, and avoid danger. Their burrows may be 5 to over 30 feet long and 2 to 4 feet deep. Ground squirrels are highly social and live in colonies with up

to several dozen individuals in a complex of burrows. More than one squirrel may live in a burrow (Salmon and Gorenzel 2002). In California, colonies of these rodents can achieve population densities from about 3 to 37 adults per acre (Rulofson et al. 1993). Home ranges usually are less than a 450 ft radius around burrows. In California, home ranges of males averaged 0.3 acres and females averaged 0.5 acres (Evans and Holdenreid 1943).

Ground squirrels are diurnal (i.e., active during the day), mainly from mid-morning through late afternoon. Ground squirrels have two periods of dormancy during the year. During winter months most ground squirrels hibernate, but some young may be active at this time. During the hottest times of the year most adults go into a period of inactivity called estivation that may last a few days to a week or more (Salmon and Gorenzel 2002).

Ground squirrels breed once a year, averaging seven to eight per litter (Salmon and Gorenzel 2002). California ground squirrels in the northern Central Valley typically disperse between July and September and will fully colonize a new area within 4 months of initial immigration (Stroud 1982). Most often the individuals dispersing to new areas are juveniles less than one year old. The dispersal distance of ground squirrels can be highly variable due to many biological and environmental factors. However, ground squirrels have been found to typically disperse at distances of 200–300 meters (Evans and Holdenried 1943, Fitch 1948, Stroud 1982).

Potential to be Affected by Riparian Habitat Restoration

It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable ground squirrel habitat. The effect of riparian habitat restoration on California ground squirrel populations depends on many factors, including current population levels in the immediate area and the habitat type or crop type on land adjacent to the area being restored. In a study in the Colusa Subreach where riparian forest habitat was being restored, California ground squirrels were significantly more abundant in agricultural sites than in riparian forest sites (Golet et al. *in press-b*). In the same study, the squirrels were only common at agricultural sites. This indicates that riparian habitat restoration would not lead to increased California ground squirrel populations on restored riparian forest land. However, the conversion of a squirrel-infested orchard to riparian habitat may at least temporarily displace the disrupted population to surrounding farms if those farms have the ground squirrel's preferred habitat (Thomas pers. comm., 2007).

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, California ground squirrel populations are not likely to substantially increase with restoration activity. Ground squirrels may be attracted to riparian habitat in the initial establishment stage (0–4 years) which is similar to their preferred habitats of open or disturbed fields. However, agricultural fields can provide suitable open ground habitat and forage for ground squirrels as well. Mature riparian forest habitat with a closed canopy does not provide suitable habitat. Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable ground squirrel habitat. This is because only 7 % of Subreach land is proposed for restoration. Though a relatively small amount, the restoration would be mostly closed canopy types that, when mature, would result in a net reduction in ground squirrel habitat. Also, both restored open canopy riparian types and existing agricultural sites provide suitable habitat for ground squirrels, thus riparian open canopy habitat restoration would not be expected to result in a sizable difference in potentially suitable habitat for the ground squirrel compared to the existing farmland condition. Additional research is needed, however, to better determine usage patterns and the abundance of California ground squirrel in different Sacramento River habitat types.

Conventional Control Measures

Control of California ground squirrels can be complicated; the selection of control procedures depends heavily on the unique life cycle and behavior of the ground squirrel (Salmon and Gorenzel 2002). The most effective control measure typically involves eradication of an existing population (i.e., density-reduction program) followed by destruction of burrows to prevent rapid recolonization by adjacent populations (Thomas pers. comm. 2007).

Resident ground squirrel populations may be effectively eliminated by trapping, especially if the infestation is small (Pehling 2006). Ground squirrels depend on burrows for shelter and do not dig new burrows quickly. Thus, destruction of burrows following a density-reduction program might slow reinvasion by squirrels from adjacent areas (Loredo-Prendeville et al. 1994). Exclusion, such as fencing, and aversion measures are usually not effective in preventing recolonization of a field (Pehling 2006). Habitat manipulation is not likely to be effective. In one study, experimental planting of tall vegetation did not reduce habitat suitability (Fitzgerald and Marsh 1986). For areas where squirrels are common, an ongoing control program is necessary because ground squirrels will reinvade over time. Once ground squirrels have been controlled, the area should be periodically monitored for reinfestation by checking for new burrows.

BOTTA'S POCKET GOPHER

Habitat and Ecology

Botta's pocket gopher is a small, herbivorous, burrowing rodent that spends the majority of its life underground. It prefers disturbed habitats where forbs and grasses are abundant (Barnes 1973). These features can be found in a variety of habitats such as grasslands, agricultural fields, irrigation ditches, and young/open woodlands. Pocket gophers are also found in a wide variety of soil types and conditions. They are most abundant on friable, light-textured soils with dense, tall vegetation, especially when that vegetation has large, fleshy roots, bulbs, tubers, or other underground storage structures (Case and Jasch 1994). Shallow soils may be subject to cave-ins and thus will not maintain a tunnel. Tunnels are deeper in very sandy soils where soil moisture is sufficient to maintain the integrity of the burrow. Pocket gophers also require habitat that allows atmospheric and exhaled gases to diffuse through the soil to and from the tunnel. Thus light-textured, porous soils with good drainage allow for good gas exchange between the tunnel and the atmosphere. Soils that have high clay content or those that are continuously wet diffuse gases poorly and are unsuitable (Case and Jasch 1994). The pocket gopher prefers to use riparian habitat that includes young (0–4 yrs) restoration sites.

Pocket gophers are solitary, nocturnal, and live in a burrow system that can cover an area of 200 to 2,000 ft² (Case and Jasch 1994). Burrow systems consist of a main burrow, generally 4 to 18 inches below and parallel to the ground surface, with a variable number of lateral burrows off the main one. These end at the surface with a soil mound or a soil plug. There are also deeper branches off the main burrow that are used as nests and food caches. The maximum depth of at least some portion of a burrow may be as great as 5 or 6 feet. The diameter of a burrow is about 3 inches but varies with the body size of the gopher. Burrow systems may be linear or highly branched. The more linear systems may be those of reproductive males, since this shape would increase the likelihood of encountering a female's burrow. Pocket gopher burrows can be very dynamic, with portions constantly being sealed off and new areas excavated. The poorer the habitat, the larger the burrow system required to provide enough forage (Case and Jasch 1994).

Territories and home ranges of Botta's pocket gophers coincide. In California, home ranges of males averaged 2,700 ft², and varied from 900–4,800 ft². Those of females averaged 1,300 ft², and varied from 250–2,600 ft² (Howard and Childs 1959). Densities for various pocket gopher populations are highly variable. Densities of 16 to 20/acre are very common, but get as high as densities up to 62/acre (Case and Jasch 1994). Pocket gophers are known to have a low dispersal rate which may account for high speciation among different regions (Case and Jasch 1994).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, Botta's pocket gopher populations are not likely to substantially increase with restoration activity. Pocket gophers may be attracted to riparian habitat in which young stages (0–4 years) may provide pocket gophers with their preferred forage (e.g., grasses and forbs). Botta's pocket gopher is likely to decrease in population as riparian forest restoration sites mature, a pattern observed in a Colusa Subreach small mammal study (Golet et al. *in press-b*).

Pocket gophers were uncommon at older (12–15 yrs) forest restoration sites and in remnant habitats. A related study (Converse et al. 2006) looked at small mammal densities in relation to forest fuel reductions and found that the highest biomass of rodents was found following clearing. Uncleared mature forest had significantly fewer small mammals (Converse et al. 2006). This study found results similar to those by Golet et al. (*in press-b*). However, agricultural fields can provide forage for pocket gophers as well.

Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable pocket gopher habitat. This is because only 7 % of Subreach land is proposed for restoration. Though a relatively small amount, the restoration would be mostly closed canopy types that, when mature, would result in a net reduction in habitat for this species. Also, since agricultural habitat appears to be preferred over native open canopy riparian habitat, the Botta's pocket gopher population is likely to decline in the Subreach in both the short and long term.

Conventional Control Measures

Conventional control of Botta's pocket gophers is most effective when it involves some form of trapping or toxic baiting (Pehling 2006). Hand-baiting pocket gopher burrows with grains containing 0.5% strychnine is one typical method of controlling pocket gophers. The most effective method of hand–baiting is to dose each burrow system in two or three different places. Pocket gophers may be controlled any time of the year but it is most successful when new mounds are appearing, usually in the spring and fall seasons (Pehling 2006). The use of smoke bombs is only successful if the soil is saturated with water or consists of dense clay (Pehling 2006).

CALIFORNIA VOLE

Habitat and Ecology

The California vole is a small, herbivorous rodent that is associated with wetland, meadow, and annual grassland/open field habitats (Salmon and Gorenzel 2002). Voles may occupy a wide variety of habitats. They prefer areas with heavy ground cover of grasses, grass-like plants, or litter (O'Brien 1994). Though voles evolved in "natural" habitats, they also use habitats modified by humans, such as orchards, windbreaks, and cultivated fields, especially when vole populations are high (O'Brien 1994). Voles are found in both wet and well-drained areas, and tend to use young riparian forest habitat (0–4 years) and disturbed riparian areas (Golet et al. *in press-b*).

Most of the California vole's activities take place below ground in their burrow system. The clearest signs of voles are above ground runways that connect burrow openings. Runways lead to multiple burrow openings that are each about 1-1/2 to 2 inches in diameter, and the burrows tend to be short and shallow. Voles will leave fresh clippings of green grass and greenish-colored droppings about 3/16 in. long in the runways and near the burrows. Voles are active during the day and at night, throughout the year (Salmon and Gorenzel 2002).

Several adults and young may occupy a burrow system. Home-range size varies with habitat quality, food supply, and population levels, but in most cases it is no more than a few hundred square feet. California populations tend to range from about 2 to 7 voles/acre (Hygnstrom et al. 1994), although much higher population densities have been observed at some Sacramento River sites (Golet, pers. comm., 2007). Voles may breed throughout the year, but most commonly in spring and summer. In the field, they have 1 to 5 litters per year (O'Brien 1994). Vole numbers fluctuate from year to year, and under favorable conditions their populations can increase rapidly. In some areas their numbers are cyclical, reaching peak numbers every 3 to 6 years before dropping back to low levels (Salmon and Gorenzel 2002). In a study on voles in California, juvenile males dispersed gradually between 3 and 13 weeks of age (half before 9 weeks), with some leaving after reaching sexual maturity; a few remained at or near home. Of juvenile females, 47% remained at or near home with the rest disappearing before 9 weeks of age (Salvioni and Lidicker 1995). Lidicker and Anderson (1962) found that voles fully colonized a 47-ac island in

California during the first growing season and fully exploited it by the second season. This means that voles dispersed into more favorable areas before they fully exploited the initially inhabited areas.

Potential to be Affected by Riparian Habitat Restoration

It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable vole habitat. A recent study in the Colusa Subreach of small mammal abundance in response to riparian habitat restoration (Golet et al. *in press-b*) showed that California voles were most abundant at young riparian forest restoration sites (3–4 yrs.) where thick thatch layers were often present. The number of voles in older restored riparian forest sites (12–15 yrs.) and remnant stands were below those in agricultural sites. As forest restoration sites matured (≥ 12 years) vole abundance declined. California voles most likely prefer young riparian forest restoration sites as habitat because it has a high proportion of dense, herbaceous vegetation which can serve as a source of food and as cover from predators. Long-term population changes for the vole will depend on the target riparian community. In open savanna or moderately open woodland, the populations may persist if there is a mixture of shrubs, grasses, and forbs. A dense forest with a closed canopy would, however, be unlikely to provide long term habitat for the vole. Any possible short-term increase in vole populations in newly restored riparian sites is not expected to be substantial in the Subreach. This is because agricultural fields, such as openings between rows of orchard trees or mowed alfalfa fields, can provide forage for voles as well. Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable vole habitat. Only 7 % of Subreach land is proposed for restoration. and restored areas will mostly be composed of closed canopy forest habitats that, when mature, would result in a net reduction in vole habitat. Also, because both restored open canopy riparian types and existing agricultural sites provide suitable habitat for voles, riparian open canopy habitat restoration would not be expected to result in a sizable difference in vole habitat compared to the existing farmland condition. Nonetheless, there may be localized problem areas next to young restoration sites that merit attention.

Conventional Control Measures

Habitat manipulation is known to be an effective method of controlling California voles. When thatch, litter, and dense vegetation is regularly mowed, sprayed with herbicides, grazed, or tilled along ditch banks, right-of-ways, or field edges adjacent to agricultural lands, the number of voles will decline (Salmon and Gorenzel 2002). Most important is the control of ground vegetation immediately around trees. A 4-ft radius around the tree should be kept bare to eliminate cover for the animals (Pehling 2006). Trapping is likely to be sufficient only for very small populations of voles. A more preventative measure to keep vole populations from exploding is to encourage the use of the habitats by natural predators such as owls and hawks (Pehling 2006).

Use of toxicants is another method typically used to control vole populations. Zinc phosphide is the most commonly used toxicant for vole control. The toxicant may be placed by hand in runways and burrow openings. Anticoagulant baits are also effective in controlling voles. Anticoagulants are slow-acting and require 5 to 15 days to take effect. Multiple feedings are needed for most anticoagulants to be effective. In addition to hand placement, anticoagulant baits can be placed in various types of bait containers (Byers and Merson 1982, Radvanyi 1980). Bait containers protect bait from moisture and reduce the likelihood of non-target animals and small children consuming bait (Hygnstrom et al. 1994).

CODLING MOTH

Habitat and Ecology

Codling moths overwinter as full-grown diapausing (i.e., dormant) larvae within thick, silken cocoons under loose scales of bark and in soil or debris around the base of the tree. Larvae can remain in diapause (i.e., dormancy) for up to two years (Yothers and Carlson 1941). Adults emerge during leaf-out and then give rise to up to four generations before the next overwintering period (Ramos 1985).

Codling moth adults are dependent on the presence of suitable hosts for survival. This, coupled with their limited dispersal capabilities—the flight range of an adult generally does not exceed 165 feet from its orchard of origin (Audemard 1991)—can create very localized populations (Solomon 1991). However, a few individuals have been observed to disperse over larger distances, possibly to escape unfavorable environmental and climatic conditions (Audemard 1991). Indeed, in New Zealand, immigration of adults from infestation sites outside orchards is believed to be a major factor influencing codling moth population dynamics (Wearing 1979). Migrations from fruitless to fruit-producing orchards and from walnuts to apples have also been observed.

Ecologically, codling moth population dynamics follow a "k-selection strategy," meaning that while the species can be a major pest in cultivation, biotic and abiotic controls in natural habitats tend to keep populations at or near carrying capacity (Barnes 1991). For example, in populations that are not controlled by human intervention (i.e., systems where no pest control measures are in place), codling moth numbers are generally regulated by larval competition for fruit and cocoon sites (Audemard 1991), and survival to pupation is determined by larval dependence on host-regulated availability of shelter for overwintering (cracks and crevices in bark, soil debris, etc.) (Geier 1964).

Potential Alternative Hosts

Codling moth is a serious pest of apples, pears, plums, and English walnuts. Northern California black walnut (*Juglans californica* var. *hindsii*), a species which has hybridized with other walnuts and whose hybrids are now commonly found in California riparian forests, may also serve as a host for codling moth. A discussion of Northern California black walnut and hybrids is provided in the section below. The pest is also known to infest black walnut plantations in the Midwestern United States (Katovich 2004). Table 4-3 includes a summary of alternative hosts for pests analyzed in this study.

Table 4-3
Host Plant Associations of Pest Insects in the Study Area

Pest Name	Crop Hosts	Potential Alternate Riparian Hosts*	Riparian Host Preference
Codling moth (*Cydia pomonella*)	Apple, pear, plum, and English walnut	California black walnut hybrids (*Juglans* hybrids)	Riparian host preferred less than crop host
Navel orangeworm (*Amyelois transitella*)	Almond, fig, pomegranate, pistachio, and walnut	California black walnut hybrids (*Juglans* hybrids); *Acacia,* citrus, and *Yucca*	Preference level unknown
Walnut husk fly (*Rhagoletis completa*)	Walnut	California black walnut hybrids (*Juglans* hybrids)	Alternate host known and likely to be used when available
Peach twig borer (*Anarsia lineatella*)	Peach, nectarine, apricot, almond, cherry, prune, plum, and apple	Specific to crops in family Rosaceae, no other known natural hosts	Preference level unknown
Fruit-tree leafroller (*Archips argyrospila*)	Apple, alfalfa, apricot, blackberry, cherry, currant, gooseberry, loganberry, onion, pear, plum, prune, quince, raspberry, and English walnut	Affects many crops; alternate hosts include ash, blackberry, box elder, elm, locust, oak, poplar, rose, black walnut, and willow.	Alternate host known and likely to be used when available
Oblique-banded leafroller (*Choristoneura rosaceana*)	Apple, apricot, beans, blackberry, carnation, celery, cherry, hazelnut, loganberry, peach, pear, plum, prune, horseradish, raspberry, rose, strawberry, and sunflower	Affects many crops; alternate hosts include ash, basswood, birch, box elder, burdock, clover, dogwood, honeysuckle, horsechestnut, knotweed, lilac, maple, oak, poplar, ragweed, rose, smartweed, sumac, thistle, verbena.	Alternate host known and likely to be used when available
Omnivorous leafroller (*Platynota stultana)*	Citrus, peach, plum, cotton, bell pepper, and pomegranate	Affects many crops; has a wide host range including numerous weeds and ornamentals.	Alternate host known and likely to be used when available
Lygus bug (*Lygus hesperus*)	Beans, alfalfa, tomato, safflower, and many other field and truck crops	Affects many crops, including all kinds of flowers, grasses, fruits, and weeds; also coyote brush and many other Southwestern shrubs.	Alternate host known and likely to be used when available

Source: UC IPM 2007; Carolyn Pickel, pers. comm., 2007.

Northern California Black Walnut and Hybrids

Black walnut hybrid trees have dispersed from orchard rootstock and colonized and invaded riparian forests along Sacramento Valley streams and rivers. They are increasingly seen as a threat to the native riparian ecosystem, and are known to degrade native plant communities and wildlife habitat quality. On the other hand, northern California black walnut (*Juglans californica* var. *hindsii*), the native non-hybridized variety, is considered to be rare and may be located in only a few remaining genetically pure populations. It is thus protected as a California Native Plant Society (CNPS) List 1B (limited distribution in California and elsewhere) species.

Only two native populations of *Juglans californica* var. *hindsii* are confirmed still in existence (in Napa and Contra Costa counties), but the species has become widely naturalized in riparian areas throughout the Central Valley (Kirk 2003, CNPS 2001). Before 1850, black walnut was reported only from along the Sacramento River near Walnut Grove, Wooden Valley in Napa County, and in the Moraga area of Walnut Creek (Kirk 2003). In the 1860s settlers introduced Eastern black walnut and English walnut and began grafting these species onto the rootstocks of Northern California black walnuts by 1900. Hybrid species of *Juglans californica* var. *hindsii* are hardier than the native stock and genetic research suggests that naturalized populations of *J.c.* var. *hindsii* have a hybridized heritage and are not genetically pure *J.c.* var. *hindsii* (Kirk 2003). *J.c.* var. *hindsii* does not typically form branches less than 9 feet above ground level (CNPS 1978).

It is important to note that black walnut is not a part of native plant communities that are proposed for restoration sites in the Colusa Subreach. Moreover, black walnut has not been included in any restoration planting along the Sacramento River.

Potential to be Affected by Riparian Habitat Restoration

Codling moth is unlikely to increase as a result of proposed riparian habitat restoration and natural habitats adjacent to orchards may serve to control codling moth populations. California black walnut hybrids (*Juglans* hybrids), commonly found in California riparian forests, may serve as a host for codling moth. Codling moth has been known to infest black walnut plantations in the midwestern United States (Katovich 2004). However, in a study investigating relationships between codling moth infestation and adjacent land use in California's Central Valley, Langridge (2007) found no significant differences between codling moth population numbers in walnut orchards adjacent to the following habitat types: a) mature remnant riparian forest habitat, b) restored riparian forest habitat, and c) non-forest habitats. Langridge also found no significant distance effects, suggesting that proximity to riparian habitats did not increase the risk of codling moth infestation in orchards. UC IPM Codling Moth Management Guidelines underscore these findings by suggesting that highly-infested orchards or backyard trees with no codling moth control program are more important sources of codling moths to adjacent orchards than are natural habitats. In addition, 55% of the Colusa Subreach is currently existing riparian habitat. With only 7 % of Subreach land being restored to riparian habitat and no black walnut planted as part of restoration plans, there is unlikely to be a substantial change in native habitat for codling moth in the Subreach,

Natural habitats adjacent to orchards may also serve as a source of natural enemies to control codling moth populations. In California, carabid beetles are an important predator of codling moth larvae that fall to the ground (Essig 1958). In a laboratory study, Riddick and Mills (1994) found that 75% of the carabid beetle species they investigated were capable of devouring codling moth larvae. Dermestid beetles also devour pupae in cocoons (Essig 1958). Riparian habitats are known to support a high density and diversity of carobid beetles due to their structural complexity and high percent cover of ground litter (Magagula 2003, Hunt 2004, Tews et al. 2004). Moreover, a study in Oklahoma found that ground beetle species richness, evenness, and diversity were generally higher in natural habitat interiors and edges than in the interiors of adjacent wheat fields (French and Elliott 2001), leading the authors to advocate adding grassy strips to wheat fields and extending the saum (zone of perennial herbs and grasses) adjacent to wooded riparian habitats in order to supplement the diversity and abundance of ground beetles in the agricultural landscape.

Birds, especially cavity-nesting species such as chickadees, titmice, nuthatches, and woodpeckers, are important predators of all codling moth life stages, especially overwintering larvae (Wearing and McCarthy 1992, Solomon 1991). Indeed, codling moth population control has been found to be highest where nesting conditions for these species are good, such as in mature riparian habitats.

Conventional Control Measures

Management options for codling moth in walnut orchards include pheromone mating disruption, insecticide sprays, and biological control (UC IPM Management Guidelines). Codling moths can be very difficult to manage, especially if populations have been allowed to build up over a season or two. In addition, in hot Central Valley climates codling moth produces additional generations that can result in high population pressure. It is therefore important and much easier to keep moth numbers low from the start of the season than to suppress a well-established population. While there are several methods for reducing codling moth that do not require the use of insecticides, insecticides are the most effective measure for reducing crop damage from the moth (Fulton and Krueger pers. comm. 2007). Where populations are high and many infested trees are nearby, insecticide applications may be necessary to bring populations down.

NAVEL ORANGEWORM

Habitat and Ecology

Navel orangeworm overwinters as larvae inside mummy nuts left on the tree and in trash nuts left on the ground. Navel orangeworm produces three to four generations per year. Larvae mature inside nuts, producing large amounts of frass and webbing. Pupation begins in March and may continue through early May. Silver gray moths of the overwintered brood emerge in spring and lay eggs on nuts damaged by codling moth or blight, which act as a food bridge for this generation. After hatching, white neonate larvae also enter nuts damaged by codling moth or walnut blight. Thus, codling moth and blight control are also extremely important in controlling navel orangeworm populations.

Several factors influence the severity of infestation, including the proximity to almond orchards, the level of infestation by codling moth, and the number of mummy nuts left on the trees. Because navel orangeworm infests both almonds and walnuts, it can move from almonds to walnuts if it has a point of entry, such as is produced with codling moth damage. Mummy nuts left in the tree are also used as overwintering sites and can help increase population densities in orchards.

Host finding by navel orangeworm is based primarily on a chemically-modulated long-distance response (Phelan et al. 1991); adults have been reported to disperse up to 0.25 miles from the release site (Andrews et al. 1980). Few studies have examined the effects of landscape configuration on navel orangeworm dispersal and infestation rates. Navel orangeworm damage to pistachio nuts was found to be especially severe in portions of an orchard adjacent to blocks of infested almonds, which served as the source of immigrant moths. The degree of damage diminished as the distance from the principal external sources of moths increased, reaching economically unimportant levels at approximately 0.3 miles from the infestation site (Andrews and Barnes 1982).

Potential Alternative Hosts

Navel orangeworm is a scavenger that attacks a wide range of fruits and nuts. Almonds, figs, pomegranates, pistachio, and walnuts are major hosts. The navel orangeworm is extremely broad in its host diet, feeding on the nuts, fruits, and seed pods from plants as diverse as *Acacia,* citrus, and *Yucca*.

Potential to be Affected by Riparian Habitat Restoration

Langridge (2007) found that orchards adjacent to restored or remnant riparian forests had significantly lower infestation rates by navel orangeworm than did orchards adjacent to non-forest habitats. There also appeared to be

a trend toward lower infestation rates in sites nearer to remnant and restored riparian forests. While causes for this pattern remain to be investigated, it may be that riparian forest habitat serves as a barrier to navel orangeworm dispersal from one orchard to another (Langridge 2007).

Conventional Control Measures

Effective management of navel orangeworm depends on proper use of insecticide sprays (Fulton and Krueger pers. comm. 2007), good orchard sanitation to eliminate overwintering and feeding sites, and on harvesting crops before worms can enter the nuts (UC IPM Management Guidelines). Good control of codling moth, walnut blight, and sunburn is also essential because navel orangeworm attacks only walnuts with damaged or split husks. Two wasps that parasitize the navel orangeworm, *Copidosoma (=Pentalitomastix) plethorica* and *Goniozus legneri*, have been established in many walnut and almond growing areas and account for some larval mortality.

4.2.2 ANALYSIS OF PEST SPECIES WITHOUT RESTORATION STUDIES

For species lacking scientific studies comparing pest abundance and crop damage between riparian and agricultural habitats, this report used available information on the species' biology to analyze the potential for restoration to influence species abundances and movements between riparian and agricultural lands. These biological factors include the seasons and life cycle stages during which each species uses riparian habitat (if any), the average size of individual home ranges, and the pattern and range with which individuals disperse. For each insect pest species known to have specific multiple host plants (e.g., safflower and prunes, or cultivated walnut and California black walnut hybrids), Table 4-3 summarizes the list of potential hosts for each species. Table 4-4, located at the end of this section, includes an analysis of the potential for riparian habitat restoration to affect populations of pest species identified as being of high and medium priority for study by the External Experts group.

MULE DEER

Habitat and Ecology

The mule deer is an herbivorous ungulate associated with a wide variety of habitats including oak woodlands, chaparral, semidesert shrub woodlands, and riparian forests. In these habitats it tends to be restricted to buttes, draws, and stream bottoms with sufficient forage (Craven and Hyngstrom 1994). Deer prefer the forest edge over dense, old-growth forest. They thrive in agricultural areas interspersed with woodlots and riparian habitat. They favor early successional stages which keep brush and sapling browse within reach (Craven and Hyngstrom 1994). Thus, young or newly restored riparian habitat under 4 years old may be used by mule deer for feeding because the vegetation is still soft and tender. Although mule deer forage primarily in open (i.e., grassland habitat or open understory) habitats, they may use mature riparian habitat for shelter as an escape from predators, for thermoregulation, and for fawning (Craven and Hyngstrom 1994).

The average size of individual home ranges for the mule deer depends on the gender and age of the individual (Zeiner et al. 1990). Typical home ranges of small doe and fawn groups were 0.5–1.2 mi², but varied from 0.2–2 mi². Home ranges usually are less than 1 mile in diameter. Bucks usually have larger home ranges, and travel longer distances than doe and fawn groups (Brown 1961). Food is not a dominant factor influencing home range because there usually is a plentiful supply year-round. In the spring and summer, the home range is small because does must care for their newborn fawns. It increases in the fall when breeding activities demand greater movement and food becomes less abundant. Winter ranges are smaller since the deer restrict movements to conserve energy. During this time deer usually rely on reduced winter food supplies (Zeiner et al. 1990).

The mule deer breeding season (i.e., rut) varies considerably from region to region. The rut typically begins in the fall and extends through mid-winter, peaking in December or January. Deer reproductive success is highly dependent on habitat conditions (NRCS 2005). Fawns are born in May through July, although timing may vary

depending on habitat conditions and geographic location. Fawning occurs primarily in areas that offer protective cover, such as moderately dense shrublands and forest or thick herbaceous stands that offer both access to water and abundant nutritious spring forage (NRCS 2005). A typical family group may consist of one or more females with their young, accompanied on occasion by a yearling buck. Fawns usually remain within the family group for twelve to 30 months, after which female yearlings may be allowed to remain while bucks of the same age are either forced to leave or depart on their own (NRCS 2005). During the first dispersal of juvenile deer, they may travel several miles in search of a suitable area to establish a territory (Craven and Hygnstrom 1986).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, mule deer populations are unlikely to substantially increase following riparian habitat restoration. Both agricultural fields and riparian communities provide habitat for mule deer. Mule deer may be attracted to riparian habitat where young stages (0–4 years) will provide deer with preferred forage (e.g., saplings and forbs) and more mature (10–15 years) and remnant forests will provide deer with necessary cover. Mule deer use the dense cover for shelter as an escape from predators, for thermoregulation, and for fawning. In agricultural areas near restored riparian habitat, mule deer are one of the few species that have become problematic (Thomas pers. comm. 2007).

However, it is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable mule deer habitat. This is because only 7 % of Subreach land is proposed for restoration and both restored riparian habitat and existing agricultural sites provide suitable habitat for deer. For instance, in many orchards, such as the proposed Thousand Acre restoration site which is currently a prune orchard, irrigation systems maintain healthy forage for deer. Thus, the restored riparian communities would not be expected to result in a sizable difference in potentially suitable habitat for mule deer compared to the existing farmland condition. Additional research is needed, however, to determine how abundance, movement and usage patterns of mule deer vary within and among different Sacramento River riparian and agricultural habitat types.

Conventional Control Measures

Controlled hunting is an effective measure used to reduce deer populations when populations are relatively low. However, in order for this method to be successful, does must be removed annually (Lee 1998). Where deer populations are high and hunting is not a viable option, another technique that provides effective control is the use of a permanent electrified deer fence (Pehling 2006).

Repellents can provide some relief from mule deer damage, but the effect of repellents is temporary and works best when the deer population is not high. Repellents seldom provide complete protection from deer damage, however, and in most cases only slow down the damage. When deer pressure is high and when the deer are habituated to feeding in the area repellents are not effective (Pehling 2006).

BLACK-TAILED JACKRABBIT

Habitat and Ecology

The black-tailed jackrabbit is a mid-sized mammalian herbivore and is a habitat generalist. It occupies a wide range of habitats as long as there is diversity in plant species and structure. The black-tailed jackrabbit occupies plant communities with a mixture of shrubs, grasses, and forbs. This species prefers shrubland-herb mosaics over pure stands of shrubs or herbs (Daniel et al. 1993), and it prefers moderately open areas without a dense shrub understory. It is seldom found in closed-canopy habitats. Similarly, black-tailed jackrabbits inhabit clearcut areas and early seral coniferous forest, but not closed-canopy coniferous forest (Verner and Boss 1980). Jackrabbits primarily feed on grasses and forbs but will eat almost any vegetation that occurs in the area. Its diet changes with forage availability by season (Zeiner et al. 1990). Riparian habitat in the Sacramento Valley, such as in areas along the Feather and Bear River, is often occupied by this species (Sutter County 1996).

Home ranges of black-tailed jackrabbits in California averaged 48 acres (Lechleitner 1958). In Kansas, Tiemeier (1965) estimated home ranges from 6–120 acres. Typical dispersal distances of jackrabbits are relatively short, at less than 0.25 mile (French et al. 1965). Seasonal movements involve short distances and may be related to food availability (Bronson and Tiemeir 1959).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, black-tailed jackrabbit populations are not likely to substantially increase following riparian habitat restoration. Both agricultural fields and riparian communities provide habitat for jackrabbits. Jackrabbits may be attracted to riparian habitat in which young stages (0–4 years) may provide jackrabbits with their preferred forage (e.g., grasses and forbs). Long term population changes will depend on the target riparian community. In open savanna or moderately open woodland, the populations may persist if there is a mixture of shrubs, grasses, and forbs. However, black-tailed jackrabbit is likely to decrease in population size in riparian forest restoration sites as they mature. Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable black-tailed jackrabbit habitat because only 7% of Subreach land is proposed for restoration. Additional research is needed, however, to determine how abundance, movement and usage patterns of jackrabbits vary within and among different Sacramento River riparian and agricultural habitat types.

Conventional Control Measures

Conventional measures to control rabbits and hares (i.e., jackrabbits) are very similar as these species have similar foraging habits. One of the most effective methods found to reduce damage is exclusion, or fencing (Pehling 2006). Repellents are somewhat successful if the feeding pressure from the population is not too high (Pehling 2006). Efficacy of repellents is highly variable, depending on the behavior and number of rabbits and hares, and alternate food sources available (Craven 1994). Habitat manipulation has also been shown to be effective at reducing rabbit and hare damage. Removing briar patches, brush piles and other hiding places will reduce the overall population in the area. Additionally, encouraging populations of natural enemies of rabbits and hares is also effective at reducing damage (Craven 1994).

AUDUBON'S COTTONTAIL

Habitat and Ecology

Audubon's cottontail is a small- to mid-sized mammalian herbivore that prefers habitat such as gullies filled with debris, brush piles, or landscaped backyards where food and cover are suitable (Craven 1994). Good habitat for cottontail contains small, scattered patches of dense shrub cover with abundant shrub and herbaceous edges for foraging. Cottontails may benefit from light agricultural practices and developments that fragment large, homogeneous habitats, increase ecotones (i.e., transitions from one community to another), and provide a dispersion of nearby coverts (i.e., shelter) (Craven 1994). Cottontails use rockpiles, fallen trees and logs, fence rows, thickets and patches of shrubs, vines, and brush as cover (Fitch 1947). Cottontails may use riparian habitats or the ecotone between riparian forests and agricultural fields for foraging and shelter. Cottontails are more likely to use younger stages of restored riparian areas because they prefer to forage in woodlands with a more open canopy (Ingles 1965).

Home ranges of the Audubon's cottontail in Madera County averaged 7–10 acres, and rarely were larger than 15 acres (Fitch 1947). Ingles (1941) found that home ranges corresponded to the size of blackberry patches. Cottontails can raise as many as six litters in a year. Litters may be born year-round in favorable climates. Litter size also varies with latitude; rabbits produce five to six young per litter in the north, two to three in the south (Craven 1994). Cottontails generally spend their entire lives in an area of 10 acres or less. Occasionally they may

move a mile or so from summer range to winter cover or to a new food supply. Lack of food or cover is usually the motivation for a rabbit to relocate (Craven 1994).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, Audubon's cottontail populations are not likely to substantially increase with restoration activity. Both agricultural fields and riparian communities provide habitat for cottontail. Cottontails may be attracted to riparian habitat in which young stages (0–4 years) may provide cottontails with preferred forage (e.g., grasses and forbs). Cottontails feed in most canopy-closure classes, but they prefer more open woodlands, so as riparian forest restoration sites mature and fill in with upper canopy cover from the maturing trees and shrubs, the cottontails are less likely to use the riparian habitat. However, if the target is an open woodland or savanna with a shrubland-herb mosaic, the population could persist. Edges between riparian habitat and agricultural fields could also continuously support populations. Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable cottontail habitat because only 7% of Subreach land is proposed for restoration. Overall, cottontails are expected to affect less adjacent agricultural land in the Subreach following restoration since the extent of border areas between agricultural fields and riparian habitat will diminish. Additional research is needed, however, to determine how abundance, movement and usage patterns of cottontails vary within and among different Sacramento River riparian and agricultural habitat types.

Conventional Control Measures

Conventional control measures used for Audubon's cottontail are similar to that of black-tailed jackrabbit.

WESTERN GRAY SQUIRREL

Habitat and Ecology

The western gray squirrel is a small- to mid-sized herbivorous rodent that is dependent upon mature stands of mixed conifers and oaks. They are closely associated with oaks and require large trees, mast, and snags (Zeiner et al. 1990). Gray squirrels tend to be distributed along water courses including streams, rivers, marshes, and lakes (Ryan and Carey 1995). Western gray squirrels prefer to use remnant or mature restored riparian forests that provide them with the appropriate vegetation structure and food necessary for nesting and feeding (Zeiner et al. 1990).

Western gray squirrels eat a variety of native foods and the type of food eaten changes with the seasons (Jackson 1994). Typically, gray squirrels feed on mast (i.e., wild tree fruits and nuts) in fall and early winter. Nuts are often cached for later use. In late winter and early spring they prefer tree buds. In summer they eat fruits, berries, and succulent plant materials. During population peaks, when food is scarce, gray squirrels may chew bark from trees (Jackson 1994).

