Disclaimer

CCPs provide long term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service’s best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.
Butte Sink,
Willow Creek-Lurline, and
North Central Valley
Wildlife Management Areas

_Draft Comprehensive Conservation Plan and Environmental Assessment_

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<tr>
<td>AHMP</td>
<td>Annual Habitat Management Plan</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
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<tr>
<td>BMP</td>
<td>Best Management Practice</td>
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<tr>
<td>BOR</td>
<td>Bureau of Reclamation</td>
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<tr>
<td>BSWMA</td>
<td>Butte Sink Wildlife Management Area</td>
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<tr>
<td>CCP</td>
<td>Comprehensive Conservation Plan</td>
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<tr>
<td>CD</td>
<td>Compatibility Determination</td>
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<tr>
<td>CDFW</td>
<td>California Department of Fish and Wildlife (formerly Department of Fish and Game)</td>
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<tr>
<td>cfs</td>
<td>Cubic feet per second</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
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<td>Cooperative Land Management Agreement</td>
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<td>CVPIA</td>
<td>Central Valley Project Improvement Act</td>
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<td>Delta</td>
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<td>Improvement Act</td>
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<td>West Nile Virus</td>
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Chapter 1. Introduction and Background

1. Introduction

This document is a Draft Comprehensive Conservation Plan (CCP) which is designed to guide management of Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas (WMAs) for the next fifteen years. The U.S. Fish and Wildlife Service (Service) manages the WMAs as part of the Sacramento National Wildlife Refuge Complex (Complex), located in the Sacramento Valley of California approximately 90 miles north of the city of Sacramento (Figure 1). The WMAs consist primarily of private lands protected by perpetual conservation easements and also some Service-owned lands. Conservation easements are voluntary realty transactions in which the Service purchases a property’s development rights from the landowner to protect wetlands and other resource values on private lands. Easement and Service-owned lands in the WMAs are considered components of the National Wildlife Refuge System.

The CCP provides a description of the desired future conditions and the long-range guidance to accomplish the purposes for which the WMAs were established. The CCP and accompanying Environmental Assessment (EA) address Service legal mandates, policies, goals, and National Environmental Policy Act (NEPA) compliance. The EA (Appendix A) presents a range of land protection and habitat management alternatives that consider issues and opportunities on the WMAs. The Service’s initial proposal for future management of the WMAs is presented in the EA. The final CCP will be developed through modifications made during the internal and public review processes.

Existing plans that remain applicable to Service-owned lands are: Annual Habitat Management Plans for the Llano Seco Unit of North Central Valley WMA and Butte Sink Unit of Butte Sink WMA; Fire Management Plan; Resource Inventory and Monitoring Plan; Waterfowl Disease Contingency Plan; and Integrated Pest Management Plan.

Managed freshwater marsh, Llano Seco Unit. Photo: USFWS
Figure 1. Sacramento National Wildlife Refuge Complex:
Including Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas

Figure 1. Sacramento NWR Complex Location
2. **Need for this CCP**

The National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) (Improvement Act) requires that all Federal refuges, including WMAs, be managed in accordance with an approved Comprehensive Conservation Plan (CCP). Moreover, the WMAs currently have no integrated plan that guides the management of all its resources and uses. In order to meet the dual needs of complying with the Improvement Act and providing long-term integrated management guidance for the WMAs, the Service proposes this CCP.

Guidance within the CCP will be in the form of goals, objectives, strategies, and compatibility determinations. The purposes of this CCP are to:

- Provide a clear statement of direction for the future management of the WMAs;
- Provide long-term continuity in WMA management;
- Communicate the Service’s management priorities for the WMAs to easement landowners, partners, neighbors, visitors, and the general public;
- Provide an opportunity for the public to help shape the future management of the WMAs;
- Ensure that management programs on the WMAs are consistent with the mandates of the National Wildlife Refuge System (Refuge System) and the purposes for which the WMAs were established;
- Ensure that the management of the WMAs are consistent with Federal, State, and local plans; and
- Provide a basis for budget requests to support the WMAs’ needs for staffing, operations, maintenance, and capital improvements.