The home range of the western gray squirrel in the Sierra Nevada foothills varies from 0.5–1.7 acres for females, and from 1.2–2.5 acres for males (Ingles 1947). Home ranges of males overlap considerably. Gray squirrels breed when they are 1 year old. They breed in mid-December or early January and again in June (Jackson 1994). During fall, squirrels may travel 50 miles or more in search of better habitat. (Jackson 1994).

Potential to be Affected by Riparian Habitat Restoration

Western gray squirrels inhabit the continuous upper canopy of mature riparian forests and forest restoration sites that are over 10 years old (Golet et al. *in press-b*). They may occur in walnut orchards, however, this was not observed in the one walnut orchard where small mammals were studied in the Colusa Subreach. It is possible that walnut orchards are used for foraging excursions by gray squirrels that reside primarily in riparian habitat,

although this has not been confirmed. If this is the case, then restoration of mature riparian forest habitat may lead to localized increases in gray squirrels browsing on nearby walnuts. Overall, however, no substantial increases in the western gray squirrel population would be expected following the proposed riparian restoration because only 7% of Subreach land is proposed to be restored. Additional research is needed, however, to determine how abundance, movement and usage patterns of gray squirrels vary within and among different Sacramento River riparian and agricultural habitat types.

Conventional Control Measures

Often several control methods for western gray squirrels used simultaneously are more successful than a single method. Shooting and trapping are effective, however, during population peaks, new squirrels arrive quickly to replace those shot or trapped (Jackson 1994). Exclusion is one of the most effective methods of control (Pehling 2006). Jackson (1994) suggests a number of other methods of control that may be effective in keeping squirrels from damaging crops. These include custom-designed wire mesh fences topped with electrified wires to keep squirrels out of small orchards; and removal of woods or trees near orchards to block the pathway of gray squirrels. Additional research is needed to when, where, and how to apply these control methods to abate local increases in ground squirrel that may occur.

COYOTE

Habitat and Ecology

The coyote is a large, opportunistic canid that can adapt to nearly any ecosystem. Coyotes have adapted to and now exist in essentially every type of habitat in North America (Green 1994). Thus, it is possible that coyotes would use riparian habitat of any age (e.g., young, mature or remnant). The coyote's habitat preference, if any, tends to be towards use of younger stands of deciduous and conifer forest and woodland with low to intermediate canopy, and shrub and grass understory (Zeiner et al. 1990).

Coyotes eat a wide variety of food including rabbits, carrion, rodents, ungulates (usually fawns), livestock and poultry, and insects (Green 1994). Coyotes readily eat fruits such as watermelons, berries, and other vegetative matter when they are available. In some areas coyotes feed on human refuse at dump sites and may also take pets. Coyotes will generally take prey that is the easiest to secure (Green 1994).

Coyotes den in a variety of places, including brush-covered slopes, steep banks, thickets, and hollow logs. Den sites are typically located less than a mile from water (Green 1994). Dens previously used by other animals, such as badgers, are frequently used (Chapman and Feldhamer 1982). A single home range of a coyote may be inhabited by a family of two or more generations, a mated pair, or a single adult (Chapman and Feldhamer 1982). Bekoff (1977) reported home ranges of 3–32 mi^2. Home ranges of males overlap considerably, but those of females do not. In Sierra County, home ranges were found to vary from 4–39 mi^2 (Hawthorne 1971). Coyote young disperse in the fall and winter and can move from 50–100 mi from the parental range (Gier 1975). Juvenile coyotes usually disperse alone or sometimes in groups at 6 to 9 months of age, but some juveniles do not disperse until their second year (Bekoff 1977). In California, juvenile dispersal distances averaged 3 to 4 miles (Hawthorne 1971).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat conditions of agricultural areas in the Subreach and proposed riparian restoration sites, coyote populations are unlikely to increase following riparian habitat restoration. Both agricultural fields and riparian communities provide habitat for coyote. Coyotes are wide-ranging and opportunistic. Thus, they may take advantage of new prey availability when a restoration site is relatively young (0-4 years). Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable coyote habitat because only 7% of Subreach land is

proposed for restoration. A slight increase in coyote populations may be beneficial in controlling some high priority pests such as voles and pocket gophers and other rodent pest species. Additional research is needed, however, to determine how abundance, movement and usage patterns of coyotes vary within and among different Sacramento River riparian and agricultural habitat types.

Conventional Control Measures

For managing coyote damage, a variety of control methods must employed since no single method is effective in every situation (Bekoff 1977). Exclusion, in the form of fences, can aid significantly in reducing predation by increasing the effectiveness of other conventional control measures, such as traps (Green 1994). Trapping has also been found to be successful, but the efficacy depends on several key factors, such as conditioning to past events and locations of common pathways (Green 1994). These factors also apply to shooting coyotes. Toxicants and repellents have been used with variable success in reducing coyote populations when compared to other conventional measures (Chapman and Feldhamer 1982).

AMERICAN BEAVER

Habitat and Ecology

The American beaver is a large herbivorous rodent that uses habitat almost anywhere where there is a year-round source of water, such as streams, lakes, farm ponds, wetland areas, roadside ditches, drainage ditches, canals, mine pits, oxbows, railroad rights-of-way, drains from sewage disposal ponds, and below natural springs (Miller and Yarrow 1994). Beavers build dams to modify the environment more to their liking. Some of the surrounding timber is cut down or girdled by beavers to form dams. Subsequent flooding of growing timber causes it to die, and aquatic vegetation soon begins growing. Other pioneer species (e.g., willow, sweetgum, and buttonbush) soon grow around the edges of the flooded area, adding to the available food supply. The beaver thus helps create its own habitat (Miller and Yarrow 1994). Stream characteristics such as gradient, depth, and width are determining factors in habitat use by American beaver (Allen 1983). Habitat and food requirements of the American beaver indicate that beavers would be likely use riparian forest habitat of any age (e.g., young, mature, remnant), although they would not be expected to use sites that are located very far from open water.

Beavers fell trees and harvest branches for winter food, feeding mostly on trees and woody species on or near streambanks. Beavers prefer willows, alder, and cottonwood trees, but will also eat the leaves, twigs, and bark of most species of woody plants that grow near the water, as well as a wide variety of herbaceous and aquatic plants (CDFG 2005b, Miller and Yarrow 1994). The American beaver builds a lodge or bank den for purposes of escape, resting, thermal, and reproductive cover. Lodges may be surrounded by water or constructed against a bank (Allen 1983). Beavers live in a colony of one adult pair, young of the year, and perhaps a few second-year young. At high densities, there may be considerable inter-colony movement, and some colonies may have more than 2 adults (Zeiner et al. 1990). Colonies in Canada were found to have a home range of 0.5 mi radius from the lodge, equivalent to an area of 201 ha (497 acres) (Aleksiuk 1968). Light (1969) estimated the home range of a colony in the San Bernardino Mts. at 36 acres. Densities typically range from 0.4 to 0.8 colonies/0.5 mi², and may reach 8/mi² (Jenkins and Busher 1979). Beaver young stay with the adults for about 1–2 years before migrating away to form their own colonies of between two and twelve individuals (Pehling 2006). Dispersal may be delayed in areas with high beaver densities. Subadults generally leave the natal colony in the late winter or early spring (Van Deelen 1991). Subadult beavers have been reported to migrate as far as 147 miles, although average migration distances range from 5–10 miles (Allen 1983).

Potential to be Affected by Riparian Habitat Restoration

Based on habitat and land use conditions for the various proposed restoration sites, American beaver populations are unlikely to increase following riparian habitat restoration. American beavers will forage up to 650 feet (200 m) from water (CDFG 2005b), but generally forage no more than about 300 feet (90 m) from water (Allen 1983).

Thus, any potential increase in damage would have to be in areas adjacent to waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed near waterways.

Conventional Control Measures

Exclusion has been found to be both costly and ineffective at excluding American beavers from impoundments or lakes. However, damage to individual large trees and shrubs next to waterways can be prevented or reduced by loosely wrapping the tree with layers of chicken wire, hardware cloth or galvanized wire fencing (Miller and Yarrow 1994). Repellents can be helpful in reducing beaver damage, especially if the animals are new to the area, but repellents are seldom completely effective (Pehling 2006). The use of traps in most situations where beavers are causing damage is the most effective, practical, and environmentally safe method of control (Miller and Yarrow 1994). Because beavers usually modify their aquatic habitat so extensively over a period of time, most cultural or habitat manipulation measures generally have little adverse effect on beavers (Miller and Yarrow 1994).

NORTHERN RIVER OTTER

Habitat and Ecology

Northern river otters are large aquatic mammals that feed mainly on fish and crustaceans. Suitable habitat for this species consists of riparian vegetation associated with a large, permanent water source. Cover is provided for otters by thickets, hollow logs, stumps, snags, and other cavities (Zeiner et al. 1990). Riparian forests with the necessary cover and availability of food are likely to be used by river otters. Dens of the river otter are in burrows and cavities in banks, rocks, trees, stumps, in hollow logs in deserted beaver burrows, in thickets, or on platforms made of wetland plants. Dens are lined with dry vegetation, and occur within 0.5 mi of water (Banfield 1974). Rather than excavate their own dens, northern river otters use dens dug by other animals, or natural shelters. They commonly use hollow trunks of large trees, beaver or nutria dens, hollow logs, log jams, drift piles, jumbles of loose rocks, abandoned or unused boathouses, and duck blinds (Chapman and Feldhamer 1982).

River otters are chiefly nocturnal, but they frequently are active during daylight hours in undisturbed areas (Hill 1994). Socially, the basic group is the female and her offspring. They habitually use specific sites (latrines) for defecation (Hill 1994). Home ranges of river otters may extend an average of 15 miles or more along rivers and streams (Haley 1975). The distance they travel is highly variable and related to their food supply, suitable habitat, and individual propensity for wandering. Over the course of a year river otters may travel 50–60 miles along rivers and streams (Liers 1951).

Potential to be Affected by Riparian Habitat Restoration

River otter populations and pest effects are unlikely to change following the proposed riparian habitat restoration. Although northern river otters use aquatic habitat within riparian communities and travel far for food along waterways (mainly fish and crustaceans), they aren't expected to venture very far inland. Even if any of the restoration sites are utilized (e.g., from denning), river otters would not be expected to move further inland and into agricultural sites, as these sites lack appropriate habitat features.

Conventional Control Measures

Little control research and experimentation has been done regarding river otter because river otter damage is minor compared to that of other species, and because of its inclusion in Appendix II of the Convention on International Trade in Endangered Species (CITES). Registration of repellents, toxicants, or fumigants for river otter control has not been sought (Hill 1994). Damage problems should be approached on an individual basis. Cultural methods and habitat manipulation are normally not applicable (Hill 1994).

COMMON MUSKRAT

Habitat and Ecology

Common muskrats are large aquatic rodents that feed mostly on aquatic emergent vegetation. They prefer to use sloughs, marshes, oxbow lakes, streams, levees, dikes, and small lakes and ponds for habitat (Allen and Hoffman 1984). Muskrats will also occupy human-made habitats such as roadside and irrigation ditches (Miller 1994). Cover for escape from predators and reproduction is sought either in conical-shaped houses, built above the water level with the dominant emergent plants in the area, or in burrows excavated in waterway banks (Allen and Hoffman 1984). In general, common muskrats are abundant in aquatic habitats and are very likely to use riparian habitat of any age, but only when in close proximity to water.

Common muskrat houses and bank burrows or dens have several underwater entrances that are accessed via trails. Muskrats often have feeding houses, platforms, and chambers that are somewhat smaller than houses used for dens (Miller 1994). Home ranges for muskrats in a Maine marsh averaged 1 acre (Takos 1944). Along linear waterways, home range averaged 0.3 mi. In one study, most activity was concentrated within 50 ft of the main lodge (Willner et al. 1980). Dispersal of males, along with young that are just reaching sexual maturity, begins in the spring (Miller 1994). Dispersal is also associated with population densities and population cycles. These population cycles vary from 5 years in some parts of North America to 10 years in others (Miller 1994).

Potential to be Affected by Riparian Habitat Restoration

Common muskrat populations and pest effects are unlikely to change following the proposed riparian habitat restoration. Common muskrats typically have small home ranges and do not travel far from their lodges, which are located in aquatic areas (Willner et al. 1980), or their food, which consists mainly of emergent vegetation. Thus, any potential increase in damage would be restricted to areas adjacent to waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed adjacent to waterways.

Conventional Control Measures

The most effective ways to modify muskrat habitat are to eliminate aquatic or other suitable foods that they eat. Aversion measures are not effective in scaring the animals away from occupied habitat and no repellents are known to be effective, practical, and environmentally safe. Trapping, however, is a successful conventional measure used to control muskrats, with the type of trap being used dependant on the location and situation in question. The most effective sets are those placed in "runs" or trails where the muskrat's hind feet scour out a path into the bottom (Miller 1994).

AVIAN PEST SPECIES (AMERICAN CROW, BREWER'S BLACKBIRD, EUROPEAN STARLING)

Because these bird species have fairly similar habitat needs, life histories, and control measures, they are discussed as one group.

Habitat and Ecology

All of these bird species occupy a wide range of habitats. Specifically, the American crow has only two important requirements: openness for ground feeding, and presence of scattered trees, woodlots, windbreaks, and forest edges for safety, loafing, nesting, and roosting (Verbeek and Caffrey 2002). The Brewer's blackbird prefers open, human-modified habitats such as residential lawns, mowed urban parks and campus areas, and vacant lots with nearby trees and bushy tangles for nesting (Martin 2002). In more rural areas, Brewer's blackbirds occupy farmsteads bordered by shrubs and trees, large forest clearcuts and young forestry plantations, row crop fields, and riparian and other brushy or weedy margins of streams (Martin 2002). European starlings tend to avoid only

large expanses of undisturbed non-grassland native habitats such as wooded or forested areas, and arid chaparral and desert (Cabe 1993).

American crows are omnivorous and feed on a wide variety of food sources. Crows obtain most of their food on the ground and sometimes in fruiting trees and shrubs (Verbeek and Caffrey 2002). The diet of the opportunistic Brewer's blackbird changes with the seasons. During the breeding season, blackbirds feed mainly on insects and other invertebrates to provide protein sources to their nestlings. During migration and winter, the food consumed is primarily vegetarian (approximately 84%), concentrating on waste grains, weed and grass seeds, and stockyard spillage and leavings (Martin 2002). European starlings have an extremely diverse diet that varies by geography, age of individuals, and season. Generally starlings feed on invertebrates when available, but also eat fruits, grains and certain seeds during other times of the year (Cabe 1993).

All three of these species are highly social, at times forming large flocks and breeding in colonies. Home ranges of American crows are not known, but there is data on crow roosting and nesting densities. In California, winter density of American crows was reported as 5–25/mi² (Emlen 1940). Emlen (1942) found an even spacing of 60 nests over 108 acres in a walnut orchard in California, suggesting territoriality within a loose colony. In Pacific coastal areas where Brewer's blackbirds are year-round residents, flocks that included color-banded Brewer's were noted to wander over an area of about 12-mi diameter during the non-breeding period. During the breeding season, parents may fly up to 0.6–2 mi to foraging sites in order to feed nestlings and fledglings (Martin 2002). In New York agricultural areas, European starlings foraged up to 0.6–1.2 mi from their nest (Kessel 1957). Starlings gather in huge flocks in winter and disperse daily from roosting to feeding areas over a 5–50 mi distance (Hamilton and Gilbert 1969). In winter in Oregon, starlings moved an average of 11 miles from roosting to feeding sites and their home range averaged about 15 mi² (Bray et al. 1975).

Nests of American crows are usually well hidden in crotches and on horizontal limbs of trees and shrubs (Emlen 1942). Early nests in a walnut orchard in California, built before leaves had fully opened, were more centrally located in the orchard than later nests which were built on the edge. Once the leaves were fully open, most nests were built in small terminal branches (Emlen 1942). The breeding season for the crow in California lasts from mid-March to the end of August (Verbeek and Caffrey 2002). Of 49 crows in a study in New York, dispersal from natal to breeding site ranged from 0–37 miles (McGowan 2001). Adult crows generally remain faithful to their breeding site and territories are maintained year-round (Verbeek and Caffrey 2002).

Brewer's blackbird nests are in bushes and trees or on the ground, near open water, in marshes, fields, and urban areas (Zeiner et al. 1990). The breeding season for Brewer's blackbirds lasts from late January to early July, depending on the number of attempted nests (Martin 2002). In populations studied near Monterey, CA, a core group of birds remained in the vicinity of the home colony throughout the non-breeding period (Williams 1952). Adults repeatedly returned to the previous year's nesting location and generally paired with the same mate. The winter home range faithfulness in non-migratory populations along the Pacific coast is apparently strong (Martin 2002).

European starlings prefer to nest in cavities or nest boxes (Cabe 1993). The breeding season in California begins in late February and ends in May, depending on the number of attempted nests (Cabe 1993). Individuals may return to their natal area, but many do not (Kessel 1953, 1957). Starlings show a high degree of fidelity to breeding sites. In a study by Kessel (1957), it was found that when the nesting site was known for consecutive years, about 30% of females used the same nest box, and about 90% moved less than 0.6 mi. About half of all breeding females returned the next year. After the breeding season, juveniles may disperse up to several hundred miles. In a colony isolated by 1.2 miles from the nearest breeding starlings, Flux and Flux (1982) estimated that 60–70% of breeding adults in any given year were immigrants.

Potential to be Affected by Riparian Habitat Restoration

Based on the use of both agricultural and riparian habitats and the relatively small change in habitat types in the Subreach, Brewer's blackbird, European starling, and American crow populations are unlikely to change or increase substantially following riparian habitat restoration. These opportunistic species are highly adaptable and known to frequently use agricultural habitats. Brewer's blackbirds are most likely to use younger restored riparian forests (0–4 years) because this stage will have the preferred winter/non-breeding forage of seeds and forbs. In contrast to Brewer's blackbirds, European starlings are most likely to use mature (over10 years) restored riparian forest strips due to the higher availability of trees and snags with cavities for nesting. Crows are very opportunistic and may use young restoration sites for foraging on seeds, forbs, and grasses. However, populations of crows are more likely to use mature riparian forests where there is an established upper canopy for roosting and nesting in tall trees and snags. Currently, 55% of the Colusa Subreach is existing riparian habitat. It is unlikely that the proposed change of agricultural land to riparian habitat would result in a substantial change in suitable habitat for these avian pest species because only 7% of Subreach land is proposed for restoration.

Conventional Control Measures

Blackbird and corvid (crows and jays) species typically respond to control measures in similar manners. However, due to the opportunistic nature of these species, the effectiveness of control measures in field situations can be variable (Pehling 2006). Various "scare devices" (e.g., hanging flashers) can reduce damage to crops from birds if the devices are moved about so the birds do not become accustomed to them (Pehling 2006). The repellent, Methyl anthranilate, has recently been registered for home use on a variety of crops. This material is derived from grape skins and has proven useful in reducing bird damage in test plots (Pehling 2006).

WALNUT HUSK FLY

Habitat and Ecology

Walnut husk fly was accidentally introduced into southern California from the Midwestern United States in the early 1920s and has since spread throughout the Pacific coastal states on native black walnuts (*Juglans californica*) and cultivated Persian walnuts (*J. regia*) (Chen et al. 2006). Much of the biology of walnut husk fly is typical of other *Rhagoletis* species (see review by Boller and Prokopy 1976). Husk flies have one generation per year. They overwinter as pupae in the soil and emerge as adults from late June until early September, with peak emergence in mid-August. The female deposits eggs in groups of about 15 below the surface of the husk. Eggs hatch within 5 days. After feeding on the husk for 3 to 5 weeks, mature larvae drop to the ground and burrow several inches into the soil to pupate. Most emerge as adults the following summer, but some remain in the soil for 2 years or longer.

Information regarding the husk fly's dispersal pattern and range varies. Some sources report that adults tend to remain in their natal territories (or fly from tree to tree over relatively short distances) while others claim that that the species is highly mobile, with dispersal distances ranging from 60–825 miles (Peterson & Denno 1998). Part of the reason for this discrepancy may be that husk flies tend to remain sedentary unless conditions become unsuitable for them, at which point they are capable of long-distance migration and dispersal (Boyce 1934).

Potential Alternative Hosts

Walnut husk fly infests a variety of walnut species, including both varieties of the endemic California black walnut (*Juglans californica* var. *californica* and *Juglans californica* var. *hindsii*). which are commonly found in remnant Sacramento River riparian areas. Northern California black walnut (*J. c.* var. *hindsii*) has been known to support large walnut husk fly populations (Berlocher 1984). Katovich (2004) reported that the walnut husk fly (as well as the codling moth discussed above) also infests black walnut plantations in the midwestern United States. Data on husk fly seasonality and the life cycle for California black walnut hybrids is lacking, but observations of

the California black walnut hybrids indicate that it has a similar fruit maturation period as cultivated walnuts. Regardless, husk flies have a "general purpose genotype" which enables them to vary their life history patterns, such as diapause length, timing of emergence, and period of oviposition, with environmental variation and host plant phenology (Chen et al. 2006).

Potential to be Affected by Riparian Habitat Restoration

Based on planting plans, it is unlikely that walnut husk fly populations would increase significantly in the Subreach following riparian habitat restoration. Although California black walnut may serve as an alternate host for walnut husk fly, there is little potential for riparian restoration in the Subreach to increase walnut husk fly pest problems. This is because California black walnut is not currently, and never has been planted by TNC in riparian restoration sites along the Sacramento River (Golet, pers. comm., 2007). There is a chance that hybrid California black walnut could colonize the proposed restoration sites naturally. However, with active restoration, much of the potential walnut colonization area will be planted with competing native tree species. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial walnut husk fly population.

Conventional Control Measures

Walnut husk fly is best controlled through a combination of insecticides such as pyrethroids and organophosphates and monitoring populations (Fulton and Krueger pers. comm. 2007). Sanitation practices that reduce the number of overwintering husk flies may contribute to control (UC IPM Management Guidelines). Sanitation and early summer insecticide applications have both been proven to help reduce codling moth and husk fly populations in walnut plantations. Sanitation practices include removing and disposing of damaged nuts as soon as possible. Subsequent populations may be reduced by spreading tarps under trees from July through August to prevent maggots from entering the soil to pupate. Additional management guidelines from IPM recommend that black walnut and other walnut trees be removed from roadsides to help reduce walnut husk fly populations in neighboring agricultural areas (UC IPM Management Guidelines for Walnut Husk Fly on Walnut; Walnut Production Manual; Ramos 1998).

PEACH TWIG BORER

Habitat and Ecology

Peach twig borers overwinter on the tree as first- or second-instar larvae within tiny cells, called hibernacula, usually in crotches of 1- to 3-year-old wood, in pruning wounds, or in deep cracks in bark. Larvae emerge in early spring, usually just before and during bloom, and migrate up twigs and branches where they attack newly-emerged leaves and shoots. As shoots elongate, larvae mine the inside causing the terminals to die back. Adults from the overwintered generation begin emerging in April or early May. First generation larvae develop in twigs during May and June and give rise to the next flight of moths in late June or early July. Larvae from this and subsequent generations may attack either twigs or fruit depending on fruit maturity and population density.

Potential Alternative Hosts

Peach twig borer infests peach, nectarine, apricot, almond, cherry, prune, plum, and apple (in order of susceptibility). The pest may infest species in the family Roseaceae, so riparian species such as California wild rose may potentially serve as hosts although there is currently no evidence to substantiate this, nor is there information on the relative preference for this potential host species.

Potential to be Affected by Riparian Habitat Restoration

Riparian habitat restoration is not expected to lead to a change in peach twig borer pest populations or the level of crop damage to adjacent agricultural fields since the pest is not known to use riparian plants or habitat. In

addition, although species in the family Roseaceae may be attractive to peach twig borer as an alternative host, there is currently no evidence to substantiate or refute this claim, and rose plants do not typically form wood conducive to boring. Also, most herbivorous insects exhibit extreme host specificity and tend not to infest species to which they are not adapted (Menken 1996). Research is needed to determine the preference for California wild rose as a pest host in riparian habitat and the potential for local pest populations in riparian settings to lead to pest damage on neighboring agricultural sites.

The ability of peach twig borer to disperse to other habitats appears to be low. Pheromone traps placed in pomegranate orchards adjacent to infested plum orchards caught significantly fewer males of peach twig borer than those placed at the centre and borders of the plum orchards. Traps placed within fallow ground caught even fewer moths (Ahmad 1989).

Riparian habitat restoration may also help reduce peach twig borer densities by subsidizing natural enemies. Peach twig borer has about 30 species of natural enemies. The gray field ant, *Formica aerata,* preys on peach twig borer during spring and summer. In some years, ants destroy a significant portion of larvae, but by themselves do not generally reduce twig borer populations below economically-damaging levels. Other natural enemies found in California natural areas are chalcid wasps (*Paralitomastix varicornis* and *Hyperteles lividus*) and the grain or itch mite (*Pyemotes ventricosus*).

Conventional Control Measures

Within an IPM program, the preferred management strategy for peach twig borer includes the application of well-timed treatments of environmentally sound insecticides such as spinosad and methoxyfenozide (UC IPM Management Guidelines for Peach Twig Borer on Prune). Alternatively, peach twig borer can be controlled with a dormant spray of an organophosphate or pyrethroid insecticide, plus oil, to kill overwintering larvae in the hibernacula. Mating disruption can also be used to supplement dormant sprays, though this method has not been reliable against peach twig borer when used alone.

LEAFROLLERS (FRUIT-TREE LEAFROLLER, OBLIQUE-BANDED LEAFROLLER, OMNIVOROUS LEAFROLLER)

Habitat and Ecology

Leafrollers belong to the family Tortricidae, a group of moths with a feeding larval stage, responsible for the damage to crop plants, and an adult reproductive stage. Adults of some species are sedentary while others disperse over long distances, aided by the wind. In some species, the larvae feed on the plant where the eggs are laid, while others move from one host plant to another, some dispersing with the aid of a silken thread.

The fruit-tree leafroller (*Archips argyrospila*) produces one generation per year. Fruit-tree leafroller overwinters in the egg phase, hatching into tiny larvae in spring (mid-March to mid-May in cooler areas). These larvae feed on leaves for about 30 days and then pupate for 8–11 days in a loose cocoon within a rolled leaf or similar shelter. Adults fly during May or June, depending on the locale, but live only about a week, during which time they mate and lay eggs. Females lay overwintering egg masses mainly on twigs in the upper parts of trees.

The fruit-tree leafroller is able to subsist on many foods. Its primary host plant is apple, but it also infests alfalfa, apricot, ash, blackberry, box elder, cherry, currant, elm, gooseberry, locust, loganberry, oak, onion, pear, plum, poplar, prune, quince, raspberry, rose, English walnut, and willow (Pickel, pers. comm., 2007). Fruit is attacked by the larvae, and young fruit may fall because of deep feeding grooves made just after the fruit has formed. Leaves are rolled and tied together with silken threads to form compact hiding places. Larvae frequently drop to the ground on their silken threads and may defoliate grass or other plants beneath the trees. Very large populations may develop in certain years, partially or completely defoliating trees, and producing numerous silken threads that

blanket trees and the ground. However, even if completely defoliated, trees that are otherwise healthy will typically recover from heavy infestations.

The oblique-banded leafroller may be the most common leafroller in the Sacramento Valley. It appears about the same time as the fruit-tree leafroller, but has two generations per year instead of one.

The omnivorous leafroller has four to six generations per year depending on climatic conditions. As their name implies, this species is able to subsist on many foods and feeds on a variety of host plants. Orchards may become infested with omnivorous leafroller moths that develop on host plants outside the orchards.

Potential Alternative Hosts

The fruit-tree leafroller, oblique-banded leafroller and omnivorous leafroller are all able to subsist on many foods. The fruit-tree leafroller's primary host plant is apple, but it also infests alfalfa, apricot, ash, blackberry, box elder, cherry, currant, elm, gooseberry, locust, loganberry, oak, onion, pear, plum, poplar, prune, quince, raspberry, rose, English walnut, and willow (Pickel, pers. comm., 2007).

The oblique-banded leafroller infests apple, apricot, ash, basswood, beans, birch, blackberry, box elder, burdock, carnation, celery, cherry, clover, hazelnut, honeysuckle, horse chestnut, knotweed, lilac, loganberry, maple, oak, peach, pear, plum, poplar, prune, horseradish, ragweed, raspberry, rose, smartweed, strawberry, sumac, sunflower, thistle, and verbena (Pickel, pers. comm., 2007).

The omnivorous leafroller infests citrus, peaches, plums, cotton, and bell peppers. It also has a wide range of other host species, including numerous weeds and ornamentals (Pickel, pers. comm., 2007). An obscure reference also cited omnivorous leafroller rearing from coyote brush (*Baccharis pilularis*), a native California riparian-associated upland shrub (Keifer 1933–34).

Potential to be Affected by Riparian Habitat Restoration

Riparian habitat restoration is unlikely to result in an increase of leafroller pest populations or crop damage. Although there may be some potential for native species such as valley oak and wild rose to be a host for leafroller pests, the density of these hosts will be lower than agricultural crop host plants and will be mixed in with non-host native plants. Riparian habitats may reduce pest population densities by subsidizing natural enemies, but studies are lacking to refute or support this. Research is needed to determine the preference for valley oak, wild rose and cottonwood to serve as a pest host in riparian habitat and the potential for local pest populations in riparian settings to lead to pest damage on neighboring agricultural sites. With 55% of the Colusa Subreach is existing riparian habitat and a proposed 7% of Subreach land proposed to be changed from agricultural to riparian habitat, the population change for this species is expected to be small.

Conventional Control Measures

Not much is known about omnivorous and oblique-banded leafroller control measures, but it is likely that measures for fruit-tree leafrollers can be similarly applied. Orchard sanitation involving examination of blossoms and vegetative shoots during pre-bloom and bloom for the presence of caterpillars, webbed leaves, or feeding damage is one form of standard control for leafrollers (UC IPM Management Guidelines). *Bacillus thuringiensis* (Bt; sold as a variety of products), Carbaryl, and diazinon are effective against the larval stages of leafroller . Bt is only effective on fruit-tree leafroller larvae when they are small and usually requires more than one application. Sprays for fruit-tree leafroller are not necessary every year, but only upon evidence of a damaging leafroller population.

A number of insects serve as natural enemies for fruit-tree leafroller. Certain tachinid flies and ichneumonid wasps appear to be its main parasites while lacewing and certain beetles are its most common predators. These natural enemies may help to keep fruit-tree leafroller populations at low, non-damaging levels.

LYGUS BUG (*LYGUS HESPERUS*)

Habitat and Ecology

Lygus bug, also known as western tarnish plant bug, prefers weedy verges and field margin strips inhabited by species such as yellow starthistle (*Centaurea solstitialis*), Russian thistle (*Salsola tragus*), tarweed (*Madia* sp.), sweet clover (*Melilotus* sp.), wild mustard (*Brassica* sp.), lambsquarters (*Chenopodium album*), pigweed (*Amaranthus retroflexus*), shepherd's-purse (*Capsella bursa-pastoris*), wild radish (*Raphanus* sp.), and vetch (*Vicia* sp.). Lygus dispersal is well-characterized by a random walk model (Bancroft 2005). In this study, males moved further than females (15 ft/day versus 12 ft/day) and their movement was greater along an east-west axis than a north-south axis (23 ft/day versus 8 ft/day).

Potential Alternate Hosts

As described above, lygus bug is known and likely to use flowers, weeds, grasses, and shrubs such as coyote brush when available (Pickel, pers. comm., 2007).

Potential to be Affected by Riparian Habitat Restoration

Based on ecology of the species and habitat conditions in the Subreach, there may be a small, short term increase in lygus bug populations if weeds are abundant at younger restoration sites. In the long term, the lygus bug population would be expected to decline as weedy areas are reduced with the maturation of riparian habitat.

Riparian habitat restoration may help reduce lygus concentrations in adjacent agricultural operations if weedy habitats are converted to mature riparian habitats. A study in Washington (Fye 1980) found that while natural species served as common reproductive and overwintering sites for lygus bug, habitat restoration markedly reduced lygus bug populations, apparently by lowering the weeds' ability to compete with natural vegetative cover. Additional research is needed to determine usage patterns and the abundance of lygus bug in different Sacramento River riparian habitat types.

Conventional Control Measures

Lygus bugs may be present in substantial numbers in an orchard and cause no damage. Annual preventive treatments are costly and subject to failure because lygus bugs are quick to develop resistance to chemicals. The role of predators and parasites in controlling lygus in orchards has not been investigated, but control by beneficial organisms has been shown in cotton and strawberries. Sanitation and weed control are also important. Weed host plants should be eliminated or suppressed before fruit forms on trees, and thereafter throughout the growing season, to minimize lygus populations. However, cover crops or weeds should not be mowed when lygus bugs are present or pests will move into the trees.

WALNUT BLIGHT (*XANTHOMONAS CAMPESTRIS* PV. *JUGLANDIS*)

Habitat and Ecology

Walnut blight is a bacterial disease that attacks walnuts beginning in early spring, when moisture is available to the bacteria (UC IPM Management Guidelines). Rain is important for spreading the bacteria and aiding infection. Northern Central Valley walnut growing areas tend to have a higher incidence and severity of walnut blight than southern areas since they typically receive more spring precipitation. Early blooming walnut cultivars are more susceptible than those that bloom later. The *Xanthomonas* bacteria enter through natural openings in the tree, delivered through pollen deposition or water droplets from rain or sprinkler irrigation.

Potential to be Affected by Riparian Habitat Restoration

Based on planting plans, walnut blight is unlikely to increase following riparian habitat restoration. Northern California black walnut (*Juglans californica* var. *hindsii*) is susceptible to walnut blight (Belisario et al. 1999) and California black walnut hybrids are likely to be susceptible as well. Thus, California black walnut hybrids could facilitate the dispersal and persistence of walnut blight in the Subreach if planted or established from existing trees. If the transfer of *Xanthomonas* bacteria from riparian to agricultural areas were to occur, the mechanisms involved would most likely involve bacteria-infected irrigation water or pollen drift from riparian areas. While agricultural operations often derive irrigation water from nearby rivers and streams, it is unknown whether adjacent riparian areas would serve to increase levels of *Xanthomonas* in these sources. Since walnuts are wind-pollinated, it is possible that riparian trees might serve as a source of infected pollen to cultivated trees. More likely, adverse trans-boundary effects of walnut blight would be greater in riparian habitats than in adjacent agricultural operations, since cultivated stands typically support higher blight infestations than natural systems.

Although California black walnut could facilitate the dispersal and persistence of walnut blight, there is little potential for riparian restoration in the Subreach to increase walnut blight problems. This is because California black walnut is not currently, and never has been planted by TNC in riparian restoration sites along the Sacramento River (Golet, pers. comm., 2007). There is a chance that hybrid California black walnut could colonize the proposed restoration sites naturally. However, with active restoration, much of the potential walnut colonization area will be planted with competing native tree species. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial walnut blight infestation. The likelihood of this occurring is expected to be much lower than infections spreading directly from orchard to orchard. However, research is needed to determine the actual potential for local cross-boundary effects in riparian-agricultural versus agricultural-agricultural field settings.

Conventional Control Measures

Control of walnut blight depends on the application of protective sprays to newly developing nuts (UC IPM Management Guidelines). In orchards with histories of walnut blight damage, protective treatments at 7- to 10-day intervals during prolonged wet springs are necessary for adequate protection. In years with less-intensive rainfall, spray intervals can be stretched. Walnuts are susceptible to blight infections well beyond the pistillate bloom period whenever free moisture occurs. Additional sprays are often necessary, but they must be applied before rain for maximum benefit. The total number of sprays required depends on the judgment of the grower, based on disease history and climatic conditions.

ROOT AND CROWN ROT (*PHYTOPHTHORA* SPP.)

Habitat and Ecology

Walnut trees are attacked by approximately ten different *Phytophthora* fungal species. Like many other fungal species, *Phytophthora* thrive in saturated soils. *Phytophthora* can survive in the soil for many years. It spreads and infects trees during moist cool to moderate temperatures in spring and fall. Some infection may occur in the summer depending on the species. Infections are generally localized, affecting 20% of the orchards, though yield losses of 50% percent can occur in infected orchards (UC IPM Walnut Pest Management Guidelines). The pathogen can enter the tree either at the crown near the soil line, at the major roots, or at the feeder roots, depending on the species. Trees affected with *Phytophthora* display small leaves, sparse foliage, and a lack of terminal growth. Infected trees may decline for several years or die within the same growing season in which the foliage symptoms first appear.

Almonds and tomatoes are also susceptible to *Phytophthora*. In almonds, symptom expression depends upon how much of the root or crown tissues are affected and how quickly they are destroyed. Generally, crown rots advance

Table 4-4
Potential Effects of Restoration on Agricultural Pest Populations

Pest Name	Is this species known or expected to use riparian habitat and, if so, what age/type?	Home range size	Dispersal pattern & range	Will riparian habitat restoration lead to change in pest population?	Will this lead to a change in pest effects?	How far from riparian habitat are pest effects likely to occur, given the preceding criteria?	Rationale for change in pest population and effects
California ground squirrel (*Spermophilus beecheyi*)	Yes, disturbed areas during initial restoration activity	Usually less than a 450 ft radius around burrows. California home ranges of males average 0.25 ac and females average 0.5 ac.	Dispersal occurs between July and September. Individuals will fully colonize a new area within 4 months of initial immigration. Most often it is juveniles less than one year in age that are moving. Dispersal distances average between 200–300 m (650–1,000 ft).	A regional decrease is likeliest, though possible shift in some local populations in short term.	Possible small short term shift to adjacent farms; long term, decline likely.	Effects will most likely be within < 0.25 mile of riparian habitat, which could include adjacent farms.	A regional decrease in California ground squirrel populations is likeliest in the long term due to less preferred habitat area and increased predator populations as restoration sites mature. In the short term, if restoration is conducted on a previously infested site, the population could move to adjacent farms if those areas have the preferred habitat.
Botta's pocket gopher (*Thomomys bottae*)	Likely immature forest, open woodland or savanna with shrubland-herb mosaic	Burrows can cover 200–2,000 ft². California males' home ranges average 2,700 ft², and vary from 900–4,800 ft². Females' home ranges average 1,300 ft², and vary from 250–2,600 ft².	Generally low dispersal rate.	Likely to decline in long term.	Likely decline in long term.	Effects will most likely be within < 0.25 mile of riparian habitat, which could include adjacent farms.	Although pocket gophers may be attracted to and abundant in riparian habitat in young stages, pocket gophers were found to be more common in agricultural sites than in younger restoration sites. Since agricultural habitat is preferred over native open canopy riparian habitat, the Botta's pocket gopher population is likely to decline in the Subreach in the long term.
California vole (*Microtus californicus*)	Likely immature forest, open woodland or savanna with shrubland-herb mosaic	Varies with habitat quality, food supply, and population levels, but in most cases it is no more than a few hundred square feet.	Juvenile males disperse gradually between 3 and 13 weeks of age, with some leaving after reaching sexual maturity. Of juvenile females, 47% remain at or near home with the rest dispersing before 9 weeks of age.	Yes, a slight increase could occur during the initial growth period, persisting or diminishing at maturity, depending on target riparian community type.	Possible short term slight increase in crop damage. Long term slight increase or decrease depends on target plant community.	Effects will most likely extend out to < 0.25 mile, which would include adjacent farms.	Like pocket gophers, California voles forage on herbaceous growth (e.g., grasses and forbs), which would be most dominant in the early stages of a restored riparian site. California voles were more abundant in young (3-4 yrs.) riparian forest habitat than in agricultural habitats, but the number of voles in older restored sites (12–15 yrs.) and remnant stands were below those in agricultural sites. Long term population changes will depend on the target riparian community and whether potential vole habitat was replaced. In open savanna or moderately open woodland, the populations may persist if there is a mixture of shrubs, grasses, and forbs. A dense forest with a closed canopy would be unlikely to provide habitat for the vole. The maximum population increase in the Subreach is expected to be small because the overall planned increase in riparian habitat is small (7%) and not all restored habitat types will provide suitable vole habitat.
Mule deer (*Odocoileus hemionus*)	Yes, all ages	Small doe and fawn groups are typically 1–3 km² (0.4–1.1 mi²), but vary from 0.5 to 5.0 km² (0.2 to 1.9 mi²). Home ranges usually are less than 1.6 km (1 mi) in diameter.	Mule deer typically disperse between 12 and 30 months of age. Juvenile bucks disperse up to several miles in search of suitable habitat. Habitat changes may influence seasonal movements of deer by altering the availability of food and cover.	No, existing deer population should remain the same.	Unlikely to result in increase in crop damage.	Effect expected to be minor and widely distributed due to wide home range.	In agricultural areas near restored riparian habitat, mule deer are one of the few species that have become problematic. However, the maximum population change, if any, in the Subreach is expected to be small because the overall planned increase in riparian habitat is small (7%) and deer use both agricultural fields and riparian habitats.
Black-tailed jackrabbit (*Lepus californicus*)	Yes, immature forest, open woodland or savanna with shrubland-herb mosaic	Home ranges in California average 45 acres.	Typical dispersal distances are relatively short, at less than 0.25 mile. Seasonal movements involve short distances and may be related to food availability.	No, existing jackrabbit population should remain the same, or decline in long term.	Unlikely; possible decline in long term.	Effects will most likely extend out to < 0.25 mile, which would include adjacent farms.	Although younger stages of restoration sites may provide black-tailed jackrabbit with suitable habitat, agricultural fields can provide forage and shelter for jackrabbits as well. As restoration sites mature and fill in with canopy cover, jackrabbits are likely to either disperse to new habitats with the preferred vegetation structure and available food sources or the population may decline through an increased predator population in the restored habitat. Long term population changes will depend on whether potential jackrabbit habitat was replaced. In open savanna or moderately open woodland, the populations may persist if there is a mixture of shrubs, grasses, and forbs.

Table 4-4
Potential Effects of Restoration on Agricultural Pest Populations

Pest Name	Is this species known or expected to use riparian habitat and, if so, what age/type?	Home range size	Dispersal pattern & range	Will riparian habitat restoration lead to change in pest population?	Will this lead to a change in pest effects?	How far from riparian habitat are pest effects likely to occur, given the preceding criteria?	Rationale for change in pest population and effects
Audubon's cottontail (*Sylvilagus audubonii*)	Yes, immature forest, open woodland or savanna with shrubland-herb mosaic	Reported ranges are 7.5–10 ac, and rarely larger than 15 ac.	Entire lives may be confined to an area of 10 acres or less. Occasionally they may move a mile or so from summer range to winter cover or to a new food supply. Lack of food or cover is usually the motivation for a rabbit to relocate.	No, existing cottontail population should remain the same or decline in the long term.	Unlikely to result in increase in crop damage and may decline in long term.	Effects will most likely extend out to < 0.25 mile, which would include adjacent farms.	Although younger stages of restoration sites may provide Audubon's cottontails with suitable habitat, as restoration sites mature and fill in with canopy cover, cottontails are likely to either disperse or the population may decline through an increased predator population in the restored habitat. Long term population changes will depend on whether potential cottontail habitat was replaced. If the target habitat is an open woodland or savanna with a shrubland-herb mosaic, the population could persist. The maximum population change, if any, in the Subreach is expected to be small because the overall planned increase in riparian habitat is small (7%) and because cottontails use both agricultural fields and riparian habitats. Also, edges between riparian habitat and agricultural fields that could also support populations will decline with restoration in the Subreach.
Western gray squirrel (*Sciurus griseus*)	Yes, mature riparian forest stands (for cover)	Reported ranges are from 0.5 to 1.7 ac for females, and from 1.2 to 1.7 ac for males, with male home ranges overlapping.	During fall, squirrels may travel 50 miles or more in search of better habitat.	Yes, a slight increase could occur as a woodland or forest restoration site matures.	Unlikely to result in increase in crop damage.	Effects will most likely extend out to < 0.25 mile, which would include adjacent farms.	Western gray squirrels inhabit the continuous upper canopy of the mature riparian forest habitat (over 10 years). They may also be found in certain agricultural sites (e.g., walnut orchards). No substantial increases in population would be expected since only 7% of the Subreach land is proposed for restoration and not all target riparian communities will provide suitable habitat. However, restoration of mature riparian forest habitat may lead to localized increases in gray squirrels in established riparian forest restoration sites (over 10 years old).
Coyote (*Canis latrans*)	Yes, immature forest, open woodland or savanna	Reported home ranges are 3 to 31 mi², and 4 to 40 mi², with home ranges of males (but not females) overlapping considerably.	Coyote young disperse in the fall and winter and can move from 50 to 100 mi from the parental range.	No, existing coyote population should remain the same.	Potential for crop damage is unlikely to increase.	Effect expected to be minor and widely distributed due to wide home range.	Coyote are wide-ranging and opportunistic, so habitat is likely present in agricultural areas before restoration occurs. Coyotes may take advantage of new prey availability in riparian habitat when restoration sites are relatively young (0–4 yrs).
American beaver (*Castor canadensis*)	Yes, all ages, near water	Reported ranges include an area of 36 ac in San Bernardino, CA, to 0.5 mi radius from lodge, covering about 500 ac., in a Canadian study area.	Beavers leave the family group by 2–3 years old. Dispersal may be delayed in areas with high densities. Sub-adults leave the natal colony in the late winter or early spring. Sub-adults are known to migrate as far as 147 miles, although average migration distances range from 5 to 10 mi.	Unlikely	No likely change in effects.	Effects would likely be confined to areas close to waterways.	American beavers generally forage no more than about 300 feet from water. Any potential increase in damage would have to be in areas adjacent to waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed near to waterways.
Northern river otter (*Lutra canadensis*)	Yes, more mature riparian forest near water	Home ranges may extend an average of 15 mi or more along rivers during a year.	Travel distance is highly variable, and related to food supply, suitable habitat, and inherent wandering. May travel 50–60 mi along rivers.	Unlikely	No likely change in effects.	Effects would likely be confined to areas close to waterways.	Although northern river otters use aquatic habitat within riparian communities and travel far for food (mainly fish and crustaceans), any potential increase in damage would be restricted to their nesting areas adjacent to waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed adjacent to waterways.
Common muskrat (*Ondatra zibethicus*)	Yes, all ages	Average ranges are 0.3 mi. along linear waterways, with most activities possibly within 50 ft of the main lodge, based on limited studies.	Dispersal of males, along with young that are just reaching sexual maturity, begins in the spring. Dispersal is also associated with population densities and population cycles. These population cycles vary from 5 to 10 years.	Unlikely	No likely change in effects.	Effects would likely be confined to areas close to waterways.	Common muskrats typically have small home ranges and do not travel far from lodges, and their food consists mainly of emergent vegetation. Thus, any potential increase in damage would be restricted to areas adjacent to waterways (e.g., streams, rivers, irrigation canals, drainage ditches). However, very little riparian habitat restoration in the Subreach is proposed adjacent to waterways.

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Pest Name	Is this species known or expected to use riparian habitat and, if so, what age/type?	Home range size	Dispersal pattern & range	Will riparian habitat restoration lead to change in pest population?	Will this lead to a change in pest effects?	How far from riparian habitat are pest effects likely to occur, given the preceding criteria?	Rationale for change in pest population and effects
Brewer's blackbird (*Euphagus cyanocephalus*)	Yes, open, immature riparian forest and open shrub-grassland communities	Reported ranges are up to 6 mi. from nests during the breeding season, and as far as 1 mi. away, with most foraging near nests, however. Individuals often travel long distances to communal roosts, but return each day to the same area.	In Pacific coastal areas where birds are year-round residents, individuals cover an area of about 32 mi. diameter during the nonbreeding period. Birds in western resident populations show high colony faithfulness, repeatedly returning to the previous year's nesting location and the same mate.	No, population increase is unlikely.	Unlikely	Effect, if any, would be widely distributed due to wide home range.	Younger stages of restoration sites will provide Brewer's blackbirds with their preferred forage (e.g., insects, seeds, forbs). However, the population is unlikely to change much, since Brewer's blackbirds use agricultural habitat as well as some riparian habitat and only 7% of Subreach lands would be restored.
European starling (*Sturnus vulgaris*)	Yes, all ages	Reported foraging distances include up to 0.75 mi. from nests, to 5–50 mi. from roosts with reported home ranges averaging 15 mi². Starlings gather in huge flocks in winter, from which they disperse daily from their roosts to their feeding areas.	After the breeding season, juveniles may disperse up to several hundred miles. In a colony located 4.5 mi. from the nearest breeding starlings, up to 60–70% of breeding adults in any given year are immigrants.	Possible slight increase in population in mature stages of riparian forest restoration types.	Unlikely	Effect expected to be minor and widely distributed due to wide home range.	Mature and remnant forests could provide European starlings with some nesting habitat (e.g., tree cavities). The starling population is unlikely to change much, since starlings use agricultural habitat as well as some riparian habitat and only 7% of Subreach lands would be restored. Starlings are wide-ranging and opportunistic, so habitat is likely present in agricultural areas before restoration occurs.
American crow (*Corvus brachyrhynchos*)	Yes, all ages, but more likely to use remnant and mature restored riparian forest stands	In California, winter density of crows was reported as 5–25 per mi². There was even spacing of 60 nests over 108 ac in a California walnut orchard, suggesting territoriality within a loose colony.	In a study in New York, dispersal from natal to breeding site ranged from 0 to 37 m). Adult crows generally remain faithful to their breeding site.	No, population increase is unlikely.	Unlikely to increase in crop damage.	Effect expected to be minor and widely distributed due to wide home range.	Crows may use young restoration sites for foraging, but are more likely to use mature riparian forests where there is an established upper canopy for roosting and nesting in tall trees and snags. The crow population is unlikely to change much, since crows use agricultural habitat as well as some riparian habitat and only 7% of Subreach lands would be restored. Crows are wide-ranging and opportunistic, so habitat is likely present in agricultural areas before restoration occurs.
Codling moth (*Cydia pomonella*)	Unlikely	No quantitative data available, but an individual's home range is essentially the infested fruit and the ground beneath the host tree.	Dispersal is generally limited to less than 50 m from the natal tree. Individuals will sometimes disperse further to escape unfavorable environmental and/or climatic conditions.	Unlikely to increase and may instead decrease.	Unlikely to increase; may decrease.	Effects would likely extend to beyond adjacent farms to areas where food and habitat are available.	California black walnut hybrids may serve as a wildland host for codling moth, creating the potential for source populations to persist outside orchards. However, a recent study by Langridge (2007) in the Sacramento Valley found no such effect. Instead, riparian habitat restoration may lead to a decrease in codling moth populations by harboring natural enemies such as ground beetles and birds. Black walnut is unlikely to be planted. Volunteer black walnuts may establish on restoration sites over time, however, due to active planting of competing native trees and shrubs, substantial numbers of walnut trees are unlikely.
Navel orangeworm (*Amyelois transitella*)	Unlikely	No quantitative data available, but an individual's home range is essentially the infested fruit and the ground beneath the host tree.	Dispersal modulated by a chemically-modulated long-distance response and can reach distances of up to 375 m from the natal territory.	Likely to decrease.	Likely to decrease.	Effects could extend beyond adjacent farms to areas where food and habitat are available.	Langridge (2007) found that orchards adjacent to restored or remnant riparian forests had significantly lower infestation rates by navel orangeworm than did orchards adjacent to non-forest habitats. There also appeared to be a trend toward lower infestation rates in sites nearer to remnant and restored riparian forests. While navel orangeworm populations are likely to decrease, some infestations could occur in riparian habitat. Navel orangeworm can infest California black walnut hybrids if they colonize the site from existing wild populations; however, this is unlikely because the site will be planted with competing native plants and no walnuts will be planted.
Walnut husk fly (*Rhagoletis completa*)	Unknown; possibly riparian woodland that contains mature walnut trees.	No quantitative data available, but an individual's home range is essentially the infested fruit and the ground beneath the host tree.	Variable: most individuals remain in their natal territories or fly short distances to seek new host trees. However, individuals may disperse 60–825 mi to escape unfavorable environmental conditions.	Likely to decrease.	Likely to decrease.	Effects could extend beyond adjacent farms to areas where food and habitat are available.	California black walnut hybrids may be a host of the walnut husk fly and may facilitate its dispersal and persistence in the region if planted or established from existing trees. However, the site will be planted with competing native plants and no walnuts will be planted. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial walnut husk fly population.

Table 4-4
Potential Effects of Restoration on Agricultural Pest Populations

Pest Name	Is this species known or expected to use riparian habitat and, if so, what age/type?	Home range size	Dispersal pattern & range	Will riparian habitat restoration lead to change in pest population?	Will this lead to a change in pest effects?	How far from riparian habitat are pest effects likely to occur, given the preceding criteria?	Rationale for change in pest population and effects
Peach twig borer (*Anarsia lineatella*)	Unlikely	No quantitative data available, but an individual's home range is essentially the infested fruit and the ground beneath the host tree.	The potential for dispersal is low.	Unlikely	Unlikely	Pest effects are unlikely to originate in riparian habitat.	Peach twig borer is not known to use riparian plants or habitat and the ability of peach twig borer to disperse to other habitats appears to be low. Plants in the family Rosaceae may be attractive to peach twig borer, so riparian plants in this family (e.g., California wild rose) might serve as hosts. No evidence exists to support or refute this, however. Riparian habitat restoration may help reduce pest population densities by subsidizing natural enemies.
Fruit-tree leafroller (*Archips argyrospila*)	Yes, if valley oak is a dominant species	Home range usually encompasses the host tree and ground beneath it.	Dispersal is generally limited, except for outbreak years when larvae produce large amounts of webbing that aid wind dispersal over variable distances.	Unlikely to increase. May decrease if the restored habitat harbors natural enemies.	Unlikely to increase; may decrease.	Unknown, but larvae can travel long distances via wind.	Because fruit-tree leafrollers are typically confined to orchards, a population increase is not expected from riparian habitat restoration although the species is known to infest valley oak, wild rose and cottonwood. However, the density of these hosts will be lower than with agricultural crop host plants and will be mixed in with non-host native plants. It is also possible that riparian habitats may reduce pest population densities by subsidizing natural enemies, but studies are lacking to refute or support this.
Oblique-banded leafroller (*Choristoneura rosaceana*)	Possibly	Home range usually encompasses the host tree and ground beneath it.	First-instar larvae are often wind-dispersed.	Unlikely to increase. May decrease if the restored habitat harbors natural enemies.	Unlikely to increase; may decrease.	Unknown, but larvae can travel long distances via wind.	Oblique-banded leafroller is known to feed on box elder and rose, both included as riparian community plants. However, the density of these hosts will be low and mixed in with non-host native plants. It is also possible that riparian habitats may reduce pest population densities by subsidizing natural enemies, but studies are lacking to refute or support this.
Omnivorous leafroller (*Platynota stultana*)	Possibly	Home range usually encompasses the host tree and ground beneath it.	No information	Unlikely to increase. May decrease if the restored habitat harbors natural enemies.	Unlikely to increase	Unknown	Orchards have been known to become infested with omnivorous leafroller moths that develop on host plants outside the orchards, possibly including coyote brush. However, the density of these hosts will be low and mixed in with non-host native plants. It is also possible that riparian habitats may reduce pest population densities by subsidizing natural enemies, but studies are lacking to refute or support this.
Western tarnish plant bug (*Lygus hesperus*)	Early successional weedy habitats.	Unknown	Individuals known to exhibit random walk dispersal patterns. Dispersal distance approx. 4.6 m per day (m/d) for males and 3.6 m/d for females.	May increase initially if weeds are abundant. However, long term reduction is expected as weedy areas are reduced.	Possible short term increase and long term decrease in crop damage.	Unknown	Lygus bug breeds and overwinters on many common agricultural weed species which may be present in both agricultural fields and young riparian habitat. Restoration may reduce pest populations if weedy areas are replaced by riparian habitat.
Walnut blight (*Xanthomonas campestris* pv. *juglandis*)	Possibly, if black walnut is present	Unknown; dispersed by wind and water.	Dispersed by wind and water.	Unlikely	Unlikely	Depends on wind and hydrology.	California black walnut hybrids may facilitate its dispersal and persistence of walnut blight in the region if planted or established from existing trees. However, with active restoration, much of the potential walnut colonization area will be planted with competing native tree species. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial walnut blight infestation. Thus, the likelihood of this occurring is probably much lower than infections spreading directly from orchard to orchard.
Root and crown rot (*Phytophthora* spp.)	Possibly, if black walnut is present	Unknown; dispersed by water.	Dispersed by water.	Unlikely	Unlikely	Depends on hydrology.	California black walnut hybrids may facilitate the dispersal and persistence of *Phytophthora* in the region if planted or established from existing trees, However, with active restoration, much of the potential walnut colonization area will be planted with competing native tree species. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial *Phytophthora* infestation nor substantial dispersal of *Phytophthora* to orchard habitat. The likelihood of this occurring is expected to be much lower than infections spreading directly from orchard to orchard.
Brown rot (*Monilinia* spp.)	Unknown	Unknown	Dispersed by air, water, direct contact.	Unlikely	Unlikely	Depends on wind and hydrology.	No known potential exists for riparian habitat restoration to affect brown rot incidence or spread.

Source: EDAW 2007

rapidly and trees collapse and die soon after the first warm weather of spring. Chronic infections, usually of the roots, cause a reduction in the infected tree's growth and early senescence and leaf fall. These trees may be unproductive for several years before succumbing to the disease. *Phytophthora* infections typically kill young trees because their root systems and crown areas are small compared to those of mature trees.

Potential to be Affected by Riparian Habitat Restoration

While hydric riparian soils may harbor *Phytophthora* inoculum and California black walnut hybrids may facilitate the dispersal and persistence of *Phytophthora* in the region if planted or established from existing trees, California black walnut is not currently, and never has been planted by TNC in riparian restoration sites along the Sacramento River (Golet, pers. comm., 2007). There is a chance that hybrid California black walnut could colonize the proposed restoration sites naturally. However, with active restoration, much of the potential walnut colonization area will be planted with competing native tree species. Thus, it is unlikely that enough hybrid black walnut trees would establish in riparian restoration areas to support a substantial *Phytophthora* infestation nor substantial dispersal of *Phytophthora* to orchard habitat. The likelihood of this occurring is expected to be much lower than infections spreading directly from orchard to orchard. However, research is needed to determine whether *Phytophthora* would likely occur in riparian habitat and spread to neighboring agricultural lands.

Conventional Control Measures

Rootstocks vary in their susceptibility to the different Phytophthora species and none are resistant to all species (UC IPM Management Guidelines). Thus, the success of a rootstock may depend in part upon the species of *Phytophthora* present in the orchard. In general, plum rootstocks are more resistant to *Phytophthora* than are peach or apricot. Of the plum rootstocks, Marianna 2624 is currently considered to be the most tolerant. Paradox walnut rootstock is more tolerant than is Northern California black walnut alone.

Proper water management is the most important aspect in controlling root and crown rot. Water should not be allowed to accumulate or stand around crowns of trees. In areas where *Phytophthora* is or has been present, trees should be planted on small mounds, as shallowly as possible, or on broad ridges with the upper roots near the soil level.

BROWN ROT (*MONILINIA* SPP.)

Habitat and Ecology

Monilinia is the most common fruit decay organism. Ripe fruit rot caused by *Monilinia* or *Botrytis* results in firm, circular spots that spread rapidly over fruit. *Monilinia* causes dark brown lesions on fruit that eventually turn black from the development of pseudosclerotia (fungal tissue). Fruit becomes more susceptible as it ripens. When *Monilinia*-diseased fruit remain on the tree, they are known as mummies.

Fruit that has been injured and infected before storage provides the inoculum for the spread of *Monilinia*. Fruit in storage infected with *Monilinia fructicola* may develop visible decay within 24 hours at 72°F, and will produce spores in 30 hours. Decaying tissue changes from light brown to gray to black. Rotted tissue is firm and difficult to distinguish from healthy tissue.

Potential to be Affected by Riparian Habitat Restoration

The potential for riparian habitat restoration to affect brown rot incidence or spread is unknown.

Conventional Control Measures

Fruit rot is managed by controlling blossom and twig blight in spring, removing blighted twigs when possible, using appropriate levels of nitrogen fertilizer and water, removing or turning under thinned fruit, controlling fruit-

feeding insects such as peach twig borer and oriental fruit moth, and making pre-harvest treatments when necessary.

4.3 CONCLUSIONS ON PEST SPECIES EFFECTS

4.3.1 POTENTIAL EFFECTS OF RIPARIAN HABITAT RESTORATION ON POPULATIONS OF PEST SPECIES AND RESULTING DAMAGE TO PRIORITY CROPS

This section includes a discussion of those pest species determined in Section 4.2 to increase or decrease in population size or effects on agriculture related to riparian habitat restoration on nearby or adjacent lands. Pest species which were determined to not have a substantial change in population or pest effects compared to the existing condition are not further discussed in this section. In general, the potential changes to pest populations or effects on agriculture in the Subreach are dependant on the existing and planned conditions of land use, including both riparian and agricultural habitats, and the ecology of the pest, including its use of riparian community plants. With 55% of the Colusa Subreach in existing riparian habitat and only 7% of Subreach land proposed for restoration, population sizes for most pests are not expected to change substantially. In addition, the linear extent of riparian-agricultural habitat borders will diminish in the Subreach following restoration. Since riparian habitat is not as attractive to most pest species as agricultural habitat, most pest populations are expected to diminish in the Subreach along with fewer border areas overall experiencing transboundary pest effects. As discussed in Chapter 1, all six farmed properties adjacent to the restoration sites currently share borders with riparian habitat. Thus, the adjacent farmed parcels already have moderate to substantial degrees of riparian habitat influences at their borders.

Table 4-5 provides a summary of the anticipated potential changes in pest effects, by species, including the pest's likely dependence on the type of riparian habitat to be restored. Following is an overview of the expected pest effect changes:

Table 4-5
Summary of Potential Pest Effect Changes on Agriculture Following Riparian Restoration

Pest Name	Short Term Change in Pest Effects (0–4 years) [1]	Long Term Change in Pest Effects (> 5 years) [1]	What riparian habitats or plants may these pests associate with?	Confidence Level and Additional Research Needs
California ground squirrel	−↑	↓	Open savanna or woodland, or shrub-grassland types	Medium – Subreach studies conducted; more research needed on short term effects and long term use of open canopy riparian communities and buffers
Botta's pocket gopher	-↓	↓	Open savanna or woodland, or shrub-grassland types	Medium – Subreach studies conducted; more research needed on short term effects and long term use of open canopy riparian communities and buffers
California vole	↑	−↓	Open savanna or woodland, or shrub-grassland types	Medium – Subreach studies conducted; more research needed on short term effects and long term use of open canopy riparian communities and buffers
Mule deer	−	−	All habitat types	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Black-tailed jackrabbit	−	−↓	Open savanna or woodland, or shrub-	Medium - more research needed to determine use and abundance in different

Table 4-5
Summary of Potential Pest Effect Changes on Agriculture Following Riparian Restoration

Pest Name	Short Term Change in Pest Effects (0–4 years) [1]	Long Term Change in Pest Effects (> 5 years) [1]	What riparian habitats or plants may these pests associate with?	Confidence Level and Additional Research Needs
			grassland types	Sacramento River habitat types, and pest effects
Audubon's cottontail	–	–↓	Open savanna or woodland, or shrub-grassland types	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Western gray squirrel	–	–↑	Mature woodland or forest	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Coyote	–	–	Open savanna or woodland, or shrub-grassland types	High – population size and ecology sufficiently understood, however, more research may help confirm use and abundance in different Sacramento River habitat types, and pest effects
American beaver	–	–	Aquatic habitats and adjacent land	High – proposed restoration not generally in this species' habitat area
Northern river otter	–	–	Aquatic habitats and adjacent land	High – proposed restoration not generally in this species' habitat area
Common muskrat	–	–	Aquatic habitats and adjacent land	High – proposed restoration not generally in this species' habitat area
Brewer's blackbird	–	–	Open savanna or woodland, or shrub-grassland types	High – ecology sufficiently understood
European starling	–	–	Mature woodland or forest	High – ecology sufficiently understood
American crow	–	–	Mature woodland or forest	High – ecology sufficiently understood
Codling moth	↓	↓	Black walnut	High - Subreach studies were conclusive; additional research may help determine which riparian habitat types and buffer types may be most beneficial in controlling coddling moth populations in agricultural areas
Navel orangeworm	↓	↓	Black walnut	High - Subreach studies were conclusive; additional research may help determine the cause for lower infestation rates in orchards near remnant and restored riparian forests
Walnut husk fly	↓	↓	Black walnut	High – type and amount of proposed restoration and plant palette is sufficient comparison to existing use; additional research can help determine pest use of different habitat types and reinfestation levels in adjacent orchards

Table 4-5
Summary of Potential Pest Effect Changes on Agriculture Following Riparian Restoration

Pest Name	Short Term Change in Pest Effects (0–4 years) [1]	Long Term Change in Pest Effects (> 5 years) [1]	What riparian habitats or plants may these pests associate with?	Confidence Level and Additional Research Needs
Peach twig borer	−↓	−↓	Possibly wild rose; but not known to use riparian habitat	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Fruit-tree leafroller	−↓	−↓	Valley oak, wild rose, Fremont cottonwood	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Oblique-banded leafroller	−↓	−↓	Ash, blackberry, box elder, oak, rose	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Omnivorous leafroller	−↓	−↓	Coyote brush	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Lygus bug	−↑	↓	Ruderal or weedy habitat	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects
Walnut blight	↓	↓	Black walnut	High – type and amount of proposed restoration and plant palette is sufficient comparison to existing use; additional research can help determine pest use of different habitat types and reinfestation levels in adjacent orchards
Root and crown rot	↓	↓	Black walnut	High – type and amount of proposed restoration and plant palette is sufficient comparison to existing use; additional research can help determine pest use of different habitat types and reinfestation levels in adjacent orchards
Brown rot	−	−	Riparian habitat use is unknown	Medium - more research needed to determine use and abundance in different Sacramento River habitat types, and pest effects

Notes:
[1] Short and long term increases or decreases in pest effects from existing conditions are anticipated to be small for all pest species in this study based on the ecology of the pests, existing agricultural and riparian habitat in the Subreach, and the proportionately small amount of agricultural habitat proposed for riparian habitat restoration in the Subreach. See Sections 4.21 and 4.22 for detailed analyses on each pest species.
↑ = potential increase
↓ = potential decrease
− = no change
−↑ = no change or increase, depending on conditions
−↓ = no change or decrease, depending on conditions

- Most of the pest species examined in this report are considered unlikely to increase in pest effects. Out of 25 species, only California ground squirrel, western gray squirrel, California vole and western tarnish plant bug, or lygus bug, are considered to have potentially slight increases in pest effects on adjacent or nearby agricultural crops or operations. Additionally, even though there is potential for increase, this increase is expected to only be in the short term (i.e., first few years) following restoration implementation. After these first few years, and once the proposed restoration sites mature and fill in with canopy cover, the habitat within these sites will be less attractive to voles and lygus bug, and the populations and related crop effects should decrease. California ground squirrel populations which may attempt to shift to adjacent farmland following restoration would be expected to diminish in population size in the short term due to habitat saturation effects (density dependence).

- Eleven species (mule deer, black-tailed jackrabbit, Audubon's cottontail, coyote, American beaver, northern river otter, common muskrat, Brewer's blackbird, European starling, American crow, and brown rot) are expected to remain the same in pest effects.

- Ten species (Botta's pocket gopher, codling moth, navel orangeworm, walnut husk fly, peach twig borer, fruit-tree leafroller, oblique-banded leafroller, omnivorous leafroller, walnut blight, and root and crown rot) may yield decreased pest effects in the short and long term. Decreased pest effects would be due to a decrease in preferred habitat and, for insect species, potential host species. Decreased pest effects may also result from a reduced density of host plant species along with their mixture with non-host native plants that may support populations of natural enemies to the pests.

HIGH AND MEDIUM PRIORITY RODENT PESTS

Only three rodent pests (California ground squirrel, western gray squirrel and California vole) identified as high or medium priority for study by the Colusa Subreach Advisory Workgroup and the External Experts Group were found to have potential population or pest effect increases following riparian habitat restoration. Studies on the effects of riparian habitat restoration in the Colusa Subreach indicated that ground squirrels are common in agricultural habitats but not in riparian habitat. This suggests that riparian habitat restoration will not lead to increased California ground squirrel populations in adjacent agricultural lands although there may be a short term shift in populations to adjacent farms that provide suitable habitat when restoration projects are first implemented. In the long term, ground squirrel populations are expected to decrease in the Subreach with loss of their preferred (agricultural) open habitat and with closure of the riparian forest habitat areas as they mature.

The California vole population is likely to increase slightly in riparian habitat restoration sites in comparison to agricultural sites which also provide habitat. The increase may be substantial but is expected to occur only during the first few years due to changes in plant species composition brought about by clearing existing vegetation and planting new riparian vegetation, and by natural plant recruitment. Long term changes in the population size for this species are dependent on the riparian community type to be restored. In moderately open woodland or mixed shrub-grassland with a mixture of shrubs, grasses, and forbs, vole populations may persist, although perhaps at a smaller size than in agricultural areas. However, a dense forest with a closed canopy would be unlikely to provide habitat for this species.

The western gray squirrel population is unlikely to substantially increase in the Subreach because only 7% of the Subreach land is proposed to be restored. However, restoration of mature riparian forest habitat may lead to localized increases in gray squirrels in established riparian forest restoration sites (over 10 years old). While not confirmed during local research studies thus far conducted, these populations may browse on nearby walnuts.

MEDIUM PRIORITY AVIAN PESTS

No medium priority avian pests identified for study by the Colusa Subreach Advisory Workgroup and External Experts Group were found was found to have a potential population or pest effect increase following riparian habitat restoration. No avian pests were indicated as high priority.

HIGH AND MEDIUM PRIORITY INSECT AND OTHER PESTS

Only one (Lygus bug) of the insect pests identified as high or medium priority for study by the Colusa Subreach Advisory Workgroup and External Experts Group was found was found to have a potential population or pest effect increase following riparian habitat restoration.

Lygus bug populations may have an initial population increase in young restoration sites until the weedy host plants that support them are outshaded or outcompeted by the planted native vegetation. In the long term, Lygus bug populations would be expected to decline as the restored riparian habitats reach maturity. It will be important, however, to control weeds at riparian forest edges and in light gaps, as these areas may harbor weeds conducive to *Lygus*. However, removal or management of weedy verges or field margins should not be attempted if lygus bugs are present since this may encourage the pests to move into orchard trees.

4.3.2 DISCUSSION AND CONCLUSIONS ON PEST EFFECTS

Based on the analyses, it appears that riparian habitat restoration can provide both benefits and risks in terms of changes in pest effects to adjacent or nearby agricultural operations. Strategic planning can also increase the likelihood of benefits while reducing the potential for adverse effects. This conclusion is based on the limited amount of information available on transboundary pest effects arising from riparian habitat restoration adjacent to agricultural operations. The likelihood of changes in pest effects depends on a number of factors including:

- whether adjacent or nearby agricultural land provides the pest's preferred food and habitat and whether it is within the pest's home or dispersal range;
- whether the land to be restored is more or less likely to be infested than the riparian habitat type proposed to be restored;
- how effectively existing pest management practices are in controlling the pests and whether or not changes in pest pressure from a restored riparian habitat site may change the magnitude or frequency of pest control treatments; and
- the size, type and location of riparian habitat types proposed, relative to potentially affected crop types.

The enhancement of ecosystem functions, replacement of weed-infested areas by mature riparian forest, subsidy of natural predators, and installation of barriers to pest dispersal are some of the key factors potentially leading to reduced pest effects on agricultural operations associated with restoration of riparian habitat on adjacent lands. Since only three pest species were found in this analysis to have even a slight increase in population size following riparian habitat restoration, most pest prevention and abatement strategies may be directed toward those three species. If substantial populations of ground squirrels or voles are present on proposed restoration sites, consideration should be given to reducing those populations prior to installing the riparian habitat. Since those populations decrease with increased canopy cover and/or reduced herbaceous plants for forage, consideration should be given to planting densely covered shrub or forest habitat types as buffers or near agricultural fields if research indicates that these species may be a persistent problem in some locations. This is contrary to the existing school of thought that buffer areas should be maintained as grass or other low canopy cover herbaceous vegetation. Currently, the proposed acreage of open canopy riparian habitat types is relatively small (see Table 1-3 in Chapter 1).

Some additional pest prevention and abatement strategies include removing woody debris from decommissioned orchards and controlling weeds in newly establishing riparian habitat restoration sites so they cannot serve as potential pest (e.g., Lygus bug) habitat areas, including overwintering sites for pest species. Enhancement of existing riparian forest habitat could also include the removal of invasive plants that may serve as pest hosts including hybrid black walnut trees that have colonized native riparian habitat from the rootstock of adjacent walnut orchards. If deer populations increase, they may need to be reduced through hunting.