3. **Legal and Policy Guidance**

WMAs are guided by the purposes of the individual WMAs, the mission and goals of the Refuge System, and Service policy, laws and international treaties. Service-owned lands and conservation easement interests acquired within the WMAs are components of the Refuge System and are subject to applicable laws and regulations. It is important to note that not all Refuge System laws and regulations apply to conservation easements. For example, regulations controlling public use are not applicable to conservation easements because these rights have not been purchased by the Service.

Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the Improvement Act of 1997, Refuge Recreation Act of 1962, selected portions of the Code of Federal Regulations, and the Service Manual. WMAs are also governed by a variety of other laws, treaties and executive orders pertaining to the conservation and protection of natural and cultural resources (refer to Appendix N for additional information about these laws and executive orders).

### 3.1 National Wildlife Refuge System Improvement Act

The Improvement Act of 1997, which amends the National Wildlife Refuge System Administration Act of 1966, provides comprehensive legislation on how the Refuge System should be managed and used by the public. The Improvement Act:

- Identified a new mission statement for the Refuge System;
- Established six priority public uses (hunting, fishing, wildlife observation and photography, environmental education and interpretation);
- Emphasized conservation and enhancement of the quality and diversity of fish and wildlife habitat;
- Stressed the importance of partnerships with Federal and State agencies, Tribes, non-governmental organizations, industry, and the general public;
- Mandated public involvement in decisions on the acquisition and management of refuges;
Required, prior to acquisition of new refuge lands, identification of existing compatible wildlife-dependent uses that would be permitted to continue on an interim basis pending completion of comprehensive conservation planning.

The Improvement Act also establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a CCP for each refuge System unit by the year 2012; and provides guidelines and directives for the administration and management of all areas in the Refuge System, including refuges, WMAs, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, or waterfowl production areas.

3.2 Appropriate Use Policy

This policy describes the initial decision process the refuge manager follows when first considering whether or not to allow a proposed use on a refuge or WMA. The refuge manager must find a use appropriate before undertaking a compatibility review of the use. An appropriate use, as defined by the Appropriate Use Policy (603 FW 1 of the Service Manual), is a proposed or existing use on a refuge or WMA that meets at least one of the following four conditions:

- The use is a wildlife-dependent recreational use as identified in the Improvement Act;
- The use contributes to the fulfilling of the WMA purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law;
- The use involves the take of fish and wildlife under State regulations;
- The use has been found to be appropriate as specified in section 1.11 (603 FW 1 of the Service Manual).

If an existing use is not appropriate, the refuge manager will eliminate or modify the use as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. If a use is determined to be an appropriate use, the refuge manager will then determine if the use is compatible (see Compatibility section below). Although a use may be both appropriate and compatible, the refuge manager retains the authority to not allow or modify the use. Uses that have been administratively determined to be appropriate are hunting, wildlife observation and photography, environmental education, interpretation, plant material gathering, grazing, research, mosquito monitoring and management, and take of fish and wildlife under State regulations.

3.3 Compatibility Policy

Service-owned lands within the Refuge System are different from other multiple use public lands in that they are closed to all public uses unless specifically and legally opened. The Improvement Act states “... the Secretary shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety.”

In accordance with the Improvement Act, the Service has adopted a Compatibility Policy (603 FW 2 of the Service Manual) that includes guidelines for determining if a use proposed on a refuge or WMA is compatible with the purposes for which the refuge or WMA was established. A compatible use is defined in the policy as “a proposed or existing wildlife-dependent recreational use or any other use of a refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge”. Sound professional judgment is defined as “a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and applicable laws.” The Service strives to provide priority public uses when they are compatible. If financial resources are not...
available to design, operate, and maintain a priority use, the refuge manager will take reasonable steps to obtain outside assistance from the State and other conservation interests.

When a determination is made as to whether a proposed use is compatible or not, this determination is provided in writing and is referred to as a Compatibility Determination (CD). An opportunity for public review and comment is required for all CDs. For compatibility determinations prepared concurrently with a CCP or step-down management plan, the opportunity for public review and comment is provided during the public review period for the draft plan and associated NEPA document. The CDs included in the Appendix B to the CCP include: Environmental Education, Grazing, Mosquito Monitoring and Management, Plant Material Gathering, Research, and Wildlife Observation, Wildlife Photography and Interpretation.