With the exception of studies performed by Langridge (2007), most of the evidence for transboundary invertebrate pest effects between riparian habitats and agricultural operations is speculative or focused on specific pest-host species relationships. Overall, there are few studies specifically focused on the potential for restored natural systems to serve as reservoirs for agricultural pest species. In addition, because crop invertebrate pests are typically heavily controlled through insecticidal and other management practices, it is difficult to find study areas where pest population dynamics are not kept artificially low (Van Der Geest and Evenhuis 1991). Thus, much of the analysis and discussion is based on the potential for certain plant species, often found in isolation or low abundance in natural systems, to serve as hosts for priority invertebrate pest species, rather than whether natural ecosystems, with their numerous control mechanisms, may function as pest reservoirs to agricultural areas. It is unknown, for instance, how much correlation exists between a pest insect's ability to feed on a certain plant species and the potential for that plant, or for the habitat in which that plant grows, to foster the proliferation and spread of that pest. However, there is some evidence indicating that the potential is low for natural systems to harbor and foster the spread of insect pests. Most herbivorous insects exhibit extreme host specificity and may not infest even other congeners of their preferred host species (Menken 1996). Numerous control mechanisms, such as the availability of overwintering sites and the presence of natural enemies, exist in natural systems to keep pest populations in check, so it does not necessarily follow that natural habitats would serve as sources of invertebrate pest organisms to agricultural systems, even if those pests were known to feed on specific plants found in those habitats.

On the other hand, riparian habitat restoration may help reduce pest populations in adjacent agricultural operations as indicated in studies on navel orangeworm, Lygus bug, and peach twig borer. There are various reasons for this. Restoring native riparian habitat can restore some degree of ecological stability that reduces non-native host plants' (weeds) ability to compete with the natural vegetative cover, thereby reducing populations of the pests which use the weeds. Riparian habitat restoration may also reduce pest population densities by subsidizing natural enemies of agricultural pests, such as ants, beetles, wasps, and birds. To get a complete picture, adverse impacts must be balanced against benefits, yet this was beyond the scope of this report.

Preliminary evidence indicates that the likelihood for any increase or decrease in adverse pest effects on nearby or adjacent farmland following riparian habitat restoration will be small. The potential effects will depend on the crop, the pests involved and the proposed restoration habitat types. Because so little scientific data is available on transboundary pest effects between restored riparian habitat and agricultural land, an adaptive management approach should be used with focused research on the high and medium priority pests indicated in Table 4-5. This approach would include monitoring and evaluating pest species usage of different riparian and agricultural habitat types, changes in pest populations, and changes in infestation rates and pest effects to adjacent agricultural operations. Based on findings, adjustments may be made to reduce any detrimental effects in planted restoration sites and/or to modify restoration strategies for future sites. In this way, monitoring can act as both an early warning system for agricultural and riparian habitat management, as well as part of a long term research element to enable improvements in planning for both agriculture and riparian habitat restoration.

5 PEST SOLUTIONS

This chapter includes a description and analysis of potential solutions to address increased pest damage to agricultural land that could result from the restoration of riparian habitat in the Colusa Subreach. These solutions include a mix of conventional practices (e.g., pesticides) and alternative practices (e.g., planting protocols, buffer zones). In addition to this chapter, a detailed discussion of conventional control measures for specific pests is provided in Section 4.2.

As discussed in Chapter 4, with only 7% of the Subreach proposed for riparian habitat restoration and only about 11% of the perimeters of the restoration tracts directly adjacent to cropland, the anticipated change in pest populations and pest effects is unlikely to be substantial. For the most part, riparian habitat does not support agricultural pests evaluated in this study, and there may be a decrease in pest effects. Pest effects that do occur, however, could shift to farmlands adjoining a few of the restoration sites. It is important to note however, that all of those farmlands already are bounded by at least some riparian habitat and in some cases, they are substantially surrounded by riparian habitat. As a result, it is expected that the proposed restoration will not introduce completely new influences on the existing cropland. This study found a chance for potentially slight increases in pest effects from California ground squirrel, western gray squirrel, California vole, and Lygus bug following riparian habitat restoration, at least in the first few years of site establishment.

Increased pest populations and damage to crops are typically reduced or eliminated through two main approaches, prevention and abatement. A number of pest solutions do both. In addition, coordination between project proponents and neighboring property owners may be able to address some pest damage issues that can arise from restoring riparian habitat. Solutions considered under these three categories include:

Pest prevention

- Restoration design solutions
- Habitat type configuration
- Planting protocols
- Buffer zones
- Biological control
- Adaptive management, pest monitoring, and research

Pest abatement

- Pesticides
- Trapping and shooting

Coordination with neighbors

- Good Neighbor Policy
- Coordination during restoration design
- Coordination during restoration implementation

Sections 5.1, 5.2, and 5.3 describe the possible solutions, and Section 5.4 includes an evaluation and comparison of these solutions.

5.1 PEST PREVENTION

This section describes pest prevention approaches including restoration design solutions; biological control; and adaptive management, pest monitoring, and research.

5.1.1 RESTORATION DESIGN SOLUTIONS

The following section describes restoration design solutions (e.g., habitat type configuration, planting protocols, buffer zones) that may be employed to limit pest populations in restored riparian habitat or limit pest movement between restored riparian habitat and adjacent agricultural lands.

HABITAT TYPE CONFIGURATION

The potentially slight increases in pest effects from California ground squirrel, California vole, and Lygus bug may be minimized by avoiding restoration of open canopy habitat types such as savanna, open woodland, or shrub-grassland community types near adjacent agricultural property. The likelihood of these pests using open canopy habitat types is higher than their use of closed canopy habitat types such as forests. However, since the likelihood of increased pest effects from these species is small, and because little is currently known regarding the real value of planting different habitat types to further reduce potential pest problems, further research should be conducted before making decisions on planting configurations based on this potential. Also, western gray squirrel, a fourth potential pest species, favors closed canopy habitats.

PLANTING PROTOCOLS

Although there may be some potential for native species such as valley oak, wild rose, box elder, ash, coyote brush, and blackberry to be a host for leafroller pests, the density of these hosts will be lower than agricultural crop host plants and will be mixed in with non-host native plants. In addition, these native plant species are highly valuable and essential for riparian habitat to function. It is also uncertain to what extent the pest species that might use these plants in other settings would actually infest the specific species that would be planted in the restoration sites, nor whether controls such as various predators supported by the restored habitat would negate any potential use by pests. For all these reasons, the project proponents should not avoid planting native riparian plants near adjacent farmland. Long term research should be considered to determine the extent to which pest populations are supported by these plants when planted in restored habitat and the tendency for pest effects to occur on agricultural lands as a result.

California black walnut (*Juglans californica* var. *hindsii*) has limited potential to be an alternate host for several insect pest species, in particular walnut husk fly. Omitting native California black walnut from riparian restoration planting protocols in close proximity to orchards is therefore important. Fortunately, black walnut is not part of the planting palette for native plant communities proposed for restoration sites in the Colusa Subreach and has not been included in any restoration planting along the Sacramento River. Black walnut (at least the hybrid black walnut trees now prevalent in Central Valley riparian forests) is not considered a desirable species for native riparian forests along the Sacramento River. This is because hybrid black walnut trees have dispersed from orchard rootstock and colonized and invaded riparian forests along Sacramento Valley streams and rivers. They are increasingly seen as a significant threat to native plants and the habitat quality for wildlife. This is discussed in more detail in the northern California black walnut section within "Section 4.2 – codling moth."

Not planting native California black walnut would not prevent existing hybrid black walnut trees from dispersing naturally to the restoration sites from nearby riparian forest habitat. The spread of hybrid black walnut trees into restoration sites is likely to be low, however, where source populations in adjacent areas are small or where the planting density of competing native plants is sufficient. Conversely, restoration sites with substantial hybrid walnut trees nearby or with lower planting densities of competing native trees and shrubs may experience higher rates of recruitment by invasive hybrid walnuts. Regardless, the density of hybrid black walnut trees that could potentially spread into restoration sites would be lower than the density of host walnut orchards and would be mixed in with non-host native plants. Short-term monitoring by the project proponent to actively search for and remove all hybrid black walnut saplings in the proposed restoration sites could be effective and fairly simple, depending on the size of the restoration site. However, a long-term monitoring program may be logistically infeasible as the restoration sites mature and become more structurally complex.

If applicable, a neighboring orchard grower could also plant a cultivar on his or her farm that repels particular pest species (Flint 1998). Cultivars that require minimal pesticides, have reduced pest loads and are pest resistant would be most appropriate. In the Subreach, for example, walnut farmers have begun planting walnut varieties that are less susceptible to codling moth and blight infestations (Pickel, pers. comm., 2007).

BUFFER ZONES

As with other pest prevention strategies, a buffer zone is a tool useful to consider to reduce pest effects; however, buffer zones may be unnecessary given the likelihood that pest populations will be reduced or show only small increases following riparian habitat restoration. The goal of a buffer zone or barrier is to provide an area between different land use types that would reduce or eliminate potential damages to the adjacent land uses and assist with a successful transition between them. Buffer zones located between riparian habitat and farmland may be unvegetated (e.g., disced firebreak), vegetated (e.g., grassland, scrub), or a primary or secondary crop (e.g., orchard, row crop, pasture). The buffer zone may be located on conservation property or farm property. Buffer zones are also discussed in Chapter 3 as a potential solution for regulatory constraints that could affect neighboring farmers when riparian habitat is restored to adjacent properties.

There are several advantages to incorporating a buffer zone. Buffer zones may be effective against insect pests directly and indirectly. As a non-habitat zone, they can reduce the potential for pest dispersal. If they provide habitat for species that prey on insect pests, they can provide natural controls to some pest populations. In addition, vegetated buffer zones typically need minimal maintenance activity. Maintenance consists mainly of vegetation management (mowing, irrigation if needed, weeding) and litter removal. General maintenance costs are about $350/acre/year (adapted from SWRPC 1991). This cost, even when adjusted to match current rates, is relatively inexpensive and might overlap with regular landscape maintenance costs. In addition, buffer zones could potentially be used to grow crops, which can offset potential damage costs to the primary crop on the main property by providing a profit from the buffer zone crop.

Buffer zones may not be effective against all possible pests, however. In general, they are likely to be fairly ineffective in stopping vertebrate pest damage, depending on the species. For example, a vegetated buffer of mowed grass may be effective in preventing the exchange of codling moth between orchards and riparian forests by providing a barrier to movement, but would not be expected to deter the spread of vertebrate pests such as California voles, Botta's pocket gopher, or California ground squirrel in the Subreach unless it was at least 400–900 feet wide (based on home and dispersal ranges for these species) and did not itself provide habitat for those species.

Appropriate buffer zones for the Colusa Subreach may be focused primarily on further reduction in California ground squirrel, California vole, and Lygus bug population sizes. The most appropriate habitat type to minimize these populations would be a dense closed canopy shrub or tree type with low cover of herbaceous plants. These might include willow scrub, densely planted rose/Bachharis scrub, cottonwood riparian forest, or valley oak riparian forest. The forest habitats could, however, promote population increases of western gray squirrel.

5.1.2 BIOLOGICAL CONTROL

Biological control, or biocontrol, may be used by riparian habitat restoration proponents on the restoration site as a preventative pest control measure. Biocontrol, in the area of pest management, is defined as the use of native or introduced beneficial organisms that are a natural enemy of the pest to prevent and/or control damage to crops. Natural predators are highly varied and include raptors, insects, nematodes, fungi, bacteria, viruses and microbial organisms. The choice of the predator depends on the pest species that needs to be controlled. Examples of biocontrol measures applicable to the Subreach include bird nest boxes and/or bat boxes, and parasitic wasps.

There are a number of advantages of using a biocontrol approach. It should have little to no adverse effect on the environment or non-target wildlife, given that biocontrols now go through a long research and approval process.

Biocontrol does not use any chemicals, thus avoiding concerns of unintentional effects of those chemicals. There are benefits to the species used as natural predators. For instance, putting up barn owl and bat boxes also increases available habitat for these animals.

Birds and bats are important insect predators, particularly during the spring and summer when they are raising their young. Their activities complement each other. Birds, including hawks and owls, feed on small rodents such as mice and voles, while bats feed on mosquitoes, moths, and other nocturnal insects. Birds and bats are both amenable to living in artificial shelters—free-standing or attached to a tree (Dufour 2000). To be effective near areas infested with rodent pests, four to six owl nest boxes should be established for every 50 acres of habitat (Hoffman 1997). For bats, three to five houses that accommodate 500–800 bats may be beneficial for each restoration site. There is minimal cost and maintenance required for either box type. Boxes can be constructed from wood or plastic, sometimes even recycled material may be used, and they only need to be cleaned 1–2 times per year. Also, neighboring farmers would have no responsibility for cost or maintenance when the bird nest and bat boxes are placed in the riparian habitats.

Use of owl nest boxes or bat boxes has been shown to be effective in reducing pest populations. For example, in a study where owl nest boxes were established along the Sacramento River, boxes were rapidly colonized and California voles were the top prey item for barn owls (Golet and Bogiatto, unpublished data).

Generally biocontrol for insect pests can be effective on or near small farms and with minor infestations or population levels. However, biocontrol is not as effective when the pest infestation or population is already high or for large operation farms (Flint 1998).For example, commercial growers mass-release the egg parasite *Trichogramma* as a preventative pest control strategy when peak egg-laying by codling moth is occurring (Flint 1998). 12,000 *Trichogramma* will treat up to 500 square feet. For orchards, field crops, and other crops, a farmer needs to use 40,000 - 200,000 per acre on a weekly basis for 2–6 weeks during peak seasons. However, the use of *Trichogramma* wasps to control codling moth in the Subreach was attempted but was found to be too expensive (Pickel, pers. comm., 2007). Biocontrol cannot always keep codling moth populations below economically damaging levels and must be supplemented with other control methods in order to be effective. In addition, there is often a high amount of maintenance involved.

5.1.3 ADAPTIVE MANAGEMENT, PEST MONITORING, AND RESEARCH

While adaptive management, pest monitoring, and research are included as part of pest prevention solutions, they can be applied to all areas of pest management. Simply stated, adaptive management is the practical cycle of planning, implementing, monitoring, evaluating and refining the plans and implementation, based on whether and how well the approach is achieving the planned goals and objectives. With a goal of minimizing pest effects and maximizing benefits in terms of pest effect reductions to nearby and adjacent farmland, riparian habitat restoration projects and farmlands can be monitored for pests and pest effects related to various combinations of crops; habitat types, sizes, distances, and ages; plant composition; restoration management approaches; and other factors.

Pest monitoring is conducted throughout the year to determine when pest populations reach a threshold that warrants a response with one or more pest solutions (Flint 1998). Monitoring makes all pest solutions more cost-effective when properly conducted. It can be applied to restoration sites in transboundary areas adjacent to agricultural lands as an early warning system that facilitates early application of potential solutions. If problems persist, monitoring can be used to determine if and when pests reach a threshold at which to apply a specific treatment. The monitoring can be conducted by either the riparian habitat restoration proponent or the farmer, or both, in a cooperative agreement.

Long term research is clearly needed to provide sound scientific understanding of agricultural-riparian habitat transboundary pest effects and potential solutions. A list of recommended research studies is provided below in Section 5.6.

Adaptive management, pest monitoring, and research are likely to provide a better understanding of pest effects and solutions, and facilitate the development of guidelines to avoid restoration-related increases in pest effects and further reduce pest effects in comparison to existing conditions.

5.2 PEST ABATEMENT

5.2.1 PESTICIDES

Pesticides are chemical applications to the air, soil, or crops/plants that are widely used to reduce pest populations and crop damage. Some common examples in the Colusa Subreach include spraying insecticides in an orchard for treatment of walnut husk fly, and hand-baiting pocket gopher burrows with grains containing 0.5% strychnine. Pesticides are frequently used as a part of a multi-layered control approach consisting of monitoring, timely harvest, control with low impact pest specific methods like insect growth regulators, and the use of broad spectrum pesticides for serious insect infestations.

Pesticides, in particular insecticides, are generally conventional farmers' top choice for pest control for several reasons. First, pesticides are very effective at reducing populations if used properly. For example, populations of walnut husk fly have been successfully reduced by spraying pyrethroids and organophosphates on the walnut crop (Krueger, pers. comm., May 2007). In addition, pesticides are readily available and easy to use, can be used over large areas to control large populations of pests, and are often cost effective, and treatments can be rapidly implemented, as needed and with minimal lag time.

However, pesticides can have several disadvantages, depending on the pesticide. One disadvantage is pesticide resistance. In an attempt to achieve better or total pest control, pesticide resistance problems have increased because pesticides are applied more frequently, at higher dosage rates, and/or without rotation of pesticide types (i.e., active ingredients) for the same crop. With each passing generation, the pest population becomes more difficult to control with the same pesticides. Another disadvantage is that many pesticides are toxic to non-target wildlife. In addition to timing and location of use constraints that result from this effect, some pesticides can also have unintended consequences on natural controls. For example, gypsy moths do not reach problematic population levels every year throughout the Northeast because many different natural enemies help to keep them in check. Unfortunately, many broad-spectrum, non-selective pesticides are more detrimental to beneficial species than to the pests. The use of such pesticides often causes resurgences in pest populations and at a much faster rate compared to the natural enemies (Adams and Clark 1996). Other environmental disadvantages of using pesticides include public health and environmental concerns. Pesticide sprays can drift to non-target areas and contaminate ground and surface waters. Finally, some pesticides are becoming more expensive due to increasing problems with pest resistance and increased fuel costs necessary for application (Adams and Clark 1996).

While pesticide use in agricultural settings is typically well defined and understood, pesticide use in riparian habitat is less understood. Pesticides, if used in riparian habitat, must be used by licensed or qualified personnel in accordance with label directions, as elsewhere. However, due to the unknown effects of many pesticides, particularly insecticides, on the ecological balances among non-target beneficial insects, pesticides may be inadvisable within riparian habitat areas except for localized spot treatments to target isolated pest outbreaks.

5.2.2 TRAPPING AND SHOOTING

This section covers lethal pest control without the use of pesticides. For more detail specific to each pest species mentioned below, refer to Section 4.2, Responsiveness to Control Measures. While pests discussed in this section are not considered likely to increase in population size or effects following restoration, and some may in fact decrease, methods to control them are discussed nonetheless as a tool to address possible localized issues. Controlled hunting is an effective measure used to reduce mule deer populations. However, in order for this method to be successful, does must be removed annually (Lee 1998). Trapping in most situations where American beavers are causing damage is the most effective, practical, and environmentally safe method of control (Miller

and Yarrow 1994). For insect pests, pheromone traps are often used en mass (1 to 2 per tree) in many regions, including the Colusa Subreach to reduce codling moth populations (Flint 1998, Pickel, pers. comm., 2007). In order for this approach to be effective, however, it needs to be used in combination with sanitation and other control methods (Flint 1998).

Trapping and shooting can be very effective, depending on the pest species in question. The advantage to this approach over pesticides is that it has less chance of leading to adverse effects on the environment when conducted properly. Additionally, this approach is flexible in terms of which party is responsible for implementing the pest control. Farmers can use trapping or shooting methods on their property, or project proponents can bear the responsibility of conducting control measures. For example, the project proponent could set up pheromone bait stations for codling moth at key sites near borders with orchards.

There are some disadvantages to the use of trapping and shooting. The main problem is that this approach is only effective at reducing a few out of the many pest species analyzed in this study. There is also the chance that vertebrate and invertebrate pests can become conditioned to trap locations or become resistant to pheromone types.

5.3 COORDINATION WITH NEIGHBORING PROPERTY OWNERS

Many, if not most, of the actions and approaches described below have been implemented by the project proponent in previous restoration efforts in the Sacramento River Valley. These actions have the potential to make the riparian habitat restoration process run more smoothly and avoid and/or minimize potential problems.

5.3.1 GOOD NEIGHBOR POLICY

The Sacramento River Conservation Area Forum (SRCAF) has recently approved a Good Neighbor Policy (GNP) to address neighboring landowner concerns throughout the Sacramento River Conservation Area, which includes this report's study area. This policy is introduced in Section 3.2.1, and is included in its entirety in Appendix I.

Portions of the SRCAF GNP that are especially relevant to pest effects include the recommendations that proponents of land use changes communicate with their neighbors regarding possible concerns, conduct studies to evaluate potential adverse effects to neighboring land uses, consider the establishment and maintenance of buffer zones, and consider contingency funds to provide for unforeseen adverse effects to neighbors. Many of the recommendations made in this report are consistent with what is called for under the GNP.

Advantages of a GNP include an emphasis on personal responsibility for all involved parties. The approved GNP states that it "envisions all landowners being good stewards of the land." In addition, there is an intended prompt response.

5.3.2 COORDINATION DURING RESTORATION DESIGN

The project proponent has several methods available to create an atmosphere of positive collaboration and cooperation with neighboring landowners. First, the project proponent could designate a specific contact person to field any questions or concerns of landowners. TNC does this with each project. For example, Gregg Werner and Ryan Luster are designated contacts for the proposed restoration in the Colusa Subreach.

Second, the project proponent could develop baseline assessments of the proposed habitat restoration and provide these assessments to interested parties. TNC has developed baseline assessments for each of the eight proposed restoration tracts in the Subreach as published by California State University, Chico (CSUC 2006, 2007). These reports include aerial photographs and GIS analyses which may help landowners anticipate where and how their property may be affected by proposed activities. Exhibits 1-3 to 1-8 in Chapter 1 of this document, for example,

are from the CSUC baseline assessment reports, and depict the locations of the eight proposed restoration areas and adjacent agricultural lands.

Third, the project proponent could arrange multiple meetings with neighboring landowners and other concerned parties during the design process. For example, for the proposed Subreach restoration, TNC has participated in establishing an Advisory Workgroup to provide a forum for project outreach and input, and an External Experts Group to provide expert guidance on the study design and interpretation of results. Since these groups have been formed, TNC and EDAW have facilitated several meetings to discuss current and emerging concerns and potential solutions with neighboring landowners.

Finally, the project proponent could provide neighboring landowners with draft restoration plans containing details of the proposed restoration activities along with a list of adjustments made to address landowners' concerns. These draft plans take the design process a step further than what is provided in baseline assessment reports in that they include adjustments to planting designs, as required, to reduce societal impacts. See Golet et al. (2006), listed in Chapter 7, for a review of the typical scientific studies that are conducted to assess societal impacts of habitat restoration on the Sacramento River. Interested landowners may obtain copies of the draft restoration plans by contacting Ryan Luster or Gregg Werner at TNC (contact information is provided on this report's title page.

5.3.3 COORDINATION DURING RESTORATION IMPLEMENTATION

Once the proposed project has been implemented and enough time has passed to assess any restoration effects, the project proponent should discuss these effects and any related concerns with neighboring landowners. This would help to resolve ongoing problems and, potentially, prevent their occurrence in future projects. The project proponent should also adjust restoration and management protocols, as needed, following an adaptive management approach (as described above in the Pest Prevention section).

5.4 EVALUATION OF POTENTIAL PEST SOLUTIONS

This section includes an evaluation and comparison of the potential pest solutions. The following six criteria were used in the evaluation, focused on each solution's likelihood for successfully addressing pest issues in the Colusa Subreach:

- ***Simplicity to apply*** – Simplicity of implementation (simpler is preferred);
- ***Effects on pests*** – Efficacy in reducing pest effects to neighboring farms (higher effectiveness is preferred);
- ***Adverse non-target effects*** – Adverse effects on the riparian ecosystem and non-target species (lower level of adverse effects is preferred);
- ***Duration of benefits*** – The duration of beneficial effects (longer duration is preferred);
- ***Maintenance period*** – The duration of required actions to maintain beneficial effects (shorter maintenance period is preferred); and
- ***Cost*** – Relative cost of solution and maintenance (low cost is preferred).

Table 5-1 includes the results of the pest solution evaluations. The evaluations are based on knowledge of the ecology of pests found or expected to occur in the Colusa Subreach, professional experience, and the best available science. They are most useful in making relative comparisons among the solution choices.

Because studies are often lacking on these possible pest solutions, the evaluation results should be considered preliminary and subject to change pending further research and better understanding. The evaluation results will also vary depending on the circumstances (i.e., depending on the crop, pests, and other factors involved).

Table 5-1
Overall Evaluations of Various Solutions to Increased Pest Damage in the Colusa Subreach

Solution	Simplicity to apply	Effects on pests	Adverse non-target effects	Duration of benefits	Maintenance period	Cost
Pest Prevention Solutions						
Restoration Design: Habitat Type Configuration	Simple	Assumed to be effective if habitat type is unavailable	May reduce habitat value to wildlife	Long term, but there may be some transitioning among habitat types (succession) at certain sites	Short, unless succession needs to be arrested	Low to medium, depending upon maintenance needs
Restoration Design: Planting Protocol	Simple	Assumed to be effective if host plant is unavailable	Potential to reduce native habitat	Long term, but some potential for host plant (e.g., black walnut) to colonize in long-term	Long, if continuous host plant removal is needed	Low to medium, depending upon maintenance needs
Restoration Design: Buffer Zones	Simple	Effective against invertebrates; efficacy against vertebrate pests likely low for grassland, higher for closed canopy	Reduces native habitat area if included on restoration site	Long term for invertebrates; duration against small vertebrate pests may be long if closed canopy buffer	Short or long if continued maintenance is needed	Low to medium, depending on buffer type and maintenance needs
Biological Control	Simple	Generally effective only with low infestation levels or in combination with other measures	Benefits native predators; generally no detrimental effects	Depends on biocontrol agent and pest	Short to long	Low
Adaptive Management, Pest Monitoring, and Research	Generally simple	None; can improve efficacy of other solutions	None	Can help to lengthen benefit period	Long	Low to medium; most importantly, reduces costs for other solutions
Pest Abatement Solutions						
Pesticides	Simple	Effective	None to potentially detrimental, depending on pesticide formulation, timing and use	Requires frequent applications; risk of pesticide resistance over time	Generally short	Generally low

Table 5-1
Overall Evaluations of Various Solutions to Increased Pest Damage in the Colusa Subreach

Solution	Simplicity to apply	Effects on pests	Adverse non-target effects	Duration of benefits	Maintenance period	Cost
Trapping and Shooting	Simple	Effective, but only against select group of species	No effect	Unlikely to be effective in long-term—pests may become conditioned to control	Short	Generally low
Coordination with Neighboring Property Owners						
Good Neighbor Policy	Complex	Not applicable	Not applicable	Depends on local parties and situation	Depends on local parties and situation	Unknown and possibly difficult to assess; depends on difference in crop loss and crop value between like farms adjacent and not adjacent to riparian habitat
Coordination During Design	Simple	Not applicable	Not applicable	Depends on local parties and situation	Not applicable	Medium; depends on number of meetings, plan analyses and modifications required
Coordination During Implementation	Simple	Not applicable	Not applicable	Depends on local parties and situation	Not applicable	Depends on implementation changes needed

Source: EDAW 2007

5.5 POTENTIAL PEST SOLUTIONS CONCLUSIONS

Solutions to potential increased pests and/or damage presented in this chapter include a mix of tested and untested approaches. The evaluation results comparing potential solutions are based on professional judgment, with very limited information from studies, because very few studies have been conducted.

It is important to note two points that are well known among farmers and the pest control community. First, each of the potential solutions described in this chapter greatly depends on the context, including factors such as weather, soil type, proximity to habitat features, crop variety, the biology and ecology of the pest species, and interactions with non-target species. In other words, what may work well in one location to control one pest may be ineffective in a different location or when applied to a different pest species. Second, the best solution is likely to be one that integrates many of the above measures and customizes the measures to each farm. Therefore, an adaptive management approach, as discussed above should be followed when implementing all solution activities.

Additional studies will be needed to determine if, when, and where pest problems increase or decrease as a result of riparian habitat restoration adjacent to farmland. When pest problems of sufficient magnitude occur, studies will be needed to determine the true efficacy, environmental risk, duration of benefits, maintenance period, and

cost for different pest solutions, or combinations of solutions, in different crop and pest situations, and which solutions and combinations are best to use in each situation.

5.6 PEST SOLUTIONS RECOMMENDATIONS

The following are recommendations to reduce pest effects to adjacent agricultural properties by using appropriate riparian restoration practices:

- Conduct long term research to provide scientific understanding of agricultural-riparian habitat transboundary pest effects on the following areas:
  - usage patterns and the abundance of key Subreach pests such as California ground squirrel, mule deer, black-tailed jackrabbit, Audubon's cottontail, western gray squirrel, coyote, vole, and lygus bug in different Sacramento River habitat types,
  - the potential for restored open-canopy riparian habitats such as valley oak – elderberry savannah to support agricultural pest species,
  - the potential for local cross-boundary effects in riparian-agricultural versus agricultural-agricultural field settings,
  - the potential for restored natural systems to serve as reservoirs for agricultural pest species; specifically, how much will a pest proliferate and spread to agricultural areas from different riparian habitats that contain the pest's host plant,
  - the extent to which riparian habitat restoration may also reduce pest population densities by subsidizing natural enemies of agricultural pests,
  - the effectiveness of different buffer types between various habitat types and crop types, and
  - the effectiveness of combining solutions; specifically, the effectiveness of combining owl nest boxes with closed canopy buffer zones to minimize pest (primarily ground squirrel, western gray squirrel, vole and lygus bug) populations and effects on agricultural properties.
- Develop guidelines, based on research results, to avoid increases in pest effects and possibly reduce pest effects in comparison to existing conditions;
- If feasible, assess current and planned future crops and determine consistent key pest issues on adjacent or nearby agricultural properties;
- Choose buffer zone habitat types based on the pest species effects to minimize. Open canopy habitat types may actually increase pest damages from vertebrate pest species by providing habitat for small vertebrate populations. Closed canopy types such as dense riparian scrub communities and forests may be best for the Colusa Subreach, to minimize effects from ground squirrel, vole, and lygus bug; however these habitat types may promote western gray squirrel.
- Conduct best restoration area management practices such as clearing away woody debris from decommissioned orchards and removing weeds from newly establishing riparian habitat restoration sites so they cannot serve as potential pest habitat areas, including overwintering sites for pest species;
- Enhance existing riparian habitat, where feasible, by removing invasive plants that may serve as pest hosts, such as black walnut hybrids;

- Utilize monitoring of riparian restoration sites for pests and pest effects to serve as an early warning system for agricultural and riparian habitat management;
- Conduct best pest management practices including active treatment of pest infestations, as needed;
- Coordinate and establish a forum for regular communication with adjacent and nearby landowners and floodplain or levee maintenance entities to resolve issues and maximize good neighbor actions during restoration planning, and during and following implementation; and
- Establish an adaptive management approach (monitor, evaluate, and refine management actions) to better understand how and where to modify planted riparian habitats to minimize or reduce pest effects.

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USFWS. *See* U.S. Fish and Wildlife Service.

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APPENDIX A

Members of the Colusa Subreach Planning Advisory Workgroup

APPENDIX A
MEMBERS OF THE COLUSA SUBREACH PLANNING ADVISORY WORKGROUP

Name	Title, Association
Don Anderson	Glenn County Farmer, Landowner Representative on Sacramento River Conservation Area Forum Board of Directors
Beverley Anderson-Abbs	Manager, Sacramento River Conservation Area Forum
Annalena Bronson	Project Manager, California Department of Water Resources
Denny Bungarz	Glenn County Supervisor, Public Interest Representative on Sacramento River Conservation Area Forum Board of Directors
John Garner	Colusa County Farmer, Board Member, Princeton Codora Glenn Irrigation District
Armand Gonzales	Supervising Biologist, California Department of Fish and Game
Greg Golet	Ecoregional Ecologist, The Nature Conservancy
Kelly Moroney	Assistant Refuge Manager, Sacramento River National Wildlife Refuge, United States Fish and Wildlife Service
Dan Obermeyer	Planning and Public Works Director, Glenn County
Brendan Reed	CALFED Ecosystem Restoration Program
Denise Reichenberg	Supervising Ranger, California Department of Parks and Recreation

APPENDIX B

Members of the Pest and Regulatory Effects Study External Experts Group

APPENDIX B
MEMBERS OF THE PEST AND REGULATORY EFFECTS STUDY EXTERNAL EXPERTS GROUP

Name	Title, Association
David Alves	Farmer adjacent to the Womble proposed restoration site; also Secretary/Treasurer, Northern California Water Association (NCWA)
Beverley Anderson-Abbs	Manager, Sacramento River Conservation Area Forum (SRCAF)
Allison Barrett	University of California Davis student
Stacy Cepello	Environmental Program Manager, California Department of Water Resources
Kim Davis	Assistant to Senator Sam Aanestad
John Edstrom	Pomology Farm Advisor, University of California Cooperative Extension, Colusa County
Ashley Emery	Executive Director, Family Water Alliance
Lincoln Forry	Farmer adjacent to the Ward proposed restoration site
Allan Fulton	Irrigation and Water Resources Farm Advisor, University of California Davis Cooperative Extension, Tehama, Glenn, Colusa, and Shasta counties
Bob Gaines, Jr.	Farmer adjacent to the Jensen proposed restoration site
Armand Gonzales	Supervising Biologist, California Department of Fish and Game
Warren Halsey	Farmer adjacent to the Ward proposed restoration site
Paul Hofmann	Wildlife Biologist, California Department of Fish and Game (DFG)
Mike Hoover	Deputy Assistant Field Supervisor, United States Fish and Wildlife Service
John Hunt	Wildlife Biologist, US Department of Agriculture, Natural Resource Conservation Service
William Krueger	County Director and Farm Advisor, University of California Cooperative Extension, Glenn County
Suzanne Langridge	Doctoral Student, Department of Environmental Studies, University of California, Santa Cruz – research focus on pests and pest control
Gregory Maciel	Farmer adjacent to the Boeger proposed restoration site
Catrina Martin	United States Fish and Wildlife Service; also *Ex-officio* member of SRCAF
Carolyn Pickel	Sacramento Valley Regional Integrated Pest Management (IPM) Farm Advisor, University of California Cooperative Extension and the UC IPM Program
Ed Richter	Farmer adjacent to the 1,000 Acre Ranch proposed restoration site
Jon Richter	Deputy County Agricultural Commissioner, Colusa County
Ken Sanchez	Assistant Field Supervisor, United States Fish and Wildlife Service
Tom Scott	University of California Riverside Cooperative Extension
Ajay Singh	Stony Creek Watershed Coordinator, Glenn County Resource Conservation District; also Technical Advisory Committee (TAC) Chairman, SRCAF
Jeff Sutton	Executive Director (previous position), Family Water Alliance
Fred Thomas	Agricultural Specialist, Cerus Consulting
Woodford “Woody” and Kathy Yerxa	Farmers adjacent to the 1000 Acre Ranch proposed restoration site
Minghua Zhang	Professor, University of California, Davis, and Statistician for California Pesticide Information Portal

APPENDIX C

Environmental Laws and Regulations Websites

APPENDIX C
ENVIRONMENTAL LAWS AND REGULATIONS WEBSITES

The following web pages may be accessed for the full text of the natural resource laws and regulations discussed in Chapter 2, Regulatory Effects. All websites were accessed in 2007.

Bald and Golden Eagle Protection Act of 1940: http://ipl.unm.edu/cwl/fedbook/eagleact.html.

California Code of Regulations (3 CCR 6400-6489 and 3 CCR 6800-6960) sections on restricted and exempt pesticide materials and environmental protections pursuant to the California Food and Agricultural Code: http://www.cdpr.ca.gov/docs/inhouse/calcode/chapter_.htm.

California Endangered Species Act. *See* Sections 2050-2100 of the California Fish and Game Code.

California Environmental Quality Act: http://ceres.ca.gov/ceqa/.

California Fish and Game Code: http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fgc&codebody=&hits=20.

California Food and Agricultural Code: http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fac&codebody.

CEQA. *See* California Environmental Quality Act.

CESA. *See* California Endangered Species Act.

Clean Water Act: http://www.epa.gov/region5/water/cwa.htm.

Endangered Species Act: http://www.epa.gov/region5/defs/html/esa.htm.

ESA. *See* Endangered Species Act.

Federal Insecticide, Fungicide, and Rodenticide Act: http://www.epa.gov/region5/defs/html/fifra.htm.

Federal Register searchable database of documents 1994-present: http://www.gpoaccess.gov/fr/index.html.

This database includes the following documents referenced in this report: MBTA updated list of covered species on August 24, 2006 (71 FR 50194).

NPDES water transfers proposed rule on June 7, 2006 (71 FR 32887).

NPDES aquatic pesticide final rule on November 27, 2006 (71 FR 68483).

FIFRA. *See* Federal Insecticide, Fungicide, and Rodenticide Act.

Irrigated Lands Waiver. *See* Regional Water Quality Control Board Irrigated Lands Waiver.

Magnuson-Stevens Fishery Conservation and Management Act: http://www.nmfs.noaa.gov/sfa/magact/

MBTA. *See* Migratory Bird Treaty Act.

Migratory Bird Treaty Act: Text of the law: http://www.fws.gov/migratorybirds/intrnltr/treatlaw.html

Updated list of birds protected by the law: *See* Federal Register.

Exception for birds depredating crops: http://www.fws.gov/permits/.

National Environmental Policy Act: http://www.epa.gov/region5/defs/html/nepa.htm.

NEPA. *See* National Environmental Policy Act.

NPDES. *See* Federal Register.

Pesticide Label Restrictions searchable database: http://www.epa.gov/pesticides/pestlabels/.

Porter-Cologne Water Quality Control Act (California Water Code section 13000 *et seq*.):
www.swrcb.ca.gov/water_laws/docs/portercologne.pdf.

PRESCRIBE database searchable by location, crop, and/or pesticide product:
http://www.cdpr.ca.gov/docs/es/prescint.htm.

Regional Water Quality Control Board Irrigated Lands Waiver:
http://www.swrcb.ca.gov/rwqcb5/programs/irrigated_lands/.

APPENDIX D

Pesticides Used in the Study Area

APPENDIX D
LIST OF PESTICIDES USED IN THE STUDY AREA IN 2004

Product Name	Registration Number
ABOLISH 8 EC RICE HERBICIDE	59639-79-ZA
AD-WET	7001-50516-AA
BOLERO 15G	59639-112-AA
BRAVO WEATHER STIK	50534-188-AA-10182
BROAD SPRED	1051080-50020-AA
CAPTAN 50-WP	10182-145-ZA-51036
CERANO 5 MEG	279-3269-AA-2935
CLEAN CROP MALATHION 8-E INSECTICIDE	34704-452-AA
CLINCHER	62719-1012-EE
CLINCHER CA	62719-356-AA
CONFIRM 2F AGRICULTURAL INSECTICIDE	707-238-AA
COPPER SULFATE CRYSTALS	56576-1-ZA
CROP OIL CONCENTRATE	17545-50008-AA
CROP OIL CONCENTRATE	5905-50085-AA
DEVRINOL 50-DF SELECTIVE HERBICIDE	10182-258-AA-70506
DIAZINON 50W	51036-108-AA
DIMILIN 2L	400-461-AA
DIREX 4L	1812-257-AA
DIREX 4L	1812-257-ZA
DIREX 80DF	1812-362-AA
DREXEL CAPTAN 50W	19713-235-AA
DREXEL SIMAZINE 4L	19713-60-AA
DU PONT ASANA XL INSECTICIDE	352-515-AA
DU PONT LANNATE INSECTICIDE	352-342-ZA
DU PONT LONDAX HERBICIDE	352-506-AA
DU PONT MATRIX HERBICIDE	352-556-AA
DU PONT STEWARD INSECTICIDE	352-598-AA
DU PONT VELPAR L HERBICIDE	352-392-ZA
ETHEPHON 2	51036-243-AA
ETHREL PLANT REGULATOR	264-267-AA
FIRE POWER HERBICIDE	524-520-AA
FREEWAY	36208-50030-AA
GALIGAN 2E OXYFLUORFEN HERBICIDE	66222-28-AA
GLY STAR ORIGINAL	42750-60-AA
GOAL 2XL	62719-424-AA
GOAL 2XL HERBICIDE	707-243-AA
GORDON'S ORCHARD MASTER BROADLEAF HERBICIDE	2217-703-ZA
GRAMOXONE MAX	100-1074-AA
GRAMOXONE SUPER HERBICIDE	10182-103-AA

Product Name	Registration Number
GRANDSTAND CA	62719-215-AA
GUIDE-IT	65343-50002-AA
HASTEN	2935-50160-AA
HELENA AGRI-DEX	5905-50017-AA
HELENA INDUCE	5905-50066-AA
HONCHO HERBICIDE	524-445-ZE
IMIDAN 70-WP	10163-169-AA
IMIDAN 70-WSB	10163-184-AA
INDUCE	5905-50091-AA
IN-PLACE	2935-50169-AA
KARMEX DF HERBICIDE	1812-362-ZB
KELTHANE MF AGRICULTURAL MITICIDE	707-202-AA
KINETIC	38167-50012-AA
KOCIDE 101	1812-288-AA
KOCIDE 2000	1812-358-AA
KOCIDE DF	1812-334-AA
LOCK-ON INSECTICIDE	62719-79-AA
LORSBAN 4E-HF	62719-220-AA
LORSBAN-4E	62719-220-ZA
MANEX	1812-251-AA
MANEX	1812-251-ZA
MO-BAIT	36208-50002-AA
MON-35085	524-445-AA
MUSTANG 1.5 EW INSECTICIDE	279-3126-ZA
NORDOX	48142-1-AA
NORDOX 75 WG	48142-4-AA
NU-COP 50DF	51036-269-AA
NU-COP 50WP	51036-270-AA
OMITE-30W	400-82-AA
OMITE-30WS	400-427-AA
OMITE-6E	400-89-AA
ORDRAM 15-GM	10182-420-AA
PENNCAP-M MICROENCAPSULATED INSECTICIDE	4581-393-AA
PERM-UP 3.2 EC INSECTICIDE	70506-9-AA
PHT CROP OIL CONCENTRATE	65343-50010-AA
PHT CROP OIL CONCENTRATE CA	7001-50006-AA
POUNCE 3.2 EC	279-3014-AA
PRISM HERBICIDE	59639-78-AA
PROWL 3.3 EC HERBICIDE	241-337-AA
QUADRIS FLOWABLE FUNGICIDE	10182-415-ZB
QUADRIS FLOWABLE FUNGICIDE	100-1098-ZA
QUEST	5905-50076-AA

Product Name	Registration Number
R-11 SPREADER-ACTIVATOR	2935-50142-AA
R-56 SPREADER-STICKER	2935-50144-AA
RED TOP SUPERIOR SPRAY OIL	2935-311-AA
RED-TOP MOR-ACT ADJUVANT	2935-50098-AA
REGIMENT CA HERBICIDE	59639-105-AA
RELY HERBICIDE	264-652-AA
RIVERDALE SOLUTION WATER SOLUBLE	228-260-AA
RNA ACTIVATOR 85	1050990-50016-AA
RNA BUPHER	1050990-50015-AA
RNA CROP OIL CONCENTRATE 1915	1050990-50012-AA
RNA TRI-AD 73	1050990-50011-AA
ROUNDUP ORIGINAL HERBICIDE	524-445-ZF
ROUNDUP ORIGINAL MAX HERBICIDE	524-539-AA
ROUNDUP PRO HERBICIDE	524-475-ZA
ROUNDUP ULTRA HERBICIDE	524-475-ZB
ROUNDUP ULTRAMAX HERBICIDE	524-512-AA
SHARK HERBICIDE	279-3194-AA
SIMAZINE 90DF	19713-252-AA
SMOOTH SPREAD 100	1050950-50001-AA
STAM 80 EDF HERBICIDE EXTRUDED DRY FLOWABLE	707-226-AA
STAM 80EDF HERBICIDE EXTRUDED DRY FLOWABLE (WITHDRAWN)	62719-413-AA
STRIKE ZONE DF	5905-50084-AA
SUNSPRAY 11E	862-9-AA
SUPER SPREAD 7000	2935-50170-AA
SUPER WHAM! CA	71085-5-ZA
SUPRACIDE 25W	10163-244-AA
SYLGARD 309	2935-50161-AA
SYL-TAC	2935-50167-AA
TENKOZ TRIFLURALIN 10G	62719-131-AA-55467
THIOLUX JET	100-1138-AA
TRIANGLE BRAND COPPER SULFATE ALGICIDE-HERBICIDE	1278-8-AA
TRI-FOL	2935-50152-AA
TRILIN 10G HERBICIDE	1812-328-ZA
WARRIOR INSECTICIDE WITH ZEON TECHNOLOGY	10182-434-ZA
WARRIOR INSECTICIDE WITH ZEON TECHNOLOGY	100-1112-AA
WARRIOR T INSECTICIDE	10182-434-AA
WHAM! EZ CA	71085-5-AA
WILBUR-ELLIS SPREADER STICKER R-56	2935-50144-ZA

Source: California Pesticide Information Portal 2004

APPENDIX E

PRESCRIBE Query Results: Pesticide Use Restrictions for Endangered Species in the Colusa County Study Area

APPENDIX E
PRESCRIBE QUERY RESULTS FOR THE COLUSA SUBREACH, COLUSA COUNTY

Department of Pesticide Regulation
California Pesticide Information Portal

Endangered Species Custom Bulletin

Endangered Species Pesticide Use Limits

Step 5. Use Limit Codes for Selected Products

Pesticide use limitations for the products that you have selected, applicable to the species identified in your locations, if they exist, are listed below. Scroll to the bottom of the page to see a description/instruction of the use limits.

For protection of the following species:

- [E] CHINOOK SALMON SACRAMENTO WINTER RUN ESU
- [T] VALLEY ELDERBERRY LONGHORN BEETLE
- [R] WESTERN YELLOW-BILLED CUCKOO
- [R] BANK SWALLOW
- [R] SWAINSON'S HAWK
- [R] WILLOW FLYCATCHER

That occur in the following selected sections:

County	Township	Range	Sections
06 Colusa	16N	01W	04 , 05 , 07 , 08 , 09 , 10 , 15 , 16 , 17 , 18 , 19 , 20 , 21 , 22 , 27 , 28 , 29 , 31 , 33 , 34 , 35 , 36
06 Colusa	16N	02W	03 , 14 , 23 , 36
06 Colusa	17N	01W	04 , 05 , 06 , 07 , 08 , 09 , 16 , 17 , 18 , 19 , 20 , 21 , 28 , 29 , 30 , 31 , 32 , 33
06 Colusa	17N	02W	15 , 22 , 26 , 27 , 34 , 35
06 Colusa	18N	01W	31 , 32 , 33 , 34

When using selected products:

Product	Use Limits
BRAVO WEATHER STIK	10 , 15 , 16 , 17
CAPTAN 50-WP	10 , 15 , 16 , 17
CLEAN CROP MALATHION 8-E INSECTICIDE	10 , 15 , 16 , 17

Product	Use Limits
CONFIRM 2F AGRICULTURAL INSECTICIDE	10 , 15 , 16 , 17
COPPER SULFATE CRYSTALS	10 , 15 , 16 , 17
DIAZINON 50W	10 , 15 , 16 , 17
DREXEL CAPTAN 50W	10 , 15 , 16 , 17
DU PONT ASANA XL INSECTICIDE	10 , 15 , 16 , 17
DU PONT LANNATE INSECTICIDE	10 , 15 , 16 , 17
DU PONT LONDAX HERBICIDE	11 , 15 , 16 , 17
IMIDAN 70-WSB	10 , 15 , 16 , 17
KOCIDE 101	10 , 15 , 16 , 17
KOCIDE 2000	10 , 15 , 16 , 17
LOCK-ON INSECTICIDE	10 , 15 , 16 , 17
LORSBAN 4E-HF	10 , 15 , 16 , 17
LORSBAN-4E	10 , 15 , 16 , 17
MANEX	10 , 15 , 16 , 17
NU-COP 50DF	10 , 15 , 16 , 17
NU-COP 50WP	10 , 15 , 16 , 17
OMITE-30W	10 , 15 , 16 , 17
OMITE-30WS	10 , 15 , 16 , 17
OMITE-6E	10 , 15 , 16 , 17
PENNCAP-M MICROENCAPSULATED INSECTICIDE	10 , 15 , 16 , 17
PERM-UP 3.2 EC INSECTICIDE	10 , 15 , 16 , 17
POUNCE 3.2 EC	10 , 15 , 16 , 17
PROWL 3.3 EC HERBICIDE	11 , 17
QUADRIS FLOWABLE FUNGICIDE	10 , 15 , 16 , 17
SUPRACIDE 25W	10 , 15 , 16 , 17
TENKOZ TRIFLURALIN 10G	11 , 17
TRIANGLE BRAND COPPER SULFATE ALGICIDE-HERBICIDE	10 , 15 , 16 , 17
TRILIN 10G HERBICIDE	11 , 17

That contain these active ingredients (chemicals):

- SIMAZINE
- TRISODIUM PHOSPHATE
- SYNTHETIC VEGETABLE GUMS
- SULFUR
- ALPHA-OCTYLPHENYL-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- ALPHA-2,6,8-TRIMETHYL-4-NONYLOXY-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- DIMETHYLPOLYSILOXANE
- METHYL PARATHION
- METHOMYL
- DIAZINON
- CITRIC ACID
- CALCIUM CHLORIDE
- TRIFLURALIN
- RIMSULFURON
- ALPHA-[PARA-(1,1,3,3-TETRAMETHYLBUTYL)PHENYL]-OMEGA-HYDROXYPOLY(OXYETHYLENE)

That contain these active ingredients (chemicals):

- AMMONIUM SULFATE
- PROPYLENE GLYCOL, METHYL ETHER
- OLEIC ACID
- THIOBENCARB
- CAPTAN
- CHLOROTHALONIL
- ORCHEX 796 OIL
- FATTY ACIDS DERIVED FROM TALLOW
- INDOXACARB
- CYHALOFOP BUTYL
- BISPYRIBAC-SODIUM
- ALPHA-ALKYL (C10-C14)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- TRICLOPYR, TRIETHYLAMINE SALT
- SORBITAN FATTY ACID ESTERS
- ALPHA-(PARA-NONYLPHENYL)-OMEGA-HYDROXYPOLY (OXYETHYLENE) SULFATE, AMMONIUM SALT
- PERMETHRIN
- PETROLEUM DISTILLATES, ALIPHATIC
- CLOMAZONE
- AZOXYSTROBIN
- METHYL PARATHION, OTHER RELATED
- CAPTAN, OTHER RELATED
- TEBUFENOZIDE
- CARFENTRAZONE-ETHYL
- (S)-CYPERMETHRIN
- POLYETHYLENE GLYCOL MONO(3-(TETRAMETHYL-1-(TRIMETHYLSILOXY)DISILOXANYL)PROPYL)ETHER
- LAMBDA-CYHALOTHRIN
- SOYBEAN FATTY ACIDS, DIMETHYLAMINE SALT
- HEXAZINONE
- 4-NONYLPHENOL, FORMALDEHYDE RESIN, PROPOXYLATED
- ETHEPHON
- BENZOIC ACID
- TALL OIL FATTY ACIDS
- OLEIC ACID, METHYL ESTER
- ALPHA-ALKYL (C9-C11)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- METHYL SILICONE RESINS
- MOLASSES
- MINERAL OIL
- ISOPROPYL ALCOHOL
- MALATHION
- GLYPHOSATE, ISOPROPYLAMINE SALT
- ALPHA-(PARA-DODECYLPHENYL)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- ALPHA-ALKYL (C12-C14)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- 2,4-D, DIETHANOLAMINE SALT
- CHLORPYRIFOS
- 2,4-D, DIMETHYLAMINE SALT
- PARAQUAT DICHLORIDE
- PHOSMET
- DIURON
- PENDIMETHALIN

That contain these active ingredients (chemicals):

- ESFENVALERATE
- HYDROTREATED PARAFFINIC SOLVENT
- 2-(3-HYDROXYPROPYL)-HEPTA-METHYL TRISILOXANE, ETHOXYLATED, ACETATE
- MANEB
- METHIDATHION
- MOLINATE
- NAPROPAMIDE
- ALPHA-(PARA-NONYLPHENYL)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- COPPER HYDROXIDE
- OXYFLUORFEN
- POLYETHYLENE GLYCOL DIACETATE
- POLYACRYLIC POLYMER
- PROPARGITE
- PROPANIL
- PROPYLENE GLYCOL
- PETROLEUM OIL, PARAFFIN BASED
- PETROLEUM DISTILLATES, REFINED
- PHOSPHORIC ACID
- ALLYLOXYPOLYETHYLENE GLYCOL ACETATE
- BENSULFURON METHYL
- BUTYL ALCOHOL
- COPPER SULFATE (PENTAHYDRATE)
- GLYPHOSATE, POTASSIUM SALT
- ALPHA-ALKYL (C12-C16)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- POLYOXYETHYLENE SORBITAN MIXED FATTY ACID ESTERS

Observe Use Limits for Selected Products:

Code	Use Limitations
10	Do not use in currently occupied habitat (see Species Descriptions table for possible exceptions).
15	Provide a 20-foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur. Prepare land around fields to contain run-off by proper leveling, etc. Contain as much water "on-site" as possible. The planting of legumes, or other cover crops for several rows adjacent to off-target water sites is recommended. Mix pesticides in areas not prone to runoff, such as concrete mixing/loading pads, disked soil in flat terrain, or graveled mix pads, or use a suitable method to contain spills and/or rinsate. Properly empty and triple-rinse pesticide containers at time of use.
16	Conduct irrigations efficiently to prevent excessive loss of irrigation waters through run-off. Schedule irrigations and pesticide applications to maximize the interval of time between the pesticide application and the first subsequent irrigation. Allow at least 24 hours between application of pesticides listed in this bulletin and any irrigation that results in surface run-off into natural waters. Time applications to allow sprays to dry prior to rain or sprinkler irrigations. Do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application.
17	For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift.
11	Do not use in currently occupied habitat except: (1) as specified in Habitat Descriptors, (2) in organized habitat recovery programs, or (3) for selective control of invasive exotic plants.

APPENDIX F

PRESCRIBE Query Results: Pesticide Use Restrictions for Endangered Species in the Glenn County Study Area

APPENDIX F
PRESCRIBE QUERY RESULTS FOR THE COLUSA SUBREACH, GLENN COUNTY

Department of Pesticide Regulation
California Pesticide Information Portal

Endangered Species Pesticide Use Limits

Step 5. Use Limit Codes for Selected Products

Pesticide use limitations for the products that you have selected, applicable to the species identified in your locations, if they exist, are listed below. Scroll to the bottom of the page to see a description/instruction of the use limits.

For protection of the following species:

- [E] CHINOOK SALMON SACRAMENTO WINTER RUN ESU
- [R] WESTERN YELLOW-BILLED CUCKOO
- [R] BANK SWALLOW

That occur in the following selected sections:

County	Township	Range	Sections
11 Glenn	18N	01W	08 , 09 , 10 , 15 , 16 , 17 , 18 , 19 , 20 , 21 , 22 , 27 , 28 , 29 , 30

When using selected products:

Product	Use Limits
COPPER SULFATE CRYSTALS	10 , 15 , 16 , 17
DIMILIN 2L	10 , 15 , 16 , 17
DU PONT ASANA XL INSECTICIDE	10 , 15 , 16 , 17
DU PONT LONDAX HERBICIDE	11 , 15 , 16 , 17
IMIDAN 70-WP	10 , 15 , 16 , 17
KELTHANE MF AGRICULTURAL MITICIDE	10 , 15 , 16 , 17
KOCIDE DF	10 , 15 , 16 , 17
LORSBAN 4E-HF	10 , 15 , 16 , 17
MANEX	10 , 15 , 16 , 17
OMITE-30WS	10 , 15 , 16 , 17
PENNCAP-M MICROENCAPSULATED INSECTICIDE	10 , 15 , 16 , 17
PERM-UP 3.2 EC INSECTICIDE	10 , 15 , 16 , 17
QUADRIS FLOWABLE FUNGICIDE	10 , 15 , 16 , 17

That contain these active ingredients (chemicals):

- DIFLUBENZURON
- DIMETHYLPOLYSILOXANE
- METHYL PARATHION
- CITRIC ACID
- CALCIUM CHLORIDE
- AMMONIUM SULFATE
- OLEIC ACID
- THIOBENCARB
- ORCHEX 796 OIL
- POLYSILOXANE
- DERIVATED NATURAL POLYMERS
- CYHALOFOP BUTYL
- BISPYRIBAC-SODIUM
- POLYOXYETHYLENE POLYOXYPROPYLENE
- TRICLOPYR, TRIETHYLAMINE SALT
- SORBITAN FATTY ACID ESTERS
- ALPHA-(PARA-NONYLPHENYL)-OMEGA-HYDROXYPOLY (OXYETHYLENE) SULFATE, AMMONIUM SALT
- PERMETHRIN
- POLYACRYLAMIDE, POLYETHYLENE GLYCOL MIXTURE
- PETROLEUM DISTILLATES, ALIPHATIC
- CLOMAZONE
- AZOXYSTROBIN
- METHYL PARATHION, OTHER RELATED
- GLUFOSINATE-AMMONIUM
- (S)-CYPERMETHRIN
- LAMBDA-CYHALOTHRIN
- SOYBEAN FATTY ACIDS, DIMETHYLAMINE SALT
- HEXAZINONE
- 4-NONYLPHENOL, FORMALDEHYDE RESIN, PROPOXYLATED
- ETHEPHON
- BENZOIC ACID
- TALL OIL FATTY ACIDS
- OLEIC ACID, METHYL ESTER
- ALPHA-ALKYL (C9-C11)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- MINERAL OIL
- GLYPHOSATE, ISOPROPYLAMINE SALT
- ALPHA-(PARA-DODECYLPHENYL)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- DICOFOL
- CHLORPYRIFOS
- PARAQUAT DICHLORIDE
- PHOSMET
- DIURON
- ESFENVALERATE
- HYDROTREATED PARAFFINIC SOLVENT
- 2-(3-HYDROXYPROPYL)-HEPTA-METHYL TRISILOXANE, ETHOXYLATED, ACETATE
- MANEB

That contain these active ingredients (chemicals):

- ALPHA-(PARA-NONYLPHENYL)-OMEGA-HYDROXYPOLY(OXYETHYLENE)
- COPPER HYDROXIDE
- COPPER OXIDE (OUS)
- OXYFLUORFEN
- POLYETHYLENE GLYCOL DIACETATE
- POLYACRYLIC POLYMER
- PROPARGITE
- PROPANIL
- PETROLEUM OIL, PARAFFIN BASED
- PHOSPHORIC ACID
- ALLYLOXYPOLYETHYLENE GLYCOL ACETATE
- BENSULFURON METHYL
- BUTYL ALCOHOL
- CLETHODIM
- COPPER SULFATE (PENTAHYDRATE)
- POLYOXYETHYLENE SORBITAN MIXED FATTY ACID ESTERS

Observe Use Limits for Selected Products:

Code	Use Limitations
10	Do not use in currently occupied habitat (see Species Descriptions table for possible exceptions).
15	Provide a 20-foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur. Prepare land around fields to contain run-off by proper leveling, etc. Contain as much water "on-site" as possible. The planting of legumes, or other cover crops for several rows adjacent to off-target water sites is recommended. Mix pesticides in areas not prone to runoff, such as concrete mixing/loading pads, disked soil in flat terrain, or graveled mix pads, or use a suitable method to contain spills and/or rinsate. Properly empty and triple-rinse pesticide containers at time of use.
16	Conduct irrigations efficiently to prevent excessive loss of irrigation waters through run-off. Schedule irrigations and pesticide applications to maximize the interval of time between the pesticide application and the first subsequent irrigation. Allow at least 24 hours between application of pesticides listed in this bulletin and any irrigation that results in surface run-off into natural waters. Time applications to allow sprays to dry prior to rain or sprinkler irrigations. Do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application.
17	For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift.
11	Do not use in currently occupied habitat except: (1) as specified in Habitat Descriptors, (2) in organized habitat recovery programs, or (3) for selective control of invasive exotic plants.

APPENDIX G

Sacramento River Conservation Area Forum Good Neighbor Policy

SRCAF BOARD POLICY – ADOPTED MARCH 15, 2007

GENERAL POLICY

It is the fundamental policy of the Sacramento River Conservation Area Forum (SRCAF) to promote communication and understanding among neighbors[1] within the adopted Sacramento River Conservation Area (Conservation Area). As an essential part of this policy, the SRCAF will make every reasonable effort to prevent harm or loss to any person and public or private entity from activities prescribed in the SRCAF Handbook. It is also a policy that the SRCAF will use its resources to promptly address, and resolve to the best of its ability, any conflict between neighbors resulting from activities associated with the implementation of the Handbook within the Conservation Area.

The Sacramento River Conservation Area Forum Board fully recognizes the issues that concern all landowners along the Sacramento River, and is committed to assist in the resolution of those concerns. The SRCAF is a non-governmental entity that does not have legislative nor regulatory authority over local, state and federal programs or funding mechanisms. The SRCAF policies apply and are binding only to its allowed actions as an advisory body.

NEED FOR A GOOD NEIGHBOR POLICY

The SRCAF supports management of water and land resources that is consistent with the overall goals of the SRCAF and principles described in its Handbook. To accomplish these goals, the SRCAF recognizes that historic uses and local concerns must be respected.

The SRCAF appreciates the value of the Sacramento River as a vital habitat area for fish and wildlife and supports the overall goal to; "preserve remaining habitat and reestablish a riparian ecosystem along the Sacramento River between Redding and Chico, and to reestablish riparian vegetation along the river from Chico to Verona".* The SRCAF also appreciates the agricultural heritage of the Sacramento Valley as an important part of the Sacramento River's history, and recognizes that much of the land within the Conservation Area has been in agricultural use for more than a century and provides open space and environmental benefits. The Conservation Area extends through seven rural counties with numerous communities that rely on agriculture as their economic base. Agriculture is an essential life sustaining industry on which many local landowners and communities depend; therefore protection and preservation of agricultural land is a high priority. The SRCAF also recognizes the importance of the Sacramento River as a water supply for the local agricultural economic base and as a public recreation resource. Moreover, flood control for the local citizens, communities, and agricultural lands is also a concern. Therefore, all activities within the Conservation Area must demonstrate planning and management that is sensitive to agricultural needs, public safety, recreation, and flood protection, along with fish and wildlife and their habitat.

[1] "Neighbor" pertains to adjacent, nearby, or "in the vicinity".

* Overall goal of the Sacramento River Conservation Area Handbook, Page 1-1.

Landowners[2] often experience stress and anxiety when other land uses[3] occur near their land because such activities may directly or indirectly affect the normal management of their operation. Conflicts between different land uses are common, and those that can occur between agriculture and riparian habitat pose some unique and serious problems. Restoration of habitat seeks to enhance the living conditions of native flora and fauna. However, managers and operators of neighboring farmlands may consider plant and wildlife species that move from restored habitat areas on to farmlands as pests, predators, or competitors with the production of their crops. Possible impacts to farming operations, crop production, water supply, and flood protection, coupled with the increase in permitting requirements tied to the protection of threatened and endangered species, create an atmosphere where farmers may be opposed to any restoration near their property.

For agricultural operations, some of the possible impacts from neighboring landowners can be those that increase costs of normal farming practices, inhibit routine maintenance of agricultural facilities, add time and effort in performing tasks, and reduce production and profits. Increased crop depredation, rodent damage, and trespass problems can also negatively affect farming programs. In addition, public services and local economies may be affected by activities that impact flood protection, public facilities, recreational uses, and the rural tax base. Small local economies may be seriously affected by significant land use change. Local infrastructure and services depend on established funding streams, and when those are changed, they may never recoup.

It is noted that lands used for habitat can also be affected by activities of their neighbors. Adjacent weed and pest abatement, trespass problems, game disturbance, water management, noise, and dust pollution can create unfavorable conditions for wildlife habitat and key species. Natural ecological processes can also be impacted by nearby farming activities.

While the differences between riparian habitat and farming exist, commonalities are apparent and may offer opportunities upon which to build. Most agricultural landowners are conservation minded and can appreciate habitat on neighboring lands if the habitat and its inhabitants do not have serious negative offsite impacts. Likewise, farming is likely to be a more compatible land use than urban and industrial development on lands adjacent to habitat, especially if offsite impacts to both can be minimized. The challenge is to understand the various land uses to the extent that each can be managed to remove or minimize negative or maximize positive impacts on others. In situations where conflicts or harm do arise, there should be mechanisms established to determine the extent of the impacts and identify the resources available to promptly alleviate adverse effects, compensate the affected parties or assist in finding mutually acceptable solutions to the impacts.

This SRCAF Good Neighbor Policy (GNP) is set forth to outline an approach that all landowners (new, existing, and absentee) should follow in order to comply with the intent and spirit of the SRCAF Handbook. The goal of the GNP is to avoid negative impacts,

[2] For the purposes of this document, the term "landowner" is to apply to private and public entities and their day-to-day operating agents (e.g. managers, lessees, tenants, etc.)

[3] Land uses are those general uses as designated by the respective county planning body (e.g. agricultural, residential, commercial, industrial, etc.)

address and resolve unavoidable impacts, and foster good communication and relationships among neighbors and communities. The GNP is intended to apply to land management activities within or affecting the Conservation Area, including changes in land use where habitat is actively developed, develops naturally, or is converted to agricultural or other uses. The GNP is not intended to apply to those cultural practices normally used in farming or habitat conservation operations or to the normal maintenance practices required of public entities for public safety, as long as those practices are undertaken within the law, and with reasonable consideration to prevent impacts to others.

The Good Neighbor Policy envisions all landowners being good stewards of the land, understanding the issues facing their neighbors and the implications of land use practices on the neighbors and community. Only with this understanding can one avoid negative impacts. Open and honest communication is a very important tool in being a good neighbor.

POLICY ACTIONS

The Sacramento River Conservation Area Forum resolves to take the following actions to address the potential impacts discussed above:

1. **Communication and Review -** The SRCAF recommends that prior to initiating any land use or management actions, all landowners within the Conservation Area be considerate of, and communicate with, those neighbors potentially affected. In particular, those landowners conducting activities that affect flood control, agriculture, habitat, and recreation must be sensitive to conflicts that could arise. Consistent with that belief, the following items should be incorporated into all proposals and project[4] plans prior to beginning any physical changes to the property to help avoid any adverse impacts.

    a. Proponents of proposals for changes in land use shall emphasize proactive communication with neighbors and the community. While developing proposals and plans, project proponents should introduce themselves to all potentially affected landowners and describe the anticipated project and the desired outcome of the project. Through SRCAF Project Review[5] and discussion with nearby landowners, project proponents need to anticipate potential impacts and incorporate appropriate actions to avoid or minimize impacts to their neighbors. Their proposals should describe the activities they've undertaken to initiate proactive communication and should further describe their plans to continue communication through the completion of their project.

    b. Proponents shall designate a local contact person for their project who would make every reasonable effort to meet with adjacent landowners and discuss any issues that may be of concern. This individual should be readily known by

[4] For the purposes of this document, a "project" is defined as an activity that uses or affects public resources.

[5] "Project Review" is SRACF Policy # 3 that outlines a process and criteria for SRCAF review of publicly funded proposals and projects.

neighboring landowners and county officials and must be empowered to the maximum extent possible to address questions and problems relating to the management of the project.

c. To the extent required by law, project proponents shall follow the local processes for land use, including county permitting and zoning, and if applicable, provide environmental analyses that conform to the California Environmental Quality Act and the National Environmental Policy Act. The SRCAF will not endorse any project that has not met its legal requirements. Projects not required by law to comply with local processes for land use (such as State and Federal projects) are highly encouraged to develop proposals consistent with the spirit and intent of local plans and ordinances.

d. To the extent feasible, or as required by law, project proponents shall provide a series of baseline studies of the land targeted for conversion of land use. Where appropriate, social/economic, cultural, biologic, topographic, hydrologic and geomorphic studies should be done to help guide proposed changes in use and ascertain the potential impacts of such changes to adjacent lands. These data can also serve as a reference to demonstrate changes to the baseline condition on the project site.

e. The proposal or plan shall describe any infrastructure that may be necessary to manage access in and out of the project area and prevent trespass on adjacent landowner property.

f. As part of the development of plans to minimize negative impacts to adjacent landowners, project proponents shall consider incorporating buffer zones or barriers on the project property. The goal of a buffer zone or barrier is to provide an area between different land uses that would reduce or eliminate damage to neighboring lands and assist with a successful transition between types of land use. When a buffer or barrier is deemed appropriate, a plan to incorporate, fund and maintain this area in the final project must be included.

g. A project must include an analysis of possible flood impacts and a plan to prevent or address those impacts, as required by the State Reclamation Board or local responsible agency.

h. A source of contingency funds should be identified for each project to provide a means to remedy unforeseen adverse impacts where they may occur. This could include performance bonds, escrow accounts or a similar set-aside of funds. In some instances, a legal or procedural mechanism for providing such funds has yet to be identified, but could be specified in a Bond Act or by legislative action. Those funds would be controlled by the funding agency to address needs that require prompt resolution and be available for only a specified length of time after the project completion date. The SRCAF will continue to investigate and support such funding mechanisms.

2. **SRCA Mitigation Area and Regulatory Assurances -** The SRCAF will work to promote the concept of the Sacramento River Conservation Area as a "self-mitigating area"; where implementation of the activities prescribed in the 1989 Plan and Handbook are anticipated to provide significant net conservation benefit to fish, wildlife, and their habitats within the Conservation Area. Additionally, the SRCAF will work with signatory agencies and stakeholders to identify and pursue mechanisms that will minimize, avoid or eliminate the potential for conflict that might arise due to provisions of federal and state Endangered Species Acts. The goal of this effort would be to provide landowners in proximity to restoration sites assurance that increases in populations of listed threatened or endangered species due to restoration actions will not adversely affect their otherwise lawful current or future operations.

   A Programmatic Safe Harbor Agreement (PSHA), would allow non-profits, agencies, or private landowners to do habitat restoration pursuant to an agreement that would allow "take" of listed species which might occur "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" provided that such incidental take does not reduce the local populations of the covered species below some pre-determined baseline. Neighbors connected in some way to these restored properties would also be able to sign up under the PSHA and receive incidental take protections allowing them to avoid Endangered Species Act liability for any "otherwise lawful activities", such as existing and routine farming activities. They could also be protected from future restrictions associated with additional species or habitat on their land, and be able to return their lands to baseline levels in the future (notwithstanding requirements associated with funding received for the work). Similarly, under state law, a Voluntary Local Program could allow for "taking of any covered species whose conservation and management is provided for", and will be investigated for coverage of state listed species and their habitat.

   A *Programmatic* Safe Harbor Agreement, as opposed to an individual Safe Harbor Agreement, would have the SRCAF as the permit holder for covered activities within the Conservation Area, thereby allowing landowners to access the regulatory assurances without direct contact with agencies.

   a. The SRCAF will work with habitat project implementers, and with the agencies responsible for ensuring that a project's adverse impacts on fish and wildlife resources are mitigated, to minimize or avoid having additional mitigation requirements imposed on such projects. It is recognized that net conservation benefits for non-listed species are not appropriate mitigation for adverse impacts to listed species.

   b. The SRCAF will work with entities responsible for public works projects (i.e. flood management projects, water supply projects, other infrastructure projects, etc.) and maintenance thereof to meet any mitigation requirements they may face by brokering agreements with conservation project implementers. Such agreements could include contributing resources (funds, equipment, manpower, etc.) in exchange for net conservation benefit credits to meet mitigation needs. Using this approach, it is highly likely that net conservation benefits can be shown while simultaneously minimizing mitigation requirements and permitting time for routine

activities. In addition, it could help those entities significantly in meeting any Federal Section 7 consultation requirements.

c. The SRCAF will work on behalf of private landowners in order that they might avail themselves of some of the "net conservation benefits" created by the habitat restoration/enhancement efforts of others to meet mitigation requirements they might face. In such instances, the SRCAF might facilitate agreements between the habitat project implementers, the regulatory agencies, and the private landowner, in which some credits that accrue to a habitat restoration/enhancement project may be used to offset the private landowner's mitigation requirement in exchange for some consideration or action by the landowner (e.g. help in implementing a conservation project or measure, use of equipment or supplies, or similar consideration to be decided among the affected parties).

d. As a means of helping to achieve the habitat restoration goals of the 1989 Plan and Handbook, the SRCAF will also promote establishment of mitigation and/or conservation banking within the Conservation Area. Consideration will be given to developing conservation banking on a project-by-project basis or through a formal bank in accordance with state and federal guidelines. Priority will be given to establishing banks within the Conservation Area but they may also be outside and still contribute to the overall goal of establishing a viable habitat focused ecosystem.

3. **Conflict Resolution -** It is the intent of the SRCAF to facilitate a voluntary process to help resolve unforeseen conflicts between project activities and neighboring landowners in a quick, responsive, and cost-effective manner. It is sound policy to anticipate and resolve potential conflicts between the management, conservation and protection of fish and wildlife resources and their habitats and private and public activities. Therefore, the SRCAF will work with landowners and agencies involved in projects within the Conservation Area to utilize an informal means of settling disputes before they embark on other, more legalistic processes. This would not replace existing legal remedies: instead, it would provide a locally based alternative process for resolution of conflicts before legal remedies are instituted.

   The SRCAF, as soon as possible, but no later than fifteen (15) days after receiving written notification of a conflict, shall offer to convene the parties involved, both county SRCAF Board members, and technical experts as needed to resolve the issue. The group may bring the issue to the SRCAF's Technical Advisory Committee for technical advice or to the Board for a recommendation to the parties involved. The recommendation may include: no action, remedial action, preventative action, or identification of potential resources available (financial, technical, etc.) to resolve the issue.