3.4 Biological Integrity, Diversity and Environmental Health Policy

In addition, the Improvement Act directs the Service to “ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans...”. To implement this directive, the Service has issued the Biological Integrity, Diversity and Environmental Health Policy (601 FW 3 of the Service Manual), which provides policy for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health of the Refuge System. The policy is an additional directive for refuge managers to follow while achieving refuge or WMA purpose(s) and the Refuge System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges/WMAs and associated ecosystems. Additionally, it provides refuge managers with an evaluation process to analyze their refuge/WMA. Furthermore, the policy recommends direction to prevent further degradation of environmental conditions and, where appropriate, restore lost or degraded components in concert with refuge/WMA purposes and the Refuge System mission. When evaluating the appropriate management direction for refuges/WMAs, refuge managers will use sound professional judgment to determine the specific refuge’s/WMA’s contribution to biological integrity, diversity, and environmental health at multiple landscape scales.

4. The U.S. Fish and Wildlife Service

The mission of the Service is: “to work with others to conserve, protect, and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people”.

The Service is the primary Federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. Although the Service shares this responsibility with other Federal, State, Tribal, local, and private entities, the Service has specific responsibilities for migratory birds, threatened and endangered species, anadromous and interjurisdictional fish, and certain marine mammals. These are referred to as Federal trust species. The Service also manages the Refuge System, national fish hatcheries, enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists State fish and wildlife programs, and helps other countries develop wildlife conservation programs.

5. The National Wildlife Refuge System

The Refuge System is the world’s largest collection of lands and waters set aside specifically for the conservation of wildlife and ecosystem protection. The Refuge System consists of over 554 national wildlife refuge units (including WMAs) that provide important habitat for native fish, wildlife and plants, including many threatened and endangered species. The mission of the Refuge System, as stated in the Improvement Act, is “to administer a national network of lands and
waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (16 USC 668dd et seq.).

The goals of the Refuge System are to:

- Preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;
- Perpetuate the migratory bird resource;
- Preserve a natural diversity and abundance of fauna and flora on refuge lands; and
- Provide an understanding and appreciation of fish and wildlife ecology and the human role in the environment and to provide refuge visitors with high-quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent that these activities are compatible with the purposes for which the refuge was established.

In addition, the guiding principles of the National Wildlife Refuge System are:

- We are land stewards, guided by Aldo Leopold’s teachings that land is a community of life and that love and respect for the land is an extension of ethics. We seek to reflect that land ethic in our stewardship and to instill it in others;
- Wild lands and the perpetuation of diverse and abundant wildlife are essential to the quality of the American life;
- We are public servants. We owe our employers, the American people, hard work, integrity, fairness, and a voice in the protection of their trust resources;
- Management, ranging from preservation to active manipulation of habitats and populations, is necessary to achieve Refuge System and U.S. Fish and Wildlife Service missions;
- Wildlife-dependent uses involving hunting, fishing, wildlife observation, photography, interpretation, and education, when compatible, are legitimate and appropriate uses of the Refuge System;
- Partnerships with those who want to help us meet our mission are welcome and indeed essential;
- Employees are our most valuable resource. They are respected and deserve an empowering, mentoring, and caring work environment; and
- We respect the rights, beliefs, and opinions of our neighbors.

6. The Sacramento National Wildlife Refuge Complex

For thousands of years the Sacramento Valley has provided a winter haven for ducks, geese, swans, shorebirds and other waterbirds. Waterfowl migrate here by the millions from as far away as the Arctic regions of Alaska, Canada, and Siberia. The five National Wildlife Refuges and three WMAs of the Sacramento National Wildlife Refuge Complex (Complex) represent islands of natural habitat in a sea of agriculture (Figure 1). The Complex provides a significant amount of the wetland, upland, and riparian forest habitat that supports waterfowl, shorebirds, waterbirds and many other migratory birds in the Sacramento Valley. The Complex currently supports nearly 300 species of birds. More information about the birds within and around the WMAs is provided in Chapter 3.