Addendum "A":

Some of the possible impacts on neighboring landowners and communities are:

1. Impaired drainage of both flood water and surface (irrigation) water due to discontinued maintenance of drainage or flood control structures.
2. Farming delays and crop loss resulting from seepage and flooding.
3. Increased maintenance of hard points (ex: pumping plants, fish screens, bridges, boat landing/ramps) and facilities/infrastructure (ex: ditches, pipelines, fences, roads, parks and recreation resources) due to siltation, erosion, woody debris, and river meander.
4. Crop depredation from wildlife.
5. Migration of invasive and noxious weeds.
6. Curtailment of normally accepted agricultural practices (ex: aerial spraying and baiting) resulting in higher production costs and possible crop loss.
7. Abnormal changes in local ground water aquifers.
8. Migration of present or future endangered/threatened species stopping any or all agricultural activities.
9. Increased trespass.
10. Increased fire risk due to build up of vegetation and forests and possible increased public access and use.
11. Closure of public lands and loss of public use.
12. Loss of revenue to counties and special districts (ex: fire, irrigation and mosquito abatement) due to removal of property from local tax rolls.
13. Increased local government operation and maintenance costs such as fire protection, law enforcement.
14. De-stabilization of rural, agricultural-based economies resulting from removal of land from production and from the implementation of the federal and state Endangered Species Acts.
15. The increased cost or inability to perform operation and maintenance or repairs of flood control projects.
16. The increased cost or inability to provide flood fight response or implement federal or state public safety programs (PL84-99 or USACE Projects).
17. The increased cost or inability to maintain, modify, or expand the existing design function (i.e. flow splits at weirs) and actual carrying capacities of flood control projects.
18. Harm to habitat and species from toxic substances.
19. Harm to habitat and species from nutrients (ex: fertilizers and amendments) entering habitat from adjacent properties.
20. Harm to habitat and species from sediment runoff, noise and dust from adjacent property.
21. Loss of wildlife that wanders onto adjacent lands.
22. Loss or disturbance of nesting or rearing habitat.
23. Loss due to trespass from adjacent land.
24. Loss of wildlife and habitat caused by feral or domestic animals or livestock.

APPENDIX H

Turlock Irrigation District and Reclamation Board MOA on
Tuolumne River Restoration Project

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

GRAY DAVIS, *Governor*

THE RECLAMATION BOARD
1416 NINTH STREET, ROOM 1601
SACRAMENTO, CA 95814
(916) 653-5434 FAX: (916) 653-5805
Permits: (916) 653-5726 FAX: (916) 653-5805

Mr. Wilton Fryer
Turlock Irrigation District
Post Office Box 949
Turlock, California 95381-0949

Dear Mr. Fryer:

As requested, a signed copy of the "Memorandum of Agreement by and between Turlock Irrigation District and The Reclamation Board regarding the Tuolumne River Restoration Project," with all attachments, is enclosed.

If you have any questions, you may contact me at (916) 653-8089.

Sincerely,

Stephen T. Bradley

Stephen T. Bradley
Chief Engineer

Enclosure

MEMORANDUM OF AGREEMENT BY AND BETWEEN

TURLOCK IRRIGATION DISTRICT AND THE RECLAMATION BOARD

REGARDING THE TUOLUMNE RIVER RESTORATION PROJECT

The Reclamation Board (Board) and the Turlock Irrigation District (TID), as the Don Pedro Project Manager, have entered into this Memorandum of Agreement (MOA) to define the responsibilities of each agency with respect to the planting and maintenance of elderberry shrubs (*Sambucus caerulea*) within the designated floodway of the Tuolumne River for TID's Tuolumne River Restoration Project. This MOA addresses only two reaches of the Tuolumne River: (1) the Special Run Pools 9 and 10 Reach between River Mile (RM) 25.2 and RM 25.9, and (2) the Gravel Mining Reach between RM 34.3 and RM 40.3 (see Figure 1).

The Board and TID agree as follows:

I. TID shall:

A. be solely responsible for complying with the requirements of the Biological Opinion dated August 4, 2000 prepared by the U.S. Fish and Wildlife Service under formal consultation for the first phase of the Tuolumne River Restoration Project (Biological Opinion). This Biological Opinion is incorporated into this MOA by reference.

B. be solely responsible for complying with the requirements, with respect to the planting and maintenance of elderberry shrubs, of additional Biological Opinions prepared by the U.S. Fish and Wildlife Service under formal consultation during the implementation of future phases of the Tuolumne River Restoration Project, to the extent consistent with this MOA.

C. upon completion of each project phase, file with the Board a map showing the location of all elderberry shrubs within the limits of the designated floodway. Elderberry shrubs that were either planted or transplanted within the limits of the designated floodway as part of the Tuolumne River Restoration Project will be referred to as "project elderberry shrubs." Existing elderberry shrubs within the limits of the designated floodway that were not disturbed by the Tuolumne River Restoration Project will be referred to as "existing native elderberry shrubs." Project elderberry shrubs and existing native elderberry shrubs shall be differentiated on the map submitted to the Board.

D. be solely responsible for all Endangered Species Act consultations involving project elderberry shrubs should future activities, including but

not limited to flood fights, regular channel maintenance, or emergency channel maintenance, occur where project elderberry shrubs are disturbed.

E. be solely responsible for mitigating all impacts to project elderberry shrubs required by Endangered Species Act consultations resulting from future activities, including but not limited to flood fights, regular channel maintenance, or emergency channel maintenance.

F. be solely responsible for maintenance of all valley elderberry longhorn beetle (VELB) habitat in accordance with the Biological Opinion. This includes, but is not limited to, replacement of project elderberry shrubs that do not survive planting or transplanting, removal of all elderberry shrubs of 1 inch or less in diameter at ground level, and replacement of project elderberry shrubs damaged or removed during any future activities, including but not limited to flood fights, regular channel maintenance, or emergency channel maintenance.

G. protect, indemnify, and hold harmless the Board from all responsibility for maintenance of VELB habitat required by the Biological Opinion, future endangered species act consultation, or discussed in Item 6 above.

H. protect, indemnify, and hold harmless the Board from all financial responsibilities for VELB maintenance activities required by the Biological Opinion, future endangered species act consultation, or discussed in Item 6 above.

I. protect, indemnify, and hold harmless the Board from any impacts resulting from or caused by TID's nonconformance to this agreement.

J. reinitiate consultation with the U.S. Fish and Wildlife Service within one year of completion of the project phase covered by the August 4, 2000 Biological Opinion to address receiving credit for any actual overmitigation.

II. The Board shall:

A. be solely responsible for all Endangered Species Act consultations involving existing native elderberry shrubs should future activities, including but not limited to flood fights, regular channel maintenance, or emergency channel maintenance, occur where existing native elderberry shrubs are disturbed.

B. be solely responsible for mitigating all impacts to existing native elderberry shrubs required by Endangered Species Act consultations resulting from

future activities including, but not limited to, flood fights, regular channel maintenance, or emergency channel maintenance.

III. The term of this memorandum shall be concurrent with the term of Reclamation Board Permit No. 17240.

IV. TID shall submit to the Board a resolution or minutes order indicating TID's Board has authorized its general manager to enter into this MOA.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE EXECUTED THIS MEMORANDUM OF AGREEMENT TO BE IN EFFECT AS OF THE DATE LAST WRITTEN

By _____ Date 5/18/01

General Manager
The Reclamation Board
1416 Ninth Street, Room 1601
Sacramento, California 95814

By _____ Date 5/1/01

General Manager
Turlock Irrigation District
333 East Canal Drive
Post Office Box 949
Turlock, California 95381

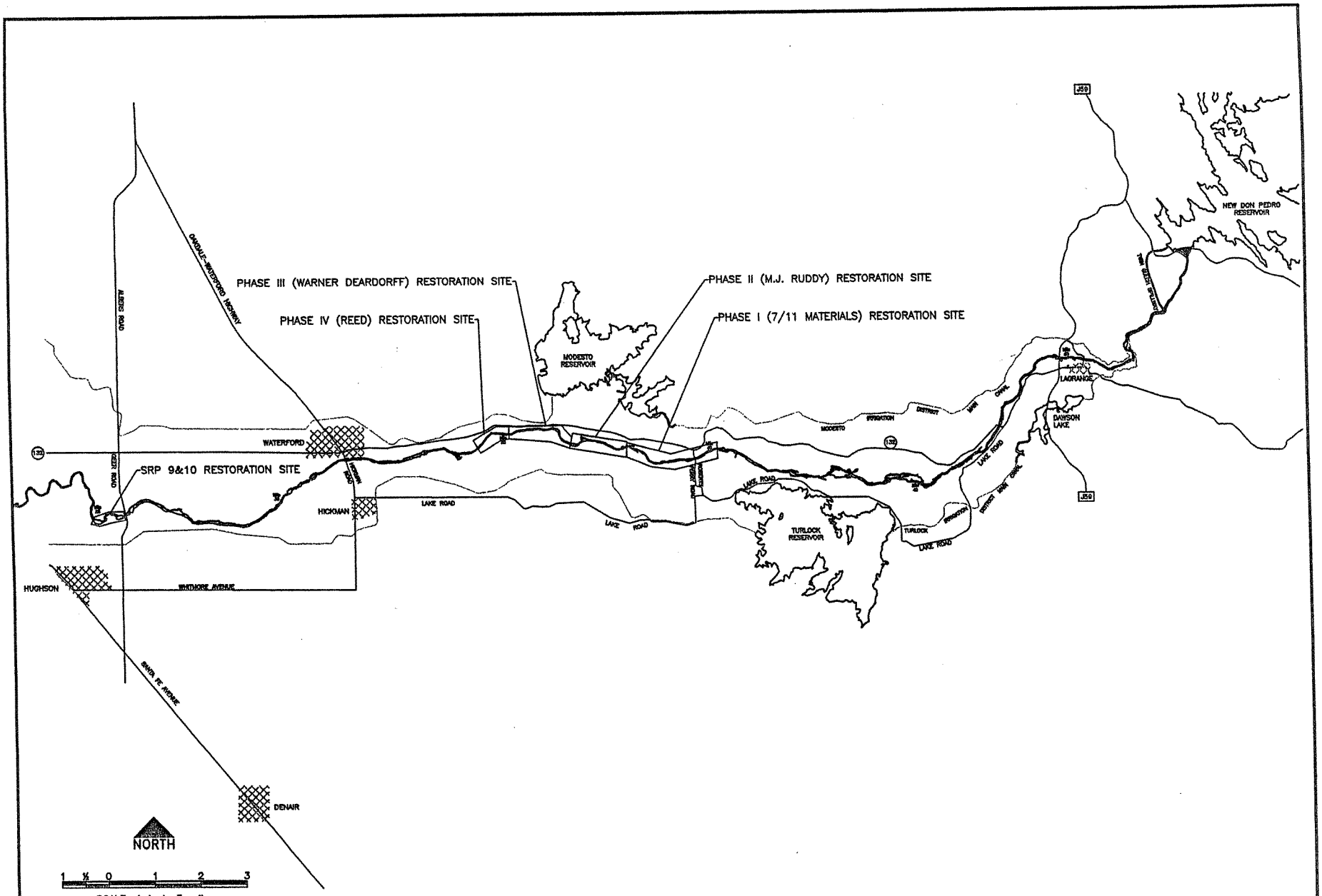

FIGURE 1. TUOLUMNE RIVER
GRAVEL MINING REACH AND SRP 9&10
RESTORATION SITE LOCATIONS

McBain & Trush 1998

6/18/98

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
1-1-00-F-0155

August 4, 2000

Memorandum

To: Program Manager, Sacramento-San Joaquin Estuary Fishery Resource Office, Anadromous Fish Restoration Program, U.S. Fish and Wildlife Service, Stockton, California (Attn: Mr. Martin Kjelson)

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Formal Consultation on the Tuolumne River Restoration Project, Segment 7/11 of the Gravel Mining Reach, Tuolumne River, Stanislaus County, California

This is in response to your request for formal consultation with the Sacramento Fish and Wildlife Office (SFWO) on Segment 7/11 of the Tuolumne River Restoration Project, Tuolumne River, Stanislaus County, California. Your request was received in our office on July 14, 2000. This document represents the SFWO's biological opinion on the effects of the action on the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

This biological opinion is based on information provided in the June 29, 1999, Intra-Service biological consultation; the May 15, 1998 draft Environmental Assessment and Initial Study; a letter from EDAW, Inc. dated May 30, 2000; telephone conversations with SFWO biologist Larry Host between February 2000 and June 2000; field investigations; and other sources of information. A letter of concurrence with "not likely to adversely affect" for Central Valley steelhead trout (*Oncorhynchus mykiss*) and Central Valley fall run chinook salmon (*Oncorhynchus tshawytscha*) was received from the National Marine Fisheries Service on June 14, 1999 (Attached). The SFWO has previously determined that the project is not likely to adversely affect other federally listed and proposed species (file no. 1-1-I-99-1581). A complete administrative record of this consultation is on file in this office.

Program Manager

BIOLOGICAL OPINION

Description of the Proposed Action

Segment 7/11 restoration proposed by the U.S. Fish and Wildlife Service's (Service) Anadromous Fish Restoration Program (AFRP) is a component of the Tuolumne River Restoration Project, Gravel Mining Reach, which is designed to restore instream and floodplain habitat on the Tuolumne River for the benefit of salmon and other native species. The Gravel Mining Reach extends approximately 6 miles from River Mile (RM) 34.3 to RM 40.3. Segment 7/11 is one of four segments in the Gravel Mining Reach and is located between RM 37.6 and 40.3 of this reach. The Tuolumne River Restoration Project is downstream of the New Don Pedro Project, a large volume storage reservoir in the Tuolumne River Basin, licensed by the Federal Energy Regulatory Commission to the Turlock and Modesto Irrigation Districts to store water for irrigation and municipal water supplies.

Construction within the four segments of the Gravel Mining Reach is intended to occur over a four- to five-year period. This work will modify the river corridor and floodplain by setting back berms at river constrictions; planting native riparian vegetation; recontouring the river channel; and potentially purchasing land, conservation easements, and associated mineral rights within the river corridor. Initial construction activities in these segments include moving berm roads, constructing short segments of permanent setback berms in key locations, and installing bio-engineered bank protection. Setback berms will require substantial quantities of imported materials to fill deep pits created by past gravel mining, and to create a riffle and run pattern that follows the restored meander channel of the river.

The channel within the four segments will be recontoured within a widened 400- to 500-foot wide riparian floodplain, with restored native vegetation in a species mix similar to that found along undisturbed segments of the river. The reconstructed channel/floodway cross section will be hydraulically sized to be an active riverine channel at currently regulated flows. The rebuilt channel will be sized assuming a river stage elevation that results from full grown riparian forest vegetation at design flows (15,000 to 20,000 cfs for short periods). It is anticipated and planned that during these high flow events there will be some movement of the channel within the flood plain to expose added spawning materials and clean existing spawning gravel. The capacity of the floodway would be increased from the present 9,000 cfs to at least 15,000 cfs. To minimize long term maintenance costs, design of this restoration work intends to provide a self maintaining riparian floodway, once the restored vegetation is established. Construction activities within the river channel will be confined to the period from June 1 through October 15.

Restoration within the 7/11 segment would consist of 14.06 acres of fill and 10.3 acres of excavation within the Ordinary High Water Mark of the Tuolumne River channel. Fill would occur within aggregate extraction pits that have been connected to the river. Therefore, approximately 24.36 acres of floodplain would be created by restoration of this segment.

Initial surveys of the 7/11 segment conducted May 5-7, 1999, identified 50 elderberry shrubs (*Sambucus caerulea*), but indicated that the shrubs were not located within the construction footprint or in the path of restoration site access. New survey results from April 17-20, 2000, however, showed 12 additional elderberry shrubs growing within the project area. The proposed project could result in adverse effects to some of these 12 shrubs.

Proposed Conservation Measures

The Fish and Wildlife Service's *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* dated July 9, 1999 (Service guidelines) (Attached), will be followed except as proposed in this section. A core avoidance area and a buffer zone will be established around elderberry shrubs having stems measuring 1 inch or more in diameter at ground level. The core avoidance area will include the area within 20 feet of the dripline of elderberry shrubs. The buffer zone will include the area within an additional 80 feet of the core area.

Construction fencing and signs will be installed during construction in accordance with Service guidelines. Crews will be instructed to comply with signage and shall be notified of the status of the beetle and the need to protect its elderberry host plant. Heavy equipment will not access the core avoidance area, and a qualified biologist shall be available to monitor any activity and ensure mitigation compliance within the core avoidance area. All elderberry shrubs having stems measuring 1 inch or more in diameter at ground level will be avoided to the extent possible. Riparian habitat will be restored or created within the core and buffer areas as defined in the restoration project's Channel Restoration Plans, 100% Design Submittal (TID 2000).

In the area approximately 3,700 feet upstream of the 7/11 Mining Corporation Bridge, it is expected that a 20-foot core avoidance area may be difficult to maintain. Therefore, in areas where grading and excavation will occur, a minimum avoidance area of 10 feet from the dripline of elderberry shrubs shall be maintained.

Elderberry shrubs that cannot be avoided or protected with the above measures will be transplanted within the floodplain with supplemental elderberry seedlings and seedlings of associated species in accordance with Service guidelines, or be compensated with seedlings of elderberry and associated species planted in greater numbers, as determined by the SFWO. A qualified biologist shall be available to monitor transplanting activity. Elderberry shrubs would be transplanted during the period between July and October 2000 using methods in accordance with Service guidelines.

Based on Service guidelines, the AFRP calculated that 70 elderberry seedlings and 70 seedlings of associated species will be required in conjunction with elderberry transplants to mitigate impacts to 12 shrubs having a total of 27 stems measuring 1 inch or more in diameter at ground level. These shrubs contained 18 stems $\geq$1" and $\leq$3", 2 stems >3" and <5", and 7 stems $\geq$5". All stems occurred within the riparian zone. No valley elderberry longhorn beetles or evidence of these beetles (i.e., exit holes) were observed during the surveys.

The planting area shall be at least 1,800 square feet for each transplanted elderberry shrub. Elderberry seedlings will be planted in 40 plots (modules) of about 1,624 square feet each. Elderberry seedlings would have a density of about 8 plants per module and a stem spacing of about 10 feet. Seedlings of associated species also would be planted in modules of about 1,624 square feet in area, at a density ranging about 9-13 plants per module, depending on species composition. This planting design is detailed in the project's Channel Restoration Plans, 100% Design Submittal TID (2000).

All Service guidelines for managing elderberry conservation areas in perpetuity, monitoring, and success criteria for planting will be implemented, with the exception that fencing will not be constructed. A key provision in the permanent conservation easements for the project area to be held by the Turlock Irrigation District is that there will be no public access. Therefore, there should not be any off road vehicles. Also, the site is generally inaccessible. Adequate signage shall be required on the downstream side of Roberts Ferry Bridge (RM 37.5), at the boundary of the project area, visible from the bridge and the river. If impacts to the habitat occur due to public access, then needs for signage and/or fencing would be determined to the satisfaction of the SFWO.

Status of the Species

On August 8, 1980, the valley elderberry longhorn beetle was listed as a threatened species (45 FR 52803). The beetle is dependent on its host plant, elderberry (*Sambucus* spp.), which is a common component of the remaining riparian forests of the Central Valley. Use of the plants by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the shrub's use by the beetle is an exit hole created by the larva just prior to the pupal stage. Recent field work along the Cosumnes River and in the Folsom Lake area indicates that larval galleries can be found in elderberry stems with no evidence of exit holes; the larvae either succumb prior to construction of an exit hole or are not far enough along in the developmental process to construct an exit hole. Larvae appear to be distributed mostly in stems which are 1.0 inch or greater in diameter at ground level. The *Valley Elderberry Longhorn Beetle Recovery Plan* (USFWS 1984) and Barr (1991) contain further details on the beetle's life history.

Population densities of the beetle are probably naturally low (USFWS 1984), and it has been suggested, based on the spatial distribution of occupied shrubs (Barr 1991), that the beetle is a poor disperser. Low density and limited dispersal capability may cause the beetle to be vulnerable to the negative effects of the isolation of small subpopulations due to habitat fragmentation.

Environmental Baseline

Extensive destruction of California's Central Valley riparian forests has occurred during the last 150 years due to agricultural and urban development (Katibah 1984, Katibah et al. 1984, Smith

1977, Thompson 1961). Based on a 1979 aerial survey, only about 102,000 acres out of an estimated 922,000 acres of Central Valley riparian forest remain (Katibah et al. 1981). More extreme figures were given by Frayer et al. (1989), who reported that approximately 85 percent of all wetland acreage in the Central Valley was lost before 1939, and that from 1939 to the mid-1980's, the acreage of wetlands dominated by forests and other woody vegetation declined from 65,400 acres to 34,600 acres. Differences in methodology may explain the differences between the studies. In any case, the historical loss of riparian habitat in the Central Valley strongly suggests that the range of the beetle has been reduced and its distribution greatly fragmented. Loss of non-riparian habitat where elderberry occurs (e.g., savanna and grassland adjacent to riparian habitat, oak woodland, mixed chaparral-woodland), and where the beetle has been recorded (Barr 1991), suggests further reduction of the beetle's range and increased fragmentation of its upland habitat. The SFWO believes that the valley elderberry longhorn beetle, though wide-ranging, is in long-term decline due to human activities which have resulted in widespread alteration and fragmentation of riparian habitats, and to a lesser extent, upland habitats, that support the beetle.

Effects of the Proposed Action

Direct Effects. Twelve elderberry shrubs with stems measuring one inch or greater in diameter at ground level would be directly affected and require transplanting and/or compensation by planting elderberry stems or seedlings. Because the total number of stems in these shrubs measuring one inch or greater in diameter at ground level is 27, direct effects on beetles inhabiting 27 stems is assumed. Any early-stage individuals of the beetle occupying these shrubs are likely to be killed when the shrubs are moved, because transplanted elderberry shrubs or cuttings may experience stress or health problems due to changes in soil, hydrology, microclimate, or associated vegetation. Adverse effects to elderberry shrubs may eliminate or reduce their value as habitat for the beetle. Mortality of transplanted elderberry shrubs or cuttings would preclude their future use by the beetle. Although compensation for impacts on the beetle includes restoration of habitat (transplanting of shrubs), it generally takes five or more years for elderberry shrubs to reach a size conducive to use by the beetle. This represents a temporal loss of habitat available to the beetle.

Indirect Effects. Indirect effects to the beetle resulting from construction activities of the proposed project would result from fragmentation of habitat due to the removal of the 12 shrubs from the project area. However, since the mitigation area is on-site, and the mitigation ratio is greater than required, the SFWO finds there is no net loss of suitable habitat. Increasing the floodway capacity from 9,000 cfs to at least 15,000 cfs will reduce the risk to human structures in the corridor and increase the flexibility of the New Don Pedro Project. The restoration project will increase the efficiency of flood control, but will not materially affect the overall water regime. We believe that the effect on local growth would be minimal and not likely to adversely affect any listed species. In addition, the project will expand and restore natural floodplain habitat, and acquisition of land, mineral rights, and conservation easements to protect floodplain habitat are anticipated. The resulting flow and flood regimes within the modified floodplain is

expected to benefit elderberry and beetle habitat. As a result, unlikely impacts due to future development would be expected to be offset by project benefits.

Effects of Proposed Conservation Measures. Habitat for the beetle will be temporarily lost due to project activities. However, the conservation measures proposed by the project proponent will minimize adverse effects and result in a net benefit to the beetle over time. Once replacement elderberry plants mature to where they provide usable habitat (stems one inch or greater in diameter at ground level), the local population of beetles would experience a net gain in available habitat. By protecting these areas in perpetuity, beetles and their habitat would be allowed to persist in the local landscape, thus maintaining the regional distribution of the species. The AFRP has a strong incentive to protect ecosystem values long-term, which should help ensure the success of beetle habitat compensation.

The AFRP calculated the number of elderberry seedlings (70) and associated native species (70) required to mitigate impacts to transplant 12 elderberry shrubs and 27 stems. This is correct should transplantation occur during the winter dormant period. However, the AFRP proposes to transplant shrubs in summer, and the SFWO requires a multiplier of 2.5 with the normal compensation ratios. Thus, 175 elderberry seedlings and 175 seedlings of associated species would be the minimum needed if the impacted elderberry shrubs are transplanted. This requirement would be met under the proposed restoration planting plan (TID 2000), as the plan specifies that 320 elderberry seedlings and more than 10,000 seedlings of associated species will be planted.

Because elderberry shrubs are less likely to survive transplantation outside the dormant season when the plants are fully leaved-out and actively growing, and no exit holes were found on any of the elderberry stems, a reasonable alternative to transplanting would be increasing the quantities of compensatory seedlings planted. If additional seedlings of elderberry and associated species are planted in lieu of transplanting impacted elderberry shrubs, a multiplier of 4.5 would be used with the normal compensation ratios, as specified by the SFWO. In this case, 315 elderberry seedlings and 315 seedlings of associated species would be the minimum needed. This requirement also would be met under the proposed restoration planting plan (TID 2000).

Because the 7/11 segment is an incremental step of the overall Tuolumne River Restoration Project, it is necessary to consider the sum of effects for all segments. Other segments could have incidental adverse effects on the beetle due to project activities. However, adverse effects of the other segments probably would be minor and temporary, and conservation measures similar to those developed for the 7/11 segment would be implemented. Because other segments would be implemented incrementally, any adverse effects would be spread over time. Similarly, benefits from earlier segments would develop during the time that later segments are implemented, and help offset any adverse effects of the later segments. The Tuolumne River Restoration Project is expected to produce an overall benefit to the beetle and its habitat.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The SFWO is not aware of specific projects in the action area that might affect the beetle or its habitat that are currently under review by State, county, or local authorities. Nevertheless, continued human population growth in the Central Valley, in general, and Stanislaus County, in particular, is expected to cause further development of agriculture, cities, industry, transportation, and water resources in the foreseeable future. Some of these future activities will not be subject to Federal jurisdiction and, thus, are considered cumulative effects, which likely will result in loss of riparian and other habitats where elderberry shrubs and the beetle occur.

Conclusion

After reviewing the current status of valley elderberry longhorn beetle, the environmental baseline for the action area, the effects of the proposed project in either in the 7/11 segment or the overall Tuolumne River Restoration Project area, and cumulative effects, it is the SFWO's biological opinion that the Tuolumne River Restoration Project, as proposed, is not likely to jeopardize the continued existence of the valley elderberry longhorn beetle. Critical habitat for this species has been designated in Sacramento County, however, this action does not affect that area and no destruction or adverse modification of that critical habitat is anticipated.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service, as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary, and must be implemented by the agency, or made binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The AFRP has a continuing duty to regulate the activity covered by this incidental take statement. If the AFRP(1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The SFWO expects that incidental take of the valley elderberry longhorn beetle will be difficult to detect or quantify for the following reasons: The cryptic nature of the organisms and their relatively small body size make the finding of a dead specimen unlikely. The species occurs in habitats that make them difficult to detect. Due to the difficulty in quantifying the number of valley elderberry longhorn beetles that will be taken as a result of the proposed action, the SFWO is quantifying take incidental to the number of elderberry stems one inch or greater in diameter at ground level (beetle habitat) that will become unsuitable for beetles due to direct or indirect effects as a result of the action. Therefore, the SFWO estimates that 27 elderberry stems will become unsuitable for use by the beetle as a result of the proposed action.

Upon implementation of the following reasonable and prudent measure, incidental take associated with Tuolumne River Restoration Project, Segment 7/11 on the valley elderberry longhorn beetle from habitat loss, harm, harassment, or mortality will become exempt from the prohibitions described under section 9 of the Act for direct impacts. In addition, incidental take in the form of harm, harassment, or mortality associated with Tuolumne River Restoration Project, Segment 7/11 will be exempt from the prohibitions described under section 9 of the Act for indirect impacts as a result of the management activities described.

Effect of the Take

The SFWO has determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

The following reasonable and prudent measure is necessary and appropriate to minimize the impact of the Tuolumne River Restoration Project, Segment 7/11 on valley elderberry longhorn beetle:

Minimize the effects of project impacts to the beetle and to elderberry shrubs (beetle habitat) throughout the proposed project area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of ESA, the AFRP must comply with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

A. Clearing shall be confined to the minimal area necessary to facilitate construction activities.

B. Movement of heavy equipment to and from the project site shall be restricted to established roadways to minimize habitat disturbance.

C. Work crews shall be trained by a qualified individual on the importance of avoiding elderberry shrubs throughout the action area. The AFRP shall provide the SFWO with a letter verifying that training of work crews was completed prior to the beginning of construction activities. A description of the training program shall be included.

D. The AFRP shall ensure compliance with the Reporting Requirements below.

E. To compensate for impacts to beetles inhabiting up to 27 elderberry stems in conjunction with project activities on Segment 7/11:

1. At least 175 elderberry seedlings and 175 seedlings of associated shrub species shall be planted in the project area according to the planting plan proposed by the AFRP (TID 2000), and 12 elderberry shrubs shall be transplanted within Segment 7/11.

-OR-

2. At least 315 elderberry seedlings and 315 seedlings of associated shrub species shall be planted in the project area according to the planting plan proposed by the AFRP (TID 2000), and no elderberry shrubs shall require transplanting.

The AFRP shall notify the SFWO which mitigation option will be followed before construction begins.

F. The buffer zones, transplantation sites, and replacement-planting sites shall be maintained and monitored in accordance with SFWO's guidelines for the valley elderberry longhorn beetle dated July 9, 1999.

G. The SFWO waives the guidelines requirement of fencing in this active floodplain, provided that there is no unauthorized entry by off-road vehicles, equestrians, or other parties that might damage or destroy the habitat of the beetle. If impacts to the habitat occur due to public access, then needs for signage and/or fencing would be determined to the satisfaction of the SFWO.

The reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize the impact of incidental take on a species that might result from the proposed action. If, during the course of the action, the level of incidental take described above is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measure provided. The AFRP must immediately provide an explanation of the causes of the taking and review with the SFWO the need for possible modification of the reasonable and prudent measure.

Reporting Requirements

The SFWO is to be notified within three working days of the finding of any listed species or any unanticipated take of species addressed in this biological opinion. The SFWO's contact person for this is the Division Chief for Endangered Species at (916) 414-6620.

Any dead or severely injured beetles found (adults, pupae, or larvae) shall be deposited in the Entomology Department of the California Academy of Sciences. The Academy's contact is the Senior Curator of Coleoptera at (415) 750-7239. All observations of valley elderberry longhorn beetles–live, injured, or dead–or fresh beetle exit holes shall be recorded on California Natural Diversity Data Base (NDDB) field sheets and sent to California Department of Fish and Game, Wildlife Habitat Data Analysis Branch, 1416 Ninth Street, Sacramento, California 95814.

A post-construction compliance report prepared by the SFWO-approved monitoring biologist(s) shall be forwarded to the Chief, Endangered Species Division, at the Sacramento Fish and Wildlife Office within 60 calendar days of the completion of each project. This report shall detail: (i) dates that construction occurred; (ii) pertinent information concerning the applicant's success in meeting project compensation measures; (iii) an explanation of failure to meet such measures, if any, and recommendations for remedial actions and request for approval from the SFWO, if necessary; (iv) known project effects on federally listed species, if any; (v) occurrences of incidental take of federally listed species, if any; and (vi) other pertinent information

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

1. The AFRP should assist in the recovery of the valley elderberry longhorn beetle by supporting an assessment of where beetle habitat is most needed along riparian corridors within its range (e.g., where gaps in suitable habitat occur along water courses). This information should then be made available to the SFWO, other agencies, project applicants, and conservation organizations, in an effort to coordinate the needs of both the development and environmental conservation communities.
2. In order for the SFWO to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the SFWO requests notification of the implementation of any conservation recommendations.

REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the action(s) outlined in the (request for formal consultation). As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals that the agency action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Please contact Marla Macoubrie of this office at (916) 414-6557, if you have any questions. If you have any questions regarding wetlands, contact Mark Littlefield at (916) 414-6580.

Cay C. Goude

Attachments

cc: ARD, Portland, OR
AFRP, SSJEFRO, Stockton, CA (Attn: Scott Spaulding)
USCOE, Sacramento, CA (Attn: Tom Cavanaugh)
CDFG, Sacramento, CA (Attn: Rhonda Reed)
Turlock Irrigation District, Turlock, CA (Attn: Wilton Fryer)
EDAW, Inc., Sacramento, CA

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
TEL (310) 980-4000; FAX (310) 980-4018

June 10, 1999 F/SWR4:SAE

Mr. Dale A. Pierce
Acting Field Supervisor
U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
3310 El Camino avenue, Suite 130
Sacramento, California 95821-6340

Dear Mr. Pierce:

This responds to your request of April 23, 1999, for our concurence that implementing the proposed Tuolumne River restoration and mitigation project (Project) as described in the attached Environmental Assessment/Initial Study (EA/IS) is not likely to adversely affect Central Valley steelhead trout (*Oncorhyncus mykiss*), listed as threatened under the Endangered Species Act (Act) and fall-run chinook salmon (*Oncorhyncus tshawytscha*) proposed for listing under the Act. The Project is the result of a collaborative process among the Turlock Irrigation District, Tuolumne River Technical Advisory Committee, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service (FWS). The Project goals are to enhance salmonid habitat, increase flood protection and restore native riparian plant communities.

The Project consists of Habitat restoration and enhancement activities occurring on two reaches of the Tuolumne River known as the upstream Gravel Mining Reach at river miles (rm) 34 to 40 and the downstream Special Run Pools (SRP) 9 and 10 at rm 25. Construction activities will consist of establishing a river corridor bounded by setback levees at river constrictions, constructing flood plains, planting native riparian vegetation, recontouring the river channel, and potentially purchasing land, conservation easements, and associated mineral rights. The Project is expected to take 4-5 years to complete.

Instream construction activities could cause temporary impacts to listed salmonids and their habitats. However, the activities will occur at a time when adult or juvenile steelhead are not likely to be in the project area. Specific measures have been incorporated into the Project to avoid impacts to fishery resources and listed and proposed species. Instream construction activities are expected to temporarily increase water turbidity levels. Based on the seasonal occurrence of various life stages of salmonids, construction activities in the river channel will be confined to the period from June 1 through October 15. Because instream construction would occur for a short

duration in summer and early fall during low flow periods and would incorporate water quality protection measures, the Project is expected to have a negligible affect on fall-run chinook salmon and steelhead trout.

The potential for the Project to result in direct and indirect adverse effects to listed or proposed species under NMFS jurisdiction is negligible. Accordingly, based on available information, NMFS concurs with the FWS determination that the proposed Project is not likely to adversely affect Central Valley steelhead and Central Valley fall run chinook. The NMFS concurence is based upon: 1) adherence to listed mitigation and monitoring measures; and 2) the negligible potential for the proposed actions to affect listed species.

No Biological Assessment or further Section 7 Consultation pursuant to the Endangered Species Act of 1973 is required with the National Marine Fisheries Service for the described activities. Should additional information on listed species become available, this determination may be reconsidered. The above comments are provided in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.A. 1531 et seq.).

We appreciate your cooperation in the above. If you have any questions regarding this letter, please contact Dennis Smith at (707) 575-6087.

Sincerely,

for Rodney R. McInnis
Acting Regional Administrator

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

Conservation Guidelines for the Valley Elderberry Longhorn Beetle

9 July 1999

The following guidelines have been issued by the U.S. Fish and Wildlife Service (Service) to assist Federal agencies and non-federal project applicants needing incidental take authorization through a section 7 consultation or a section 10(a)(1)(B) permit in developing measures to avoid and minimize adverse effects on the valley elderberry longhorn beetle. The Service will revise these guidelines as needed in the future. The most recently issued version of these guidelines should be used in developing all projects and habitat restoration plans. The survey and monitoring procedures described below are designed to avoid any adverse effects to the valley elderberry longhorn beetle. Thus a recovery permit is not needed to survey for the beetle or its habitat or to monitor conservation areas. If you are interested in a recovery permit for research purposes please call the Service's Regional Office at (503) 231-2063.

BACKGROUND INFORMATION

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), was listed as a threatened species on August 8, 1980 (*Federal Register* 45: 52803-52807). This animal is fully protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The valley elderberry longhorn beetle (beetle) is completely dependent on its host plant, elderberry (*Sambucus* species), which is a common component of the remaining riparian forests and adjacent upland habitats of California's Central Valley. Use of the elderberry by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the elderberry's use by the beetle is an exit hole created by the larva just prior to the pupal stage. The life cycle takes one or two years to complete. The animal spends most of its life in the larval stage, living within the stems of an elderberry plant. Adult emergence is from late March through June, about the same time the elderberry produces flowers. The adult stage is short-lived. Further information on the life history, ecology, behavior, and distribution of the beetle can be found in a report by Barr (1991) and the recovery plan for the beetle (USFWS 1984).