Established in 1937, Sacramento National Wildlife Refuge is the oldest refuge in the Complex. Three additional refuges were established in the 1940s through the 1960s, including Delevan, Colusa, and Sutter Refuges. These four refuges were established primarily to provide wintering habitat for waterfowl and in some cases to reduce crop damage by waterfowl. Together, they contain approximately 23,000 acres of wetland, vernal pool, alkali meadow, grassland, and riparian habitats. Most recently,
Sacramento River Refuge was established in 1989 to help protect and restore riparian habitat along the Sacramento River between Red Bluff and Colusa. These refuges are not included in this CCP, but were recently addressed in their own CCPs in 2005 (Sacramento River Refuge) and 2009 (Sacramento, Delevan, Colusa, and Sutter Refuges).

This CCP will cover all easement lands and most Service-owned lands in the Butte Sink, Willow Creek-Lurline, and North Central Valley WMAs. Four Service-owned parcels of the North Central Valley WMA were previously addressed in the Sacramento, Delevan, Colusa, and Sutter Refuges Final CCP (USFWS 2009), and therefore, will not be covered in this CCP. These properties include four Service-owned parcels (646 acres) adjacent to Colusa Refuge, which are administered as part of the Refuge. Similar to these four parcels, an additional 388 acres of Service-owned land adjacent to Colusa Refuge was acquired in 2009 under the North Central Valley WMA. This parcel will also be managed as part of the Colusa Refuge and will be addressed in an amendment to the Sacramento, Delevan, Colusa, and Sutter Refuges Final CCP (USFWS 2009).

7. **Wildlife Management Areas**

The WMAs differ from the National Wildlife Refuges (NWRs) in that they consist primarily of private wetlands protected with conservation easements and secondarily of Service-owned lands. Currently, the WMAs consist of a combination of 30,910 acres of private lands protected with conservation easements and 2,465 acres of Service-owned lands. These lands and conservation easements were primarily purchased to protect existing and restored wetlands for waterfowl, other migratory birds and wetland-dependent wildlife. Both private lands and Service-owned lands provide managed wetlands and associated upland and riparian habitat that provide food, water and cover for a diverse array of wildlife species. Managed wetlands are those managed for wetland functions and where water is intentionally and actively applied annually through a managed process (USFWS and Reclamation 2000). For the purposes of this CCP, wetlands that receive water only from rainfall, runoff, or other natural sources are not considered managed wetlands.

As of 1970, only 5 percent of historic wetlands remained in the Central Valley of California and 60 percent of these were privately owned (CVHJV 1990). Given the importance of these remaining wetlands to waterfowl, the Service developed the Concept Plan for Waterfowl Wintering Habitat Preservation in 1977 (USFWS 1978). This document recognized conservation easements as an effective tool for protecting private wetlands in perpetuity in a timely and cost efficient manner. In addition, conservation easements were looked upon favorably as they maintained lands in private ownership and landowners retained responsibility for State and local property taxes. The Concept Plan ultimately led to the development of the WMAs, which focused on protecting private wetlands with perpetual conservation easements. While fee-title acquisition is not the primary emphasis of the WMAs, in some cases, such as the establishment of a wildlife sanctuary, it is determined to be more appropriate for the Service to purchase and manage the lands.

The Service acquires interest in lands through purchase by fee or perpetual conservation easement. The Service’s policy is to work
only with willing sellers. When purchasing conservation easements, the Service acquires the development rights and necessary water resources to protect waterfowl and migratory bird habitat in perpetuity. At the landowner’s request, the Service initiates the easement appraisal process, which includes an appraisal written to Federal standards that determines the value of the rights being acquired. To ensure property acquired by the Service is suitable for inclusion in the National Wildlife Refuge System, all acquisitions require a Level 1 pre-acquisition environmental site assessment to be performed. Following the completion and review of the appraisal, the Service presents the landowner with an offer. If accepted, the Service finalizes the easement document and pursues funding from the Migratory Bird Conservation Fund (e.g., Federal Duck Stamp funds) or Land and Water Conservation Funds (LWCF) to complete the purchase.

Once the conservation easement is purchased, the landowners maintain a number of rights, including: trespass, grazing, wetland management, hunting, and other undeveloped recreation. Landowners are not required to flood or manage their easement wetlands, however, the Service reserves the right, but not the obligation, to flood them at government cost. Accordingly, an appropriate amount of water (e.g., “easement waters”) to flood the easement wetlands to historic fall and winter levels must be maintained with the land. While not required to flood or manage their properties, easement owners are responsible for meeting a number of obligations. Some of the more important wetland easement obligations are provided in the Sacramento Valley Easement Guidelines (Appendix C).

Although not required for new or existing easements, some conservation easements need habitat restoration or enhancement to provide appropriate management capabilities. Funding for these activities is commonly provided through habitat improvement cost-share programs. Cost-share programs are available to private landowners through various Federal or State agencies and/or private conservation organizations. Typical cost-share habitat improvement programs will pay for a percentage of the cost of habitat restoration and/or enhancement activities. In turn, the landowner agrees to maintain the improvements for the life of the agreement (a 10-year minimum).

8. **Butte Sink WMA**

The Butte Sink WMA is located in Butte, Colusa, and Sutter counties. The WMA includes 34 conservation easements on approximately 10,236 acres and 733 acres of Service-owned lands referred to as the Butte Sink Unit (Figure 2). The acquisition objective of 11,000 acres for the Butte Sink WMA has been met (USFWS 1979a). While the Butte Sink WMA acquisition objective has been met, it does not preclude the acquisition of additional properties in the same geographic area under the North Central Valley WMA. See Appendix C for a list of the existing conservation easements and Service-owned lands in the Butte Sink WMA.

The Butte Sink WMA was established in 1979 with the primary purpose of preserving native wetland habitat to perpetuate the migratory waterfowl resource in the Central Valley and the Pacific Flyway. Other objectives of the WMA include assuring adequate water conditions for wintering waterfowl, preserving wetland habitat for a broad spectrum of migratory wildlife, and establishing and maintaining a wildlife sanctuary on the Butte Sink Unit. In accordance with deed restrictions, there is no public use allowed on the Service-owned Butte Sink Unit.

The Butte Sink is located immediately west of the Sutter Buttes Mountain Range and represents the largest contiguous block of wetlands in the Sacramento Valley. These wetlands annually support up to two million wintering waterfowl, with the Butte Sink Unit alone hosting concentrations of up to one million ducks and geese. In addition, the Butte Sink WMA supports large numbers of greater sandhill cranes, which are State-listed as threatened.
9. **Willow Creek-Lurline WMA**

The Willow Creek-Lurline WMA is located in Colusa and Glenn counties and currently consists of 85 conservation easements on approximately 5,859 acres (USFWS 1983) (Figure 3). The approved acquisition objective for the Willow Creek-Lurline WMA is 8,000 acres (USFWS 1985). See Appendix C for a list of the existing conservation easements.

The Willow Creek-Lurline WMA was established in 1985 with the primary purpose of preserving wetland habitat for wintering waterfowl and other wetland-dependent wildlife. The WMA is located in the Colusa Basin, and consists of two distinct wetland divisions: the Willow Creek Division located between Sacramento and Delevan Refuges, and the Lurline Division located between Delevan and Colusa Refuges. The wetlands of the Willow Creek-Lurline WMA provide an important corridor of natural habitat helping to link the three Refuges.

The Willow Creek-Lurline WMA supports tens of thousands of wintering waterfowl including a significant portion of the tule greater white-fronted goose population. In addition, the Lurline wetlands regularly support breeding tricolored blackbirds, a California Bird Species of Special Concern (Shuford and Gardali 2008).