SURVEYS

Proposed project sites within the range of the valley elderberry longhorn beetle should be surveyed for the presence of the beetle and its elderberry host plant by a qualified biologist. The beetle's range extends throughout California's Central Valley and associated foothills from about the 3,000-foot elevation contour on the east and the watershed of the Central Valley on the west (Figure 1). All or portions of 31 counties are included: Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Mariposa, Merced, Napa, Nevada, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba.

If elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level occur on or adjacent to the proposed project site, or are otherwise located where they may be directly or indirectly affected by the proposed action, minimization measures which include planting replacement habitat (conservation planting) are required (Table 1).

All elderberry shrubs with one or more stems measuring 1.0 inch or greater in diameter at ground level that occur on or adjacent to a proposed project site must be thoroughly searched for beetle exit holes (external evidence of beetle presence). In addition, all elderberry stems one inch or greater in diameter at ground level must be tallied by diameter size class (Table 1). As outlined in Table 1, the numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether a proposed project lies in a riparian or non-riparian area.

Elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level are unlikely to be habitat for the beetle because of their small size and/or immaturity. Therefore, no minimization measures are required for removal of elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level with no exit holes. Surveys are valid for a period of two years.

AVOID AND PROTECT HABITAT WHENEVER POSSIBLE

Project sites that do not contain beetle habitat are preferred. If suitable habitat for the beetle occurs on the project site, or within close proximity where beetles will be affected by the project, these areas must be designated as avoidance areas and must be protected from disturbance during the construction and operation of the project. When possible, projects should be designed such that avoidance areas are connected with adjacent habitat to prevent fragmentation and isolation of beetle populations. Any beetle habitat that cannot be avoided as described below should be considered impacted and appropriate minimization measures should be proposed as described below.

Avoidance: Establishment and Maintenance of a Buffer Zone

Complete avoidance (i.e., no adverse effects) may be assumed when a 100-foot (or wider) buffer is established and maintained around elderberry plants containing stems measuring 1.0 inch or greater in diameter at ground level. Firebreaks may not be included in the buffer zone. In buffer areas construction-related disturbance should be minimized, and any damaged area should be promptly restored following construction. The Service must be consulted before any disturbances within the buffer area are considered. In addition, the Service must be provided with a map identifying the avoidance area and written details describing avoidance measures.

Protective Measures

1. Fence and flag all areas to be avoided during construction activities. In areas where encroachment on the 100-foot buffer has been approved by the Service, provide a minimum setback of at least 20 feet from the dripline of each elderberry plant.

2. Brief contractors on the need to avoid damaging the elderberry plants and the possible penalties for not complying with these requirements.

3. Erect signs every 50 feet along the edge of the avoidance area with the following information: "This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must

not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." The signs should be clearly readable from a distance of 20 feet, and must be maintained for the duration of construction.

4. Instruct work crews about the status of the beetle and the need to protect its elderberry host plant.

Restoration and Maintenance

1. Restore any damage done to the buffer area (area within 100 feet of elderberry plants) during construction. Provide erosion control and re-vegetate with appropriate native plants.

2. Buffer areas must continue to be protected after construction from adverse effects of the project. Measures such as fencing, signs, weeding, and trash removal are usually appropriate.

3. No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant should be used in the buffer areas, or within 100 feet of any elderberry plant with one or more stems measuring 1.0 inch or greater in diameter at ground level.

4. The applicant must provide a written description of how the buffer areas are to be restored, protected, and maintained after construction is completed.

5. Mowing of grasses/ground cover may occur from July through April to reduce fire hazard. No mowing should occur within five (5) feet of elderberry plant stems. Mowing must be done in a manner that avoids damaging plants (e.g., stripping away bark through careless use of mowing/trimming equipment).

TRANSPLANT ELDERBERRY PLANTS THAT CANNOT BE AVOIDED

Elderberry plants must be transplanted if they can not be avoided by the proposed project. All elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level must be transplanted to a conservation area (see below). At the Service's discretion, a plant that is unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible the minimization ratios in Table 1 may be increased to offset the additional habitat loss.

Trimming of elderberry plants (e.g., pruning along roadways, bike paths, or trails) with one or more stems 1.0 inch or greater in diameter at ground level, may result in take of beetles. Therefore, trimming is subject to appropriate minimization measures as outlined in Table 1.

1. Monitor. A qualified biologist (monitor) must be on-site for the duration of the transplanting of the elderberry plants to insure that no unauthorized take of the valley elderberry longhorn beetle occurs. If unauthorized take occurs, the monitor must have the authority to stop work until corrective measures have been completed. The monitor must immediately report any unauthorized take of the beetle or its habitat to the Service and to the California Department of Fish and Game.

2. Timing. Transplant elderberry plants when the plants are dormant, approximately November through the first two weeks in February, after they have lost their leaves. Transplanting during the non-growing season will reduce shock to the plant and increase transplantation success.

3. Transplanting Procedure.

   a. Cut the plant back 3 to 6 feet from the ground or to 50 percent of its height (whichever is taller) by removing branches and stems above this height. The trunk and all stems measuring 1.0 inch or greater in diameter at ground level should be replanted. Any leaves remaining on the plant should be removed.

   b. Excavate a hole of adequate size to receive the transplant.

   c. Excavate the plant using a Vemeer spade, backhoe, front end loader, or other suitable equipment, taking as much of the root ball as possible, and replant immediately at the conservation area. Move the plant only by the root ball. If the plant is to be moved and transplanted off site, secure the root ball with wire and wrap it with burlap. Dampen the burlap with water, as necessary, to keep the root ball wet. Do not let the roots dry out. Care should be taken to ensure that the soil is not dislodged from around the roots of the transplant. If the site receiving the transplant does not have adequate soil moisture, pre-wet the soil a day or two before transplantation.

   d. The planting area must be at least 1,800 square feet for each elderberry transplant. The root ball should be planted so that its top is level with the existing ground. Compact the soil sufficiently so that settlement does not occur. As many as five (5) additional elderberry plantings (cuttings or seedlings) and up to five (5) associated native species plantings (see below) may also be planted within the 1,800 square foot area with the transplant. The transplant and each new planting should have its own watering basin measuring at least three (3) feet in diameter. Watering basins should have a continuous berm measuring approximately eight (8) inches wide at the base and six (6) inches high.

   e. Saturate the soil with water. Do not use fertilizers or other supplements or paint the tips of stems with pruning substances, as the effects of these compounds on the beetle are unknown.

   f. Monitor to ascertain if additional watering is necessary. If the soil is sandy and well-drained, plants may need to be watered weekly or twice monthly. If the soil is clayey and poorly-drained, it may not be necessary to water after the initial saturation. However, most transplants require watering through the first summer. A drip watering system and timer is ideal. However, in situations where this is not possible, a water truck or other apparatus may be used.

PLANT ADDITIONAL SEEDLINGS OR CUTTINGS

Each elderberry stem measuring 1.0 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) must be replaced, in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). Minimization

ratios are listed and explained in Table 1. Stock of either seedlings or cuttings should be obtained from local sources. Cuttings may be obtained from the plants to be transplanted if the project site is in the vicinity of the conservation area. If the Service determines that the elderberry plants on the proposed project site are unsuitable candidates for transplanting, the Service may allow the applicant to plant seedlings or cuttings at higher than the stated ratios in Table 1 for each elderberry plant that cannot be transplanted.

PLANT ASSOCIATED NATIVE SPECIES

Studies have found that the beetle is more abundant in dense native plant communities with a mature overstory and a mixed understory. Therefore, a mix of native plants associated with the elderberry plants at the project site or similar sites will be planted at ratios ranging from 1:1 to 2:1 [native tree/plant species to each elderberry seedling or cutting (see Table 1)]. These native plantings must be monitored with the same survival criteria used for the elderberry seedlings (see below). Stock of saplings, cuttings, and seedlings should be obtained from local sources. If the parent stock is obtained from a distance greater than one mile from the conservation area, approval by the Service of the native plant donor sites must be obtained prior to initiation of the revegetation work. Planting or seeding the conservation area with native herbaceous species is encouraged. Establishing native grasses and forbs may discourage unwanted non-native species from becoming established or persisting at the conservation area. Only stock from local sources should be used.

Examples

Example 1

The project will adversely affect beetle habitat on a vacant lot on the land side of a river levee. This levee now separates beetle habitat on the vacant lot from extant Great Valley Mixed Riparian Forest (Holland 1986) adjacent to the river. However, it is clear that the beetle habitat located on the vacant lot was part of a more extensive mixed riparian forest ecosystem extending farther from the river's edge prior to agricultural development and levee construction. Therefore, the beetle habitat on site is considered riparian. A total of two elderberry plants with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The two plants have a total of 15 stems measuring over 1.0 inch. No exit holes were found on either plant. Ten of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are greater than 5.0 inches in diameter. The conservation area is suited for riparian forest habitat. Associated natives adjacent to the conservation area are box elder (*Acer negundo californica*), walnut (*Juglans californica* var. *hindsii*), sycamore (*Platanus racemosa*), cottonwood (*Populus fremontii*), willow (*Salix gooddingii* and *S. laevigata*), white alder (*Alnus rhombifolia*), ash (*Fraxinus latifolia*), button willow (*Cephalanthus occidentalis*), and wild grape (*Vitis californica*).

Minimization (based on ratios in Table 1):

- Transplant the two elderberry plants that will be affected to the conservation area.

- Plant 40 elderberry rooted cuttings (10 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)

- Plant 40 associated native species (ratio of associated natives to elderberry plantings is 1:1 in areas with no exit holes):

  5 saplings each of box elder, sycamore, and cottonwood

5 willow seedlings
5 white alder seedlings
5 saplings each of walnut and ash
3 California button willow
2 wild grape vines
Total: 40 associated native species

• Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 80 plants must be planted (40 elderberries and 40 associated natives), a total of 0.33 acre (14,400 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

Example 2
The project will adversely affect beetle habitat in Blue Oak Woodland (Holland 1986). One elderberry plant with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The plant has a total of 10 stems measuring over 1.0 inch. Exit holes were found on the plant. Five of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are between 3.0 and 5.0 inches in diameter. The conservation area is suited for elderberry savanna (non-riparian habitat). Associated natives adjacent to the conservation area are willow (*Salix* species), blue oak (*Quercus douglasii*), interior live oak (*Q. wislizenii*), sycamore, poison oak (*Toxicodendron diversilobum*), and wild grape.

Minimization (based on ratios in Table 1):

• Transplant the one elderberry plant that will be affected to the conservation area.

• Plant 30 elderberry seedlings (5 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)

• Plant 60 associated native species (ratio of associated natives to elderberry plantings is 2:1 in areas with exit holes):
20 saplings of blue oak, 20 saplings of sycamore, and 20 saplings of willow, and seed and plant with a mixture of native grasses and forbs

• Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 90 plants must be planted (30 elderberries and 60 associated natives), a total of 0.37 acre (16,200 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

CONSERVATION AREA—PROVIDE HABITAT FOR THE BEETLE IN PERPETUITY

The conservation area is distinct from the avoidance area (though the two may adjoin), and serves to receive and protect the transplanted elderberry plants and the elderberry and other native plantings. The Service may accept proposals for off-site conservation areas where appropriate.

1. Size. The conservation area must provide at least 1,800 square feet for each transplanted elderberry plant. As many as 10 conservation plantings (i.e., elderberry cuttings or seedlings and/or associated native plants) may be planted within the 1800 square foot area with each transplanted elderberry. An additional 1,800 square feet shall be provided for every additional 10 conservation plants. Each planting should have its own watering basin measuring approximately three feet in diameter. Watering basins should be constructed with a continuous berm measuring approximately eight inches wide at the base and six inches high.

   The planting density specified above is primarily for riparian forest habitats or other habitats with naturally dense cover. If the conservation area is an open habitat (i.e., elderberry savanna, oak woodland) more area may be needed for the required plantings. Contact the Service for assistance if the above planting recommendations are not appropriate for the proposed conservation area.

   No area to be maintained as a firebreak may be counted as conservation area. Like the avoidance area, the conservation area should connect with adjacent habitat wherever possible, to prevent isolation of beetle populations.

   Depending on adjacent land use, a buffer area may also be needed between the conservation area and the adjacent lands. For example, herbicides and pesticides are often used on orchards or vineyards. These chemicals may drift or runoff onto the conservation area if an adequate buffer area is not provided.

2. Long-Term Protection. The conservation area must be protected in perpetuity as habitat for the valley elderberry longhorn beetle. A conservation easement or deed restrictions to protect the conservation area must be arranged. Conservation areas may be transferred to a resource agency or appropriate private organization for long-term management. The Service must be provided with a map and written details identifying the conservation area; and the applicant must receive approval from the Service that the conservation area is acceptable prior to initiating the conservation program. A true, recorded copy of the deed transfer, conservation easement, or deed restrictions protecting the conservation area in perpetuity must be provided to the Service before project implementation.

   Adequate funds must be provided to ensure that the conservation area is managed in perpetuity. The applicant must dedicate an endowment fund for this purpose, and designate the party or entity that will be responsible for long-term management of the conservation area. The Service must be provided with written documentation that funding and management of the conservation area (items 3-8 above) will be provided in perpetuity.

3. Weed Control. Weeds and other plants that are not native to the conservation area must be removed at least once a year, or at the discretion of the Service and the California Department of Fish and Game. Mechanical means should be used; herbicides are prohibited unless approved by the Service.

4. Pesticide and Toxicant Control. Measures must be taken to insure that no pesticides, herbicides, fertilizers, or other chemical agents enter the conservation area. No spraying of these agents must be done within one 100 feet of the area, or if they have the potential to drift, flow, or be washed into the area in the opinion of biologists or law enforcement personnel from the Service or the California Department of Fish and Game.

5. Litter Control. No dumping of trash or other material may occur within the conservation area. Any trash or other foreign material found deposited within the conservation area must be removed within 10 working days of discovery.

6. Fencing. Permanent fencing must be placed completely around the conservation area to prevent unauthorized entry by off-road vehicles, equestrians, and other parties that might damage or destroy the habitat of the beetle, unless approved by the Service. The applicant must receive written approval from the Service that the fencing is acceptable prior to initiation of the conservation program. The fence must be maintained in perpetuity, and must be repaired/replaced within 10 working days if it is found to be damaged. Some conservation areas may be made available to the public for appropriate recreational and educational opportunities with written approval from the Service. In these cases appropriate fencing and signs informing the public of the beetle's threatened status and its natural history and ecology should be used and maintained in perpetuity.

7. Signs. A minimum of two prominent signs must be placed and maintained in perpetuity at the conservation area, unless otherwise approved by the Service. The signs should note that the site is habitat of the federally threatened valley elderberry longhorn beetle and, if appropriate, include information on the beetle's natural history and ecology. The signs must be approved by the Service. The signs must be repaired or replaced within 10 working days if they are found to be damaged or destroyed.

MONITORING

The population of valley elderberry longhorn beetles, the general condition of the conservation area, and the condition of the elderberry and associated native plantings in the conservation area must be monitored over a period of either ten (10) consecutive years or for seven (7) years over a 15-year period. The applicant may elect either 10 years of monitoring, with surveys and reports every year; or 15 years of monitoring, with surveys and reports on years 1, 2, 3, 5, 7, 10, and 15. The conservation plan provided by the applicant must state which monitoring schedule will be followed. No change in monitoring schedule will be accepted after the project is initiated. If conservation planting is done in stages (i.e., not all planting is implemented in the same time period), each stage of conservation planting will have a different start date for the required monitoring time.

Surveys. In any survey year, a minimum of two site visits between February 14 and June 30 of each year must be made by a qualified biologist. Surveys must include:

1. A population census of the adult beetles, including the number of beetles observed, their condition, behavior, and their precise locations. Visual counts must be used; mark-recapture or other methods involving handling or harassment must not be used.

2. A census of beetle exit holes in elderberry stems, noting their precise locations and estimated ages.

3. An evaluation of the elderberry plants and associated native plants on the site, and on the conservation area, if disjunct, including the number of plants, their size and condition.

4. An evaluation of the adequacy of the fencing, signs, and weed control efforts in the avoidance and conservation areas.

5. A general assessment of the habitat, including any real or potential threats to the beetle and its host plants, such as erosion, fire, excessive grazing, off-road vehicle use, vandalism, excessive weed growth, etc.

The materials and methods to be used in the monitoring studies must be reviewed and approved by the Service. All appropriate Federal permits must be obtained prior to initiating the field studies.

Reports. A written report, presenting and analyzing the data from the project monitoring, must be prepared by a qualified biologist in each of the years in which a monitoring survey is required. Copies of the report must be submitted by December 31 of the same year to the Service (Chief of Endangered Species, Sacramento Fish and Wildlife Office), and the Department of Fish and Game (Supervisor, Environmental Services, Department of Fish and Game, 1416 Ninth Street, Sacramento, California 95814; and Staff Zoologist, California Natural Diversity Data Base, Department of Fish and Game, 1220 S Street, Sacramento, California 95814). The report must explicitly address the status and progress of the transplanted and planted elderberry and associated native plants and trees, as well as any failings of the conservation plan and the steps taken to correct them. Any observations of beetles or fresh exit holes must be noted. Copies of original field notes, raw data, and photographs of the conservation area must be included with the report. A vicinity map of the site and maps showing where the individual adult beetles and exit holes were observed must be included. For the elderberry and associated native plants, the survival rate, condition, and size of the plants must be analyzed. Real and likely future threats must be addressed along with suggested remedies and preventative measures (e.g. limiting public access, more frequent removal of invasive non-native vegetation, etc.).

A copy of each monitoring report, along with the original field notes, photographs, correspondence, and all other pertinent material, should be deposited at the California Academy of Sciences (Librarian, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118) by December 31 of the year that monitoring is done and the report is prepared. The Service's Sacramento Fish and Wildlife Office should be provided with a copy of the receipt from the Academy library acknowledging receipt of the material, or the library catalog number assigned to it.

Access. Biologists and law enforcement personnel from the California Department of Fish and Game and the Service must be given complete access to the project site to monitor transplanting activities. Personnel from both these agencies must be given complete access to the project and the conservation area to monitor the beetle and its habitat in perpetuity.

SUCCESS CRITERIA

A minimum survival rate of at least 60 percent of the elderberry plants and 60 percent of the associated native plants must be maintained throughout the monitoring period. Within one year of discovery that survival has dropped below 60 percent, the applicant must replace failed plantings to bring survival above this level. The Service will make any determination as to the applicant's replacement responsibilities arising from circumstances beyond its control, such as plants damaged or killed as a result of severe flooding or vandalism.

SERVICE CONTACT

These guidelines were prepared by the Endangered Species Division of the Service's Sacramento Fish and Wildlife Office. If you have questions regarding these guidelines or to request a copy of the most recent guidelines, telephone (916) 414-6600 after August 5, 1999, or write to:

U.S. Fish and Wildlife Service
Ecological Services
2800 Cottage Way, W-2605
Sacramento, CA 95825

LITERATURE CITED

Barr, C. B. 1991. The distribution, habitat, and status of the valley elderberry longhorn beetle *Desmocerus californicus dimorphus*. U.S. Fish and Wildlife Service; Sacramento, California.

Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Unpublished Report. State of California, The Resources Agency, Department of Fish and Game, Natural Heritage Division, Sacramento, California.

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USFWS. 1984. Recovery plan for the valley elderberry longhorn beetle. U.S. Fish and Wildlife Service, Endangered Species Program; Portland, Oregon.

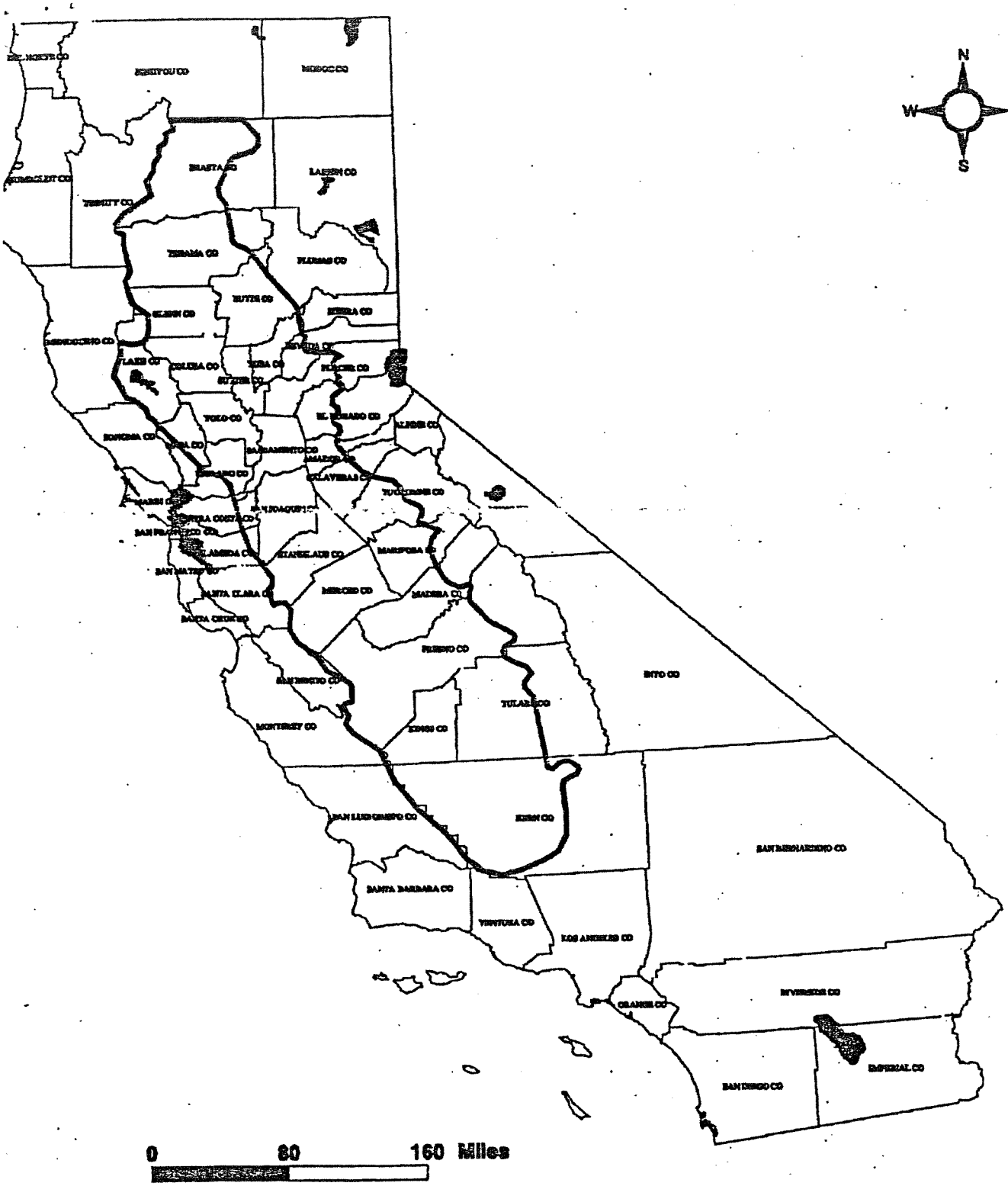


Figure 1: Range of the Valley Elderberry Longhorn Beetle

Table 1: Minimization ratios based on location (riparian vs. non-riparian), stem diameter of affected elderberry plants at ground level, and presence or absence of exit holes.

Location	Stems (maximum diameter at ground level)	Exit Holes Y/N (quantify)	Elderberry Seedling Ratio[1]	Associated Native Plant Ratio[2]
non-riparian	stems ≥ 1" & ≤ 3"	No:	1:1	1:1
		Yes:	2:1	2:1
non-riparian	stems > 3" & < 5"	No:	2:1	1:1
		Yes:	4:1	2:1
non-riparian	stems ≥ 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems ≥ 1" & ≤ 3"	No:	2:1	1:1
		Yes:	4:1	2:1
riparian	stems > 3" & < 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems ≥ 5"	No:	4:1	1:1
		Yes:	8:1	2:1

[1] Ratios in the *Elderberry Seedling Ratio* column correspond to the number of cuttings or seedlings to be planted per elderberry stem (one inch or greater in diameter at ground level) affected by a project.

[2] Ratios in the *Associated Native Plant Ratio* column correspond to the number of associated native species to be planted per elderberry (seedling or cutting) planted.

RESOLUTION NO. 2001-36

RESOLUTION APPROVING MEMORANDUM OF AGREEMENT BETWEEN TURLOCK IRRIGATION DISTRICT AND THE STATE RECLAMATION BOARD FOR PLANTING AND MAINTAINING ELDERBERRY SHRUBS ASSOCIATED WITH THE TUOLUMNE RIVER RESTORATION PROJECT

WHEREAS, Turlock Irrigation District is the project manager for the fishery restoration projects being constructed within the floodway of the Tuolumne River, known as the Mining Reach and Special Run Pools 9 & 10; and

WHEREAS, the District desires to plant elderberry shrubs on the riparian flood plains within the river restoration projects, as required by the agencies providing funding for the construction of the projects, to meet Endangered Species Act (ESA) host plant mitigation for Valley Elderberry Longhorn Beetle described in the Biological Opinion of August 4, 2000; and

WHEREAS, the State Reclamation Board regulates what can be planted and constructed within the floodway of the Tuolumne River and has issued a permit to the District prohibiting the planting of elderberry shrubs unless the Reclamation Board is protected from the ESA mitigation requirements for project planted elderberry shrubs; and

WHEREAS, the District and the Reclamation Board have developed a Memorandum of Agreement that defines the responsibilities of each agency with respect to the planting and maintenance of elderberry shrubs on the District sponsored restoration projects SRP 9 & 10 and Mining Reach within the designated floodway of the Tuolumne River.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors does hereby authorize the General Manager to sign, on behalf of the District, the Memorandum of Agreement with the Reclamation Board that is attached hereto as reference.

Moved by Director Fiorini, seconded by Director Berryhill, that the foregoing resolution be adopted.

Upon roll call the following vote was had:

Ayes:	Directors Berryhill, Fiorini, Crowell
Noes:	Director Short
Absent:	Director Long

The President declared the resolution adopted.

I, Steven E. Boyd, Deputy Secretary of the Board of Directors of the TURLOCK IRRIGATION DISTRICT, do hereby CERTIFY that the foregoing is a full, true and correct copy of a resolution duly adopted at a regular meeting of said Board of Directors held the 1st day of May, 2001.

Steven E Boyd by BAH
Deputy Secretary of the Board of Directors
of the Turlock Irrigation District

APPENDIX I

California Department of Fish and Game and Department of Water Resources Memorandum of Understanding for Sacramento and Feather River Wildlife Area Flood Control Project Maintenance

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE DEPARTMENT OF FISH AND GAME
AND
THE DIVISION OF FLOOD MANAGEMENT OF THE DEPARTMENT OF WATER RESOURCES
FOR MAINTENANCE OF FLOOD CONTROL PROJECTS IN THE SACRAMENTO RIVER AND FEATHER RIVER WILDLIFE AREAS

This Memorandum of Understanding ("MOU") is entered into between the Department of Fish and Game ("DFG") and the Division of Flood Management of the Department of Water Resources ("DWR").

WHEREAS, DFG is the trustee for fish and wildlife resources of the State of California; and

WHEREAS, DWR is a state governmental agency responsible for maintaining and operating the flood control projects described below (flood control project"); and

WHEREAS, DFG is party to a Memorandum of Understanding ("2004 MOU") among the U.S. Fish and Wildlife Service ("USFWS") regarding the Sacramento River National Wildlife Refuge, the California Department of Fish and Game regarding the Sacramento River Wildlife Area and the Feather River Wildlife Area, and the California Department of Parks and Recreation ("Parks"), Northern Buttes District, regarding the Sacramento River State Parks for the purpose of riparian restoration and management in Glenn, Tehama, Butte, and Colusa Counties, California; and

WHEREAS, DFG and DWR entered into an earlier memorandum of understanding effective January 17, 1986, entitled "Memorandum of Understanding Between the Department of Fish and Game and Department of Water Resources Regarding Streambed Alteration Notification and Maintenance Activities Under Fish and Game Code section 1601" ("1986 MOU"), which established a process to allow DFG to annually review the maintenance work on flood control projects to ensure that the work was not adversely affecting fish and wildlife resources; and

WHEREAS, DFG and DWR entered into a current memorandum of understanding effective March 24, 2003, entitled "Memorandum of Understanding for Dispute Resolution Between the Department of Fish and Game and The Division of Flood Management of the Department of Water Resources regarding Fish and Game Code Section 1601"; and

WHEREAS, DFG and DWR entered into a current memorandum of understanding effective June 06, 2003, entitled "Memorandum of Understanding Between the Department of Fish and Game and The Division of Flood Management of the Department of Water Resources For Routine Maintenance Activities Of Flood

Control Projects By The Sacramento and Sutter Maintenance Yards" ("2003 MOU"), which established a process to allow DFG to annually review the maintenance work on flood control projects to ensure that the work was not adversely affecting fish and wildlife resources; and

WHEREAS, DWR agrees to perform its maintenance work in a manner that minimizes adverse impacts to fish and wildlife resources and water quality, consistent with the MOU; and

NOW, THEREFORE, DFG and DWR mutually agree the MOU, like the 2003 MOU, satisfies the requirements of former Fish and Game Code section 1601, which is now sections 1602 and 1603, and mutually agree further as follows:

I. DESCRIPTION OF FLOOD CONTROL PROJECT

This MOU regards land management issues at the DFG Abbott Lake, O Connor Lakes, Lake of the Woods, and Star Bend Units, of the Feather River Wildlife Area (see figure 1). The purpose of the MOU is to formally document an agreement to mutually manage, monitor, restore, and enhance lands managed for fish, wildlife, and plants along the Feather River; to prevent loss of human life and reduce property damage caused by floods; and to enhance communication between the agencies to prevent duplicating or prescribing conflicting land management efforts.

II. FLOOD CONTROL OPERATION AND MAINTENANCE REQUIREMENTS

DWR may perform the maintenance work to satisfy requirements of the U.S. Army Corps of Engineers, and to maintain design conveyance capacity. DWR will limit the work to the flood control projects and work areas specified above, and complete the work in accordance with the terms and conditions specified by permits obtained by DFG.

III. ROUTINE FLOOD CONTROL MAINTENANCE PROCEDURES

DWR shall complete routine maintenance in accordance with the 2003 MOU except as described by DWR and DFG in Exhibit A, Description of Maintenance and Flood Control Activities within the Feather River Wildlife Area.

IV. PERMIT REQUIREMENTS

DWR shall act as the lead agency under CEQA for the maintenance work covered by the 2003 MOU and secure any permits required for flood control

operation and maintenance.

USFWS issued a Biological Opinion and Incidental Take Statement dated September 9, 2005, covering valley elderberry longhorn beetles and elderberry shrubs affected by or resulting from restoration and work carried out pursuant to the 2004 MOU, including within the Feather River Wildlife Area ("Elderberry BO"). The Elderberry BO covers signatories to the 2004 MOU including DFG and its agents. As recognized in the Elderberry BO, DWR shall act as an agent of DFG while performing flood maintenance activities within the Feather River Wildlife Area. The Elderberry BO states that within one year of Elderberry BO termination or reinitiation, or 2004 MOU termination or modification, DWR shall have the right to restore the site to a baseline elderberry population reflective of pre-project conditions (i.e. 130 elderberry shrubs that do not interfere with flood conveyance and capacity will be identified and allowed to remain). Therefore, DFG agrees to provide written notification to DWR within ten (10) days of any party's notice of an intent to terminate, reinitiate consultation on, or modify, either the 2004 MOU, or to the associated Elderberry BO .

DFG will be responsible for securing any necessary permits incidental to habitat manipulation and restoration work completed in the flood control project, and will provide any biological surveying, monitoring, and reporting needed to satisfy those permits.

DWR and DFG will coordinate all permits and resolve conflicts between any of the terms and conditions of the MOU and those that another local, state, or federal governmental agency might impose under the laws and regulations it administers and enforces.

V. AMENDMENT

A. The MOU may be amended or modified at any time, provided that it is by a written agreement duly executed by DFG and DWR. Any proposal for amendment or modifications must be delivered for review and approval by the Regional Manager or the official designated by the Regional Manager, unless otherwise specified.

B. Notwithstanding paragraph A above, upon review and written approval by a DFG staff person in the Lake and Streambed Alteration Program, DWR may add other locations, as well as modify descriptions of maintenance and flood control activities after the effective date of the MOU, in which case all provisions of the MOU shall apply to them.

C. DFG and DWR shall meet in January each year or at some other mutually agreed to time to discuss the maintenance activities. Both parties should be prepared at that meeting to propose any amendments to the MOU.

VI. DISPUTE RESOLUTION

Any disagreement between DFG and DWR regarding the MOU or the performance of any maintenance work covered by the MOU shall be resolved in accordance with the "Memorandum of Understanding for Dispute Resolution Between the Department of Fish and Game and Department of Water Resources Regarding Fish and Game Code section 1601," dated January 2003, which for reference is attached hereto as Attachment A.

VII. TERMINATION

The MOU shall remain in effect until it is terminated in writing by either party. Termination shall become effective 30 days after receipt of the termination notice by the other party. In the event the MOU is terminated, DWR may complete any maintenance work that DFG approved prior to the date of the termination notice.

VIII. SIGNATURE AND EFFECTIVE DATE

This agreement shall become effective on the date of DFG's signature, which shall be after DWR's signature.

DEPARTMENT OF WATER RESOURCES

Rodney G. Mayer Date: 5/18/06
~~Les Hardeff, Chief~~ Rodney Mayer, Acting Chief
Division of Flood Management

Approved as to legal form and sufficiency:

By David A. Sandino Date: 5/16/06
David A. Sandino
Acting Chief Counsel

DEPARTMENT OF FISH AND GAME

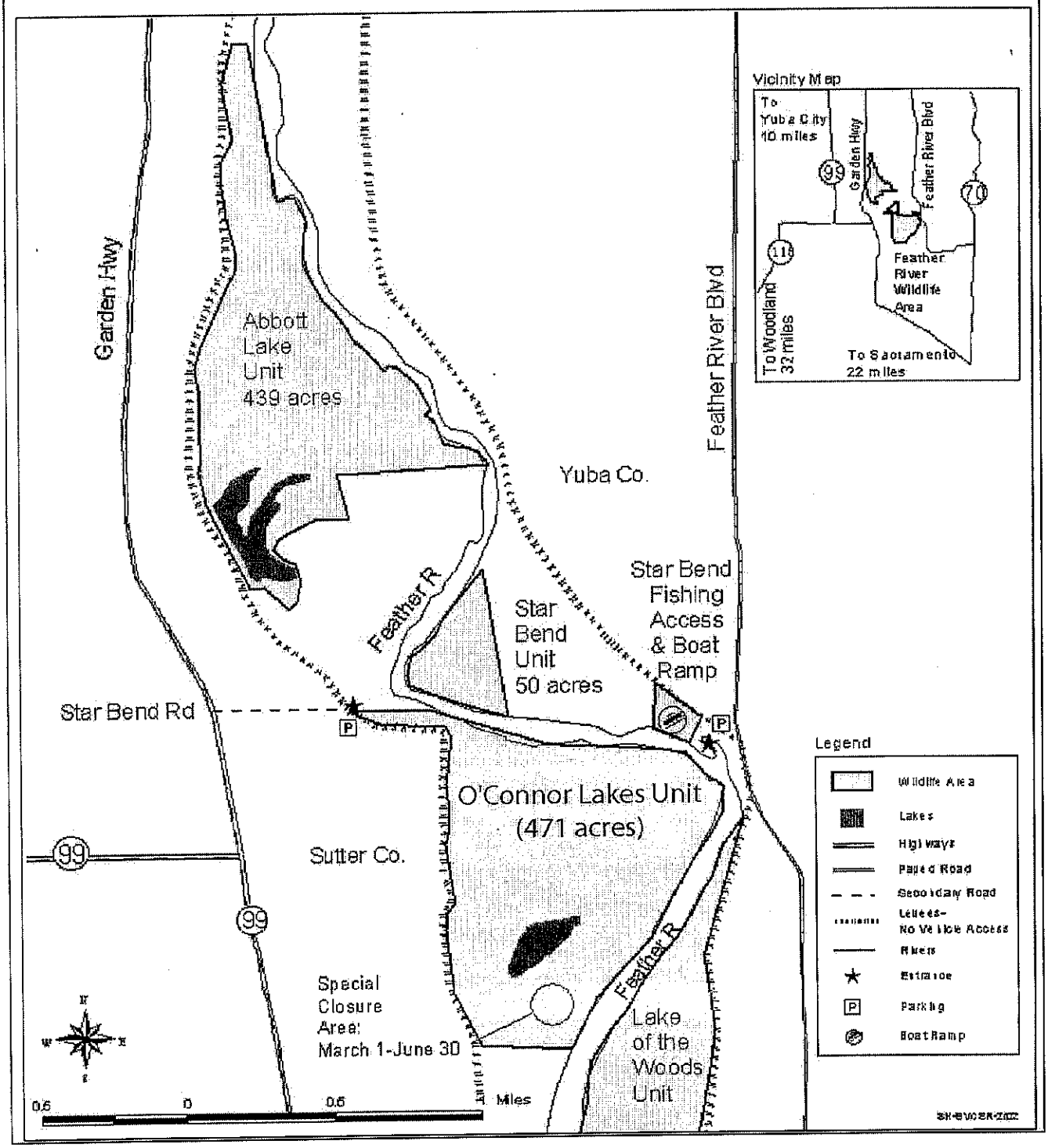
Date: 5/23/06
Sandy Morey, Regional Manager
Sacramento Valley - Central Sierra Region

Approved as to legal form and sufficiency:

By Date: 7/24/06
Ann Malcolm
General Counsel

Figure 1.

California Department of Fish and Game
Sacramento Valley Central Sierra Region
ABBOTT LAKE, O'CONNOR LAKES and STAR BEND UNITS
FEATHER RIVER WILDLIFE AREA
Sutter and Yuba Counties



APPENDIX J

Programmatic Safe Harbor Agreement Lower Mokelumne River Watershed

PROGRAMMATIC

SAFE HARBOR AGREEMENT

LOWER MOKELUMNE RIVER WATERSHED

1. INTRODUCTION

This programmatic Safe Harbor Agreement (Agreement) is entered into as of , 2006 between the California Association of Resource Conservation Districts (Program Administrator) and the U.S. Department of Interior, Fish and Wildlife Service (Service); hereinafter collectively called the "Parties." The purposes of this Agreement are (1) to promote ecosystem restoration, including the conservation of endangered species, through the voluntary restoration, enhancement, and management of native riparian habitat in the lower Mokelumne River watershed in California, (2) to provide certain regulatory assurances to landowners participating in such restoration, enhancement, and management activities, and (3) to accomplish the foregoing without negatively affecting farming activities. This Agreement follows the Service's Safe Harbor Agreement policy (64 FR 32717) and regulations (64 FR 32706), both of which implement section 10(a)(1)(A) of the Endangered Species Act (ESA).

2. LIST OF COVERED SPECIES

This Agreement covers the following Federally listed species, which is hereafter referred to as the "covered species": Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus.*

3. DESCRIPTION OF ENROLLED LANDS

The properties subject to this Agreement consist of those non-Federal lands in the lower Mokelumne River Watershed in San Joaquin County, California, that are hereafter made subject to Cooperative Agreements between the owners or managers thereof (Program Participants) and the Program Administrator in the form attached hereto as Exhibit 1. Such properties are referred to herein as the "enrolled properties." The area within which properties may be enrolled is depicted on the attached map and consists generally of those lands lying within the lower Mokelumne River watershed from the confluence with the Cosumnes River, upstream to the Camanche Dam, exclusive of lands within the watershed of Dry Creek upstream of its crossing with Highway 99. The total amount of acreage for potential lands with riparian areas eligible to enroll in the SHA is not expected to exceed 15,000 acres. The total amount of acreage within this area that may be restored to riparian habitat is not expected to exceed 3,500 acres. The enrolled properties are to be more precisely indicated on maps attached to such Cooperative Agreements. Current and recent land use practices on the enrolled properties are likely to be varied and to include grazing, viticultural, and other agricultural uses, as well as recreational uses. Such Cooperative Agreements shall be effective upon the signing thereof by the Program Participant and the Program Administrator.

4. BASELINE DETERMINATION

For each enrolled property, the baseline conditions shall be based upon a survey of the enrolled property, undertaken by a qualified person satisfactory to the Service not more than 18 months prior to the signing of the Cooperative Agreement, to delineate the

locations of all elderberry bushes having 1 or more stems that are 1 inch or greater in diameter at the base. Where possible to estimate baseline conditions based on monitoring and modeling of elderberry bushes in the watershed, such an estimate may be used in lieu of the survey of the enrolled property, provided that the Service, the Program Administrator, and the Program Participant concur. In order to receive the assurances regarding take of covered species specified in Section 10 of this Agreement, a Program Participant must maintain on the enrolled property at least as many such elderberry bushes as were present when the program participant entered into the program and in the same general locations.

5. MANAGEMENT ACTIVITIES

Each Cooperative Agreement shall specify the riparian restoration, enhancement, and management activities to be carried out on the enrolled property to which it applies and a timetable for implementing those activities. These activities shall include those listed as "standard activities" in Exhibit 3 and such "additional activities" listed in Exhibit 3 as the Program Participant agrees to implement. The object of such activities will be to create healthy native riparian plant communities that include elderberry bushes, on the enrolled properties. The Service has determined that implementation of these activities is expected to produce a net conservation benefit for the covered species.

6. NET CONSERVATION BENEFIT

Implementation of this Agreement is reasonably expected to provide a "net conservation benefit" to the covered species, because the collective management activities performed by the Program Participants pursuant to this Agreement are expected to provide an increase in the covered species' population and/or enhance, restore, or maintain the covered species' habitat.

Specifically, the Agreement supports recovery objective #5 listed in the Recovery Plan for the valley elderberry longhorn beetle (USFWS 1984) by restoring habitat sites within the presumed historical range of the animal, managing this habitat by removing exotic species as necessary, and protecting these restored sites for a minimum of 10 years. In addition, it is anticipated that many Program Participants will restore native plant species typical of Valley Foothill Riparian habitats, which may encourage colonization of the planted elderberries by the valley elderberry longhorn beetle (River Partners, 2004), as well as provide habitat for other species.

Because valley elderberry longhorn beetle populations appear to have limited dispersal capability (Collinge et al., 2001), colonization of restored habitat will be more likely if valley elderberry longhorn beetles are known to exist within a 10 to 20-km radius of the restored site. The area included in this Agreement is within the requisite radius of several valley elderberry longhorn beetle sightings recorded in the California Natural Diversity Database (e.g., #79 at Clements Glen View Cemetery, #90 on the Mokelumne River, #160 and 161 on nearby Bear Creek). This Agreement will provide additional habitat for

dispersing adults in this metapopulation, potentially increasing their occupied habitat, and therefore is expected to provide a "net benefit" to the species.

7. OTHER RESPONSIBILITIES OF THE PARTIES

A. In addition to entering into Cooperative Agreements with willing non-Federal landowners and managers, as described above, the Program Administrator agrees to:

1. Inform the Service within 30 days of any notification it receives from a Program Participant (or from a neighboring landowner who has entered into an agreement pursuant to Section 8 of this Agreement) of the latter's intent to make a change in land use likely to reduce the number of living elderberry bushes with 1 or more stems of 1 inch or greater in diameter at the base, and reasonably cooperate with the Service in the event that it chooses to relocate such bushes or capture and/or relocate potentially affected individuals of the covered species in response to such notification;

2. At least triennially, carry out surveys on not less than 20 percent of the total restored habitat on enrolled properties to assess the general condition of elderberry bushes, use of planted bushes by the covered species, and general condition of other native plant species in the restored habitat. Such surveying activities may be carried out on the Program Administrator's behalf by the East Bay Municipal Utilities District or other qualified entity pursuant to an agreement with the Program Administrator and Program Participant;

3. Provide the Service with an annual report, due by March 31 of each year, in the form attached hereto as Exhibit 2;

4. Notify the Service of any living or dead specimens of the covered species of which it becomes aware on the enrolled properties; and

5. Furnish the Service with copies of all Cooperative Agreements hereunder within 2 weeks after they are signed.

B. In consideration of the foregoing, the Service agrees to:

1. Upon execution of the Agreement, issue to the Program Administrator a permit in accordance with ESA section 10(a)(1)(A), and valid for a period of 50 years, authorizing incidental take of the covered species as a result of implementing management activities specified in a Cooperative Agreement, or as a result of other lawful activities on enrolled properties after the management activities specified in such Cooperative Agreement have been initiated, provided that such taking shall be consistent with maintaining baseline conditions on the enrolled property. The duration of the Agreement will be 50 years. The section 10 permit may extend for an additional 2 years beyond the 50 year duration of the Agreement, so long as prior to or upon expiration of the Agreement, the Service

determines that the conservation actions identified in the Agreement have been implemented and the Program Participants need not perform additional conservation activities on the properties. If extended under the conditions above, the duration of the permit will be 52 years.

2. Provide to the Program Administrator and Program Participants technical assistance, to the maximum extent practicable, when requested; and provide information on Federal funding programs.

8. OTHER LANDOWNERS WHO MAY SECURE INCIDENTAL TAKE AUTHORIZATION

Landowners who own land that abuts the Mokelumne River or its tributaries and is immediately adjacent to enrolled land may, without committing to undertake any management activities described in Section 5 of this Agreement on such adjoining land, secure the incidental take authority conferred by the permit issued by the Service to the Program Administrator pursuant to Section 7.B.1 of this Agreement, provided: (1) such adjoining landowner enters into a written agreement with the Program Administrator in the form attached hereto as Exhibit 5; (2) such written agreement specifies the baseline conditions on such adjoining property; and (3) activities resulting in such incidental take are consistent with maintaining the baseline conditions on such adjoining property. Where possible to estimate baseline conditions based on recent aerial photos, surveys undertaken from public roadways, adjacent lands, or other similar locations, the Program Administrator may, with the concurrence of the Service, propose a baseline on such basis. The adjoining landowner may either accept the Program Administrator's proposed baseline conditions or have undertaken at his own expense a survey to establish the baseline conditions more precisely. Under either event, the determination of baseline conditions shall be made by a qualified person satisfactory to the Service.

9. AGREEMENT AND PERMIT DURATION

The Agreement becomes effective upon issuance by the Service of the ESA section 10(a)(1)(A) permit described in Section 7 of this Agreement, and will be in effect for 50 years. Cooperative Agreements developed pursuant to this Agreement will be for a term of at least 10 years. When the Service determines that the conservation actions identified in the Cooperative Agreements have been implemented, then the Program Participants need not perform additional conservation activities on the property and the section 10 permit may continue in effect following termination of the Agreement for an additional 2 years. In such case, the section 10 permit authorizing incidental take of the VELB will be for a duration of 52 years from the effective date of the permit. The additional duration of the permit following termination of the Agreement will continue section 10(a)(1)(A) permit coverage of the Program Participants for two years to allow a return of the enrolled property to its baseline condition. This Agreement and the permit described in Section 7 of this Agreement may each be extended by mutual written consent of the parties.

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Deleted: Cooperative Agreements developed pursuant to this Agreement will be for a term of at least 10 years.

10. ASSURANCES REGARDING TAKE OF COVERED SPECIES

Provided that such take is consistent with maintaining the baseline conditions identified in Section 4 of this Agreement, the ESA section 10(a)(1)(A) permit referenced in Section 7 of this Agreement shall authorize the taking of covered species incidental to otherwise lawful activities by Program Participants (and by neighboring landowners who have entered into agreements pursuant to Section 8 hereof), their employees or agents, and those authorized by law to control flooding in the Mokelumne River watershed in the following circumstances:

1. Implementing the management activities identified in Section 5 of this Agreement; or
2. Making any lawful use of the enrolled property of the Program Participant after the management activities identified in Section 5 of this Agreement have been initiated, including but not limited to farming, ranching, or other agricultural use, use of registered pesticides and herbicides (provided that such use is in accordance with label restrictions, "standard activities" specified in Exhibit 3 and such "additional activities" from Exhibit 3 that are included in Exhibit B of the Cooperative Agreement), recreation, use and maintenance of access paths and of roadways, levee repair and maintenance, maintenance of floodways, and emergency flood fighting.
3. Returning to baseline.

11. MODIFICATIONS

A. Modification of the Agreement. Either party may propose amendments to this Agreement by providing written notice to, and obtaining the written concurrence of, the other Party. Such notice shall include a statement of the proposed modification, the reason for it, and its expected results. The Parties will respond to proposed modifications within 60 days of receipt of such notice. Proposed modifications will become effective upon the other Parties' written concurrence.

B. Termination of the Agreement. As provided for in Part 12 of the Service's Safe Harbor Policy (64 FR 32717), a Program Participant may terminate his Cooperative Agreement with the Program Administrator for circumstances beyond his or her control by giving written notice to the Program Administrator. In such circumstances, the Program Participant may, pursuant to the permit referenced in Section 7.B.1 of this Agreement, return the enrolled property to baseline conditions even if the management activities identified in Section 5 of this Agreement have not been fully implemented.

C. Permit Suspension or Revocation. The Service may suspend or revoke the permit referenced in Section 7.B.1 above for cause in accordance with the laws and regulations in force at the time of such suspension or revocation. The Program Administrator or any Program Participant has the right to appeal any suspension or revocation to a mutually agreed upon arbitrator.

D. Baseline Adjustment. The baseline conditions for any enrolled property may, by mutual agreement of the Parties and the Program Participant, be adjusted if, during the term of the Cooperative Agreement and for reasons beyond the control of the Program Participant or as an unintended result of properly-implemented management activities, the number of living elderberry bushes with 1 or more stems of 1 inch or greater in diameter at the base is reduced from what is was at the time the Cooperative Agreement was negotiated.

E. Inability of the Program Administrator to Continue. If the Program Administrator shall, for any reason, cease to be able to perform its obligations under this Agreement, it shall give written notice of that fact to the Service at least 60 days prior to ceasing to perform its obligations under the Agreement. Upon receiving such notice, the Service may, at its discretion after consultation with Program Participants, either amend this Agreement and the associated permit to substitute a new Program Administrator, or, if a Program Participant prefers, convert any previously approved Cooperative Agreement into an individual agreement between the Program Participant and the Service under the same substantive terms.

12. OTHER MEASURES

A. Remedies. No party shall be liable in monetary damages for any breach of this Agreement, any performance or failure to perform an obligation under this Agreement or any other cause of action arising from this Agreement.

B. Dispute Resolution. The Parties agree to work together in good faith to resolve any disputes, using dispute resolution procedures agreed upon by all Parties.

C. Succession and Transfer. As provided in Part 11 of the Service's Safe Harbor Agreement Policy, if a Program Participant transfers his or her interest in the enrolled property to another non-Federal entity, the Service will regard the new owner or manager as having the same rights and responsibilities with respect to the enrolled property as the original Program Participant, if the new owner or manager agrees to become a party to the Cooperative Agreement in place of the original Program Participant.

D. Availability of Funds. Implementation of this Agreement is subject to the requirements of the Anti-Deficiency Act and the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to require the obligation, appropriation, or expenditure of any funds from the U.S. Treasury. The Parties acknowledge that the Service will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit to such expenditures as evidenced in writing.

E. No Third-Party Beneficiaries. This Agreement does not create any new right or interest in any member of the public as a third-party beneficiary, nor shall it authorize anyone not a party to this Agreement to maintain a suit for personal injuries or damages

pursuant to the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third parties shall remain as imposed under existing law. In the event that any third party successfully challenges the permit referenced in Section 7.B.1 of this Agreement, the Service shall, at the request of a Program Participant, remove and relocate away from the enrolled property any elderberry bushes on the enrolled property in excess of baseline conditions.

F. Other Listed Species, Candidate Species, and Species of Concern. In the event that other riparian-associated species in the lower Mokelumne River Watershed in San Joaquin County not initially covered by this Agreement are subsequently listed as threatened or endangered under the Endangered Species Act, the parties agree to amend this Agreement, and subject to the concurrence of the Program Participant, any Cooperative Agreements previously approved hereunder, to include such other species as Covered Species. The amendment of any Cooperative Agreement pursuant to this provision shall specify as the baseline for such subsequently listed species the lesser of the following:

(1) the amount of habitat for that species on the enrolled property that existed at the time the Cooperative Agreement was signed (as determined by a qualifying vegetational survey, if the survey was carried out within 18 months prior to such signing), or

(2) the amount of habitat for that species on the enrolled property at the time of the amendment of such Cooperative Agreement as determined by a qualifying vegetational survey.

The term "qualifying vegetational survey" refers to a survey conducted substantially in accordance with either the California Native Plant Society's (CNPS) Releve Protocol (California Native Plant Society Vegetation Committee October 20, 2000; revised 4/2/04), or by using the existing vegetation classification and mapping protocol referenced in *Terrestrial Vegetation Communities of the Lower Mokelumne River, California* (Kent A. Reeves and James S. Jones, 2004, published by and available from East Bay Municipal Utilities District, 1 Winemaster Way, Suite K2, Lodi, CA 95240).

G. Notices and Reports. Any notices and reports, including monitoring and annual reports, required by this Agreement shall be delivered to the persons listed below, as appropriate:

California Association of Resource Conservation Districts
3823 V Street, Suite 3
Sacramento, CA 95817

Project Leader
Sacramento Fish and Wildlife Office
U.S. Fish and Wildlife Service
2800 Cottage Way, W-2605
Sacramento, California 95825

13. RELATIONSHIP TO THE SAN JOAQUIN COUNTY MULTI-SPECIES HABITAT CONSERVATION AND OPEN SPACE PLAN

Lands established as Preserves under the San Joaquin county Multi-Species Habitat Conservation and Open Space Plan ("SJCMSHCP") may be enrolled under this Agreement, and vice versa, provided that nothing in either this Agreement or the SJCMSHCP diminishes or enlarges any obligations imposed by the other with respect to such lands.

Literature Cited

Collinge, S.K., M. Holyoak, C.B. Barr, and J.T. Marty. 2001. Riparian habitat fragmentation and population persistence of the threatened valley elderberry longhorn beetle in central California. Biological Conservation 100 (2001) 103-113.

River Partners, 2004. Survey of planted elderberry on Sacramento River National Wildlife Refuge riparian restoration sites for use by Valley elderberry longhorn beetles. Prepared for US Fish and Wildlife Service, Sacramento. February 23, 2004.

US Fish and Wildlife Service, 1984. Valley elderberry longhorn beetle recovery plan. US Fish and Wildlife Service, Portland, Oregon. June, 1984.

IN WITNESS WHEREOF, THE PARTIES HERETO have executed this Safe Harbor Agreement to be in effect as of the date that the Service issues the permit referred to in Section 7.B.1 above.

_____ _____

Executive Director
California Association of Resource
Conservation Districts

Date

_____ _____

Acting Field Supervisor
Sacramento Fish and Wildlife Office
U.S. Fish and Wildlife Service

Date

EXHIBIT 1
Cooperative Agreement

This is a voluntary agreement that recognizes the unique and important role that private landowners in California can play in helping wildlife valued by the people of the state and of the nation. The purpose of the agreement is to enable land management activities beneficial to rare species to be carried out on privately owned land while minimizing the impact of such activities on the right and ability of the owner or manager thereof to use it as he or she wishes. The terms of this agreement are as follows:

1. The California Association of Resource Conservation Districts ("Program Administrator") and _____ (Program Participant) have entered into this Agreement to improve and manage native riparian habitat for the betterment of wildlife, including endangered species, on certain land owned or managed by the Program Participant that are delineated on the attached map (Exhibit A), and referred to herein as the "enrolled property."

2. The United States Fish and Wildlife Service (Service) has issued to the Program Administrator an endangered species permit that authorizes, until the year [20..], the incidental taking of valley elderberry longhorn beetles by Program Participant and other persons who enter into cooperative agreements with the Program Administrator pursuant to the permit.

3. Program Participant agrees to conduct, or allow to be conducted, activities to restore, enhance, or manage native riparian habitat in accordance with the plan set forth in the attached Exhibit B, and maintain such habitat for a period of 10 years from the date of this Agreement.

4. The Program Participant further agrees to provide the Program Administrator with a brief report, due December 31 of the year following the signing of this Cooperative Agreement, and annually thereafter. Such report, in the format shown in Exhibit 4 or in any other simple format to be developed by the Program Administrator, shall identify any management activities undertaken to restore, enhance, or manage native riparian habitat on the property subject to this Cooperative Agreement, as well as any changes in the extent of native riparian habitat in the preceding year. The Program Participant understands and agrees that the Program Administrator will include these annual reports with the reports that it is required to submit to the Service from time to time. The Program Participant further agrees to promptly report to the Program Administrator the observation of any living or dead specimens of the Valley elderberry longhorn beetle.

5. In consideration of the foregoing, the Program Administrator has issued to the Program Participant the attached Certificate of Inclusion under the Program Administrator's permit. This Certificate authorizes the Program Participant and the Program Participant's successors or assigns:

a) to take the species identified above incidental to implementing the management activities set forth in this Agreement;
b) after initiation of, and consistent with such management activities, to carry out any other lawful activity that may cause the incidental taking of such species on Program Participant's property, provided that such taking does not reduce the number of living elderberry bushes below the amount specified in Part 7 below.

As used in this Cooperative Agreement, "incidental" take refers to the unintentional or unavoidable killing or injuring of the species identified above in the course of carrying out otherwise lawful activities. Nothing in this Cooperative Agreement authorizes Program Participant to capture, collect, or deliberately kill or injure any such species.

6. After the agreed-upon management activities have been initiated, Program Participant agrees to give the Program Administrator at least 90 days notice (except when precluded by emergency situations) prior to commencing any change in land use likely to reduce the number of living elderberry bushes with 1 or more stems 1 inch or greater in diameter at the base on the enrolled property, and to allow the Program Administrator or the Service the opportunity to rescue and relocate any individuals of the above species and translocate elderberry bushes from Program Participant's land to avoid their loss.

7. The Program Participant and the Program Administrator agree that at the time that this Cooperative Agreement was signed, there were [X] living elderberry bushes with 1 or more stems of 1 inch or greater in diameter at the base on the enrolled property located at the general locations indicated on Exhibit A. That number of living elderberry bushes in those general locations shall be considered the "baseline conditions" applicable to the property. So long as at least that number of living elderberry bushes of that size remain in the same general locations on Program Participant's enrolled property, Program Participant may incidentally take the species as provided in Part 5 above. If requested by the Service within 90 days of its receiving a copy of the Cooperative Agreement, the Program Participant agrees to allow the Service access to the enrolled portion of Program Participant's property for the sole purpose of verifying the baseline determination set forth in this paragraph.

8. Successors and assigns may incur the responsibilities and benefits of this Agreement by becoming a party thereto, unless terminated in writing as specified below. If Program Participant decides to sell or otherwise transfer ownership or management of the property, Program Participant agrees to give the Program Administrator notice of such decision prior to the intended sale or transfer and to give the purchaser or transferee notice of this Cooperative Agreement so that the purchaser or transferee can become a party to it if he or she so wishes. Program Participant will inform the Program Administrator in the event all, or part of, the Program Participant's property delineated on the map labeled Exhibit A is transferred to another owner.

9. The Program Participant shall grant the Program Administrator access to Program Participant's property to confirm that the restoration, enhancement, or management

activities set forth in Exhibit B have been conducted, and to assess the condition of the habitats being managed under the Cooperative Agreement. The Program Administrator shall give the Program Participant reasonable notice of these visits and shall be accompanied by the Program Participant or an agent of the Program Participant if the Program Participant so desires.

10. The Program Participant, or the Program Participant's successors or assigns, may terminate the Cooperative Agreement for reasons beyond their control at any time by giving 60 days written notification to the Program Administrator, in which case the Program Participant or the Program Participant's successors or assigns' right to incidentally take the species under the permit and Certificate of Exclusion shall expire two years after giving such notice. This Cooperative Agreement can be renewed, extended, or modified at any time subject to both the Program Participant's and the Program Administrator's approval. The baseline conditions in any renewal or extension of this Cooperative Agreement shall be the same as set forth in Part 7 above.

11 Program Participant and the Program Administrator agree with respect to liability and indemnification for injuries to persons or property arising out of this Agreement as follows: [details may vary from agreement to agreement] Program Participant assumes no liability for injury to any employee or representative of Program Administrator in the course of any visit to the property under this agreement. Program Administrator shall not be liable for any damage to the property of the Landowner arising from any visit to the property pursuant to this agreement.

12. So long as the permit and Certificate remain in effect, and provided the management activities required by this Agreement have been carried out, the Program Participant may exercise the right conferred by the Program Administrator's permit and the Certificate to incidentally take the species identified above on the enrolled property.

13. Nothing herein affects the right of the Program Participant to seek to establish the enrolled property as a Preserve under the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan ("SJCMSHCP"), but neither this Agreement nor the SJCMSHCP diminishes or enlarges any obligations imposed by the other.

California Association of Resource Conservation Districts

_____,
Program Participant

By_____

By_____

Date_____

Date_____

Exhibit A

[map of the property subject to the cooperative agreement]

Exhibit B

[specifications for management actions to be carried out]

CERTIFICATE OF INCLUSION

This certifies that the property described as follows [DESCRIPTION], owned by [NAME OF PROGRAM PARTICIPANT], is included within the scope of Permit No. ____ issued by the U.S. Fish and Wildlife Service on [DATE] for a period of 50 years to the California Association of Resource Conservation Districts under the authority of section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended, 16 U.S.C. 1539(a)(1)(A). Such permit authorizes certain activities by participating landowners as part of a safe harbor program to restore and enhance habitat for the valley elderberry longhorn beetle. Pursuant to that permit and this certificate, the holder of this certificate is authorized to engage in activities on the above described property that may result in the incidental taking of such species, subject only to the terms and conditions of such permit and the cooperative agreement entered into pursuant thereto by the California Association of Resource Conservation Districts and [NAME OF PROGRAM PARTICIPANT] on [DATE].

_____
Name and Title of Representative of the California
Association of Resource Conservation Districts

Date: _____

EXHIBIT 2
Annual Report for
Safe Harbor Agreement between the U.S. Fish and Wildlife Service and California Association of Resource Conservation Districts

Permittee's Name: California Association of Resource Conservation Districts

Permit Tracking Number: TE-XXXXXX-0

Location: Mokelumne River Watershed, San Joaquin County, California

Agreement Approved by: California/Nevada Operations Office, U.S. Fish and Wildlife Service

Covered Species: Valley elderberry longhorn beetle

Report on the Monitoring Program (1-2 paragraphs): Describe in general terms the results of any surveys carried out pursuant to Section 7.A.2 of the Safe Harbor Agreement in the year covered by the report; append a copy of the report. Describe any major changes in the collective condition of elderberry bushes included in the baseline or planted as part of the Program Participants' restoration plans. Describe any evidence of utilization of such habitat by the covered species. Append to this report copies of all reports submitted to the Program Administrator by Program Participants since the last annual report.

Date Annual Report is Due: On or before March 31, for the prior calendar year

Date Annual Report was Received:_____

Date Annual Report was Reviewed:_____

Signature of Reviewer:_____

Printed Name and Phone # of Reviewer_____

Report on Area wide Management and Conservation Actions (1-2 paragraphs): As necessary to supplement the monitoring reports above, summarize the extent and condition of restored native riparian vegetation on the collective enrolled properties. Describe any apparent year-to-year trends in restoration success in the region, as well as significant differences in restoration success between reached and-or sites. Describe any relevant regional conditions (e.g., drought, flood) that may be required to interpret the management activities described in the appended annual reports from the Program Participants. Finally, please convey any suggestions for adaptive management of restored areas that may have emerged from the program so far.

EXHIBIT 3
Management Activities

Standard Activities

At least one of the following two management activities shall be included in all cooperative agreements:

- Plant native species typical of the canopy, subcanopy, shrub, and herbaceous layers found in Valley Foothill Riparian habitats[1], preferably with stock obtained from local sources; if elderberries already exist on the site, recruitment and growth of additional elderberries will be encouraged via natural processes, **and/or**
- Plant elderberry bushes, using local stock when practical, at a density of at least 24 bushes per acre, or at a density appropriate for conditions at the site.

In addition, both of the following management activities shall be included in all cooperative agreements:

- Limit pesticide and herbicide use within the restored area to those contact herbicides necessary to control invasive weeds.
- Do not use aerial application of pesticides or herbicides within 100 feet of the restored area, except in extreme weather that precludes other pesticide application equipment from moving through the fields.

Additional Activities

A Program Participant may elect to include one or more of the following management activities in a cooperative agreement:

- Undertake reasonable efforts to remove non-native invasive species as appropriate to facilitate restoration.
- Monitor new plantings until they are established and adjust management practices (such as irrigation, if required) accordingly.
- Create riparian pastures that promote sustainable grazing management.
- Implement prescribed burns to foster restoration of native riparian habitat, following U.S. Fish and Wildlife Service guidelines for the protection of elderberry shrubs during prescribed burns.
- Within 25 feet of the nearest elderberry bush planted as part of the initial restoration plan: monitor insect activity and nuisance plant growth; use pesticides and herbicides

[1] As defined in the "California Wildlife Habitat Relationships System" adopted by the California Department of Fish and Game. It is an adaptation of the description found in *A Guide to Wildlife Habitats of California* by K.E. Mayer and W. F. Laudenslayer, published by the California Department of Forestry and Fire Protection in 1988.

only when economic thresholds for insect pests and weeds have been exceeded and wind conditions minimize drift potential; and use the lowest-risk pesticides and herbicides appropriate to the task, as detailed below. The following may be revised to reflect advances in pest management science if such changes are approved by the Program Administrator and the Service.

- Monitor at recommended intervals[2] for the important insect, disease, vertebrate and weed pests as identified in the University of California pest management guidelines (http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html).
- Do not treat for any pest unless the economic threshold for that pest has been exceeded (http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html).
- When making a decision whether to treat or not, take into consideration the presence of pests' natural enemies, if these species are important to the natural control of the pest (e.g., mite predators in the case of Willamette or Pacific mites, or *Anagrus* wasps in the case of leafhoppers).
- If treatment is necessary use only low risk pesticides. For vineyards, the Pesticide Environmental Assessment System (PEAS)[3] model can be used to determine which pesticides are low risk.
- Spot treat, if possible, (i.e. only treat pest affected areas, not the entire vineyard or cropped area).
- Assure that sprayers/dusters have been calibrated for the material being used.
- Do not spray/dust when winds will carry the spray/dust off of the property or into the restored area.
- If application of herbicides is necessary, use a shielded sprayer to apply the herbicide.
- To the extent feasible, minimize dust in and around the property by watering or sealing roads and growing cover crops.
- Keep records of monitoring, economic threshold and toxicity determinations, and pesticide or herbicide use within the 25-foot buffer zone; provide these records to the Program Administrator and/or the Service on request.

[2] Every 10 days for vineyards.

[3] The PEAS model was developed by Dr. Chuck Benbrook, Benbrook Consulting Services. The primary goal of PEAS is to quantitatively identify risk for each pesticide used in the vineyard. Risk is calculated as pesticide impact units and is based on 5 indices: 1) Toxicity to Daphnia; 2) Toxicity to birds; 3) Toxicity to bees; 4) Worker exposure; and 5) Dietary exposure. The PEAS model calculates the number of pesticide impact units based on the amount of material applied per acre for each application, the method of application, and the time of day and time of year the material is applied. Pesticides having 10 or fewer impact units per application are considered low risk for purposes of this Agreement. Instructions for using the PEAS model can be obtained from the Lodi-Woodbridge Winegrape Commission.

Exhibit 4
Annual Report from Program Participant to Program Administrator

Directions: Walk through the restoration area observing overall conditions and paying particular attention to elderberry bushes. You may wish to have your baseline maps and restoration plan handy for reference. Explanations can be brief (one or two sentences). Please refer to the sample photos provided by the Program Administrator to assess the condition of elderberry bushes and other native vegetation.

At the discretion of the Program Administrator, you may substitute for this form a monitoring report provided to you by a biologist or restoration professional familiar with the Valley elderberry longhorn beetle.

Condition of Elderberry Bushes

1. Of the elderberry bushes or clumps of elderberry bushes documented in Exhibit A (your pre-restoration baseline), how many are in

- Excellent condition (growing larger and denser, possibly reproducing) ____
- Fair condition (no signs of stress, but little or no growth) ____
- Poor condition (showing signs of stress) ____
- No longer alive ____

Alternative to Question 1: Provide a photograph of each elderberry bush or clump of bushes listed in Exhibit A.

2. Of the elderberry bushes planted as part of the restoration plan described in Exhibit B, approximately what percentage (or how many) are in

- Excellent condition ____
- Fair condition ____
- Poor condition ____
- No longer alive ____

Alternative to Question 2: Provide photographs that show the condition of a representative sample of the elderberry bushes planted as part of the restoration project.

3. If you have noticed any "exit holes" that appear typical of Valley elderberry longhorn beetles, please note here the number of bushes on which you have noticed them.

Condition of Other Native Plants and the Restored Riparian Area

4. What is the general condition of the native vegetation that was planted as part of the restoration plan? (If relevant, please note the condition of the canopy, subcanopy, shrub, and herbaceous layers separately.)

- Excellent condition ____
- Fair condition ____
- Poor condition ____

- No longer alive ____

Alternative to Question 4: Provide photographs taken from several locations within the restored site to show annual changes. These locations should be marked for reference on Exhibit B and should remain the same from year to year.

5. Has the extent of the area that supports native riparian vegetation changed within the past year? For example, has the area expanded naturally or has it markedly decreased due to fire, flood, drought, or other natural disturbance?

- Expanded ____
- Decreased ____
- Stayed the same ____

Please explain briefly the extent and causes of any noticeable increase or decrease.

6. Did non-native grasses or other invasive species

- Spread ____
- Degrade or dominate portions of the native plantings ____
- Remain about the same ____

Please describe any action you took to control the spread of non-natives.

7. Have you noticed a change in the types or numbers of birds, beneficial insects, or other wildlife in the restored area? If so, please describe these briefly.

Management Activities

8. In what month and year were the restoration activities substantially complete? _____

9. Please list the types of activities (e.g., irrigation, grazing) you undertook this year to maintain or manage the restoration area this year and note whether they differed significantly from the activities described in Exhibit B of your Cooperative Agreement.

EXHIBIT 5
Neighboring Landowner Agreement

1. [Owner] owns land (hereafter "the Property") in San Joaquin County, California, that is designated on the attached map and that is adjacent to land enrolled in the Programmatic Safe Harbor Agreement between the California Association of Resource Conservation Districts and the United States Fish and Wildlife Service (hereafter "the Service"), dated [date]. The Programmatic Safe Harbor Agreement, and the permit issued by the Service to the California Association of Resource Conservation Districts in connection therewith, authorizes participating landowners who enter into cooperative agreements to restore riparian habitat on land enrolled in the program to take endangered Valley Elderberry Longhorn Beetles incidental to farming, ranching, and other lawful activities on the enrolled land, provided that baseline habitat conditions as specified in such cooperative agreements are maintained.

2. The California Association of Resource Conservation Districts serves as the Program Administrator of the foregoing Programmatic Safe Harbor Agreement, and as such is authorized by that Agreement to enter into both cooperative agreements with landowners who enroll land in the Programmatic Agreement, and similar Neighboring Landowner Agreements with landowners who own land adjacent to land enrolled in the Agreement. Such Neighboring Landowner Agreements confer upon such neighboring landowners the same rights to take endangered species incidental to lawful activities on such neighboring land, subject to requirements as are set forth in this Agreement, as cooperative agreements confer upon landowners who enroll land in the Programmatic Agreement.

3. The California Association of Resource Conservation Districts has determined that the "baseline conditions" applicable to the Property are as follows: [number] living elderberry bushes with 1 or more stems of 1 inch or greater in diameter at the base occur on the Property at the general locations indicated on the attached map. So long as at least that number of living elderberry bushes of that size remain in the same general locations on the Property, [owner] may incidentally take Valley elderberry longhorn beetles in the course of any lawful use of the property, subject to Section 4 below. As used herein, "incidental" take refers to the unintentional or unavoidable killing or injuring of Valley elderberry longhorn beetles in the course of carrying out otherwise lawful activities. The restoration of riparian habitat on land enrolled in the Program shall not affect in any way the use by the Owner of pesticides or herbicides on the Property. Nothing herein authorizes [Owner] to capture, collect, or deliberately kill or injure any such beetles.

Comment [MSOffice1]: This is a new sentence that clarifies how the new language in Section 10 affects neighboring landowners.

4. [Owner] agrees to give the the California Association of Resource Conservation Districts at least 90 days notice (except when precluded by emergency situations) prior to commencing any change in land use likely to reduce the number of living elderberry bushes with 1 or more stems 1 inch or greater in diameter at the base on

the Property, and to allow the Program Administrator or the Service the opportunity to rescue and relocate any individual Valley elderberry longhorn beetles and translocate elderberry bushes from the Property to avoid their loss.

5. This Neighboring Landowner Agreement remains in effect until the expiration of the Programmatic Safe Harbor Agreement between the California Association of Resource Conservation Districts and the Service on [date].

6. Nothing herein affects the right of [Owner] to seek to establish the Property as a Preserve under the San Joaquin County Multispecies Habitat Conservation and Open Space Plan ("SJCMSHCP"), but neither this Neighboring Landowner Agreement nor the SJCMSHCP diminishes or enlarges any obligations imposed by the other.

[Owner] Date

California Association of Resource Conservation Districts Date