10. **North Central Valley WMA**

The North Central Valley WMA has an acquisition boundary which includes 11 counties (Butte, Colusa, Contra Costa, Glenn, Placer, San Joaquin, Solano, Sutter, Tehama, Yolo and Yuba) and encompasses most of the Valley floor from the Sacramento-San Joaquin Delta to Red Bluff (Figure 4a). Although within the boundary of the WMA, Sacramento County was not included in the project. The North Central Valley WMA focuses on wetland protection at a landscape scale and, while its larger acquisition boundary encompasses the smaller and older Butte Sink WMA and Willow-Creek Lurline WMA, its easement objectives are in addition to the objectives of the other WMAs. In recent years, the North Central Valley WMA has been active in Butte, Colusa, Glenn, Sutter, and Yolo counties. It includes 28 conservation easements on approximately 14,740 acres and 2,765 acres of Service-owned lands (Figures 4b-c). Of the 2,765 acres of Service-owned lands, 1,732 acres comprise the Llano Seco Unit; the remaining 1,033 acres are covered under a prior CCP and its amendment (see section 6, above). The North Central Valley WMA has an approved acquisition objective of 55,000 acres (48,750 acres conservation easement; 6,250 acres fee-title) with individual
Figure 2. Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas
Figure 3. Willow Creek-Lurline Wildlife Management Area
Glenn and Colusa Counties, California

Figure 3. Willow Creek-Lurline WMA
Figure 4a. North Central Valley Wildlife Management Area:
North Section - Glenn, Butte, Colusa, and Sutter Counties

North Central Valley WMA (NCVWMA)
- NCVWMA - program area
- NCVWMA - USFWS Conservation Easement
- NCVWMA - USFWS Ownership

Other properties of Sac NWR Complex
- Willow Creek- Lurline WMA
- Butte Sink WMA
- Refugio Lands not included in this CCP

Legend:
- County Boundaries

Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas
Figure 4b. North Central Valley WMA-South Section
acreage objectives for each of the 11 counties involved (USFWS 1991). Chapter 4 describes the focus areas, acquisition areas, and acreage objectives addressed by this CCP. Appendix C provides a list of the existing conservation easements and Service-owned lands.

When established in 1991, the North Central Valley WMA was seen as an integral component in accomplishing the wetland protection goals of the 1990 Central Valley Habitat Joint Venture Implementation Plan. It is important to note that wetland protection accomplishments of the Central Valley Joint Venture partners count toward meeting the county acreage objectives of the North Central Valley WMA (USFWS 1991).

The North Central Valley WMA was established with the primary purpose of preserving wetland habitat for wintering waterfowl and other wetland-dependent species. Most of the WMAs conservation easements lie within the Butte, Yolo, and Sutter Basins. Made up of mostly managed wetlands, these easements support hundreds of thousands of wintering waterfowl, as well as tens of thousands of migrating and wintering shorebirds and thousands of State-listed threatened greater sandhill cranes. Included in these easements are some of the most important privately-owned waterfowl sanctuaries in the Central Valley.

The Llano Seco Unit supports large populations of wintering waterfowl, greater sandhill cranes, and bald eagles. A popular destination for visitors, the Llano Seco Unit provides opportunities for wildlife observation, photography, environmental education and interpretation. There is a half-mile walking trail and two observation platforms open to the public from one hour before sunrise to one hour after sunset.

### 11. WMA Purposes

The Service acquires Refuge System lands under a variety of legislative acts and administrative orders. The official purpose or purposes for a refuge or WMA are specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, refuge subunit, or WMA. The Service defines the purpose of a refuge or WMA when it is established or when new land is added to an existing refuge. These purposes, along with the Refuge System mission, are the driving force in developing refuge vision statements, goals, objectives and strategies in the CCP. The purposes also form the standard for determining if proposed refuge uses are compatible.

The purposes for which the WMAs in this CCP were established are:

#### 11.1 Butte Sink WMA

“...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C. 715d (Migratory Bird Conservation Act of 1929)

“...for the development, advancement, management, conservation, and protection of fish and wildlife resources ...” 16 U.S.C. 742f(a)(4) “... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ...” 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)

#### 11.2 Willow Creek-Lurline WMA

“...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C. 715d (Migratory Bird Conservation Act of 1929)

#### 11.3 North Central Valley WMA

“...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C. 715d (Migratory Bird Conservation Act of 1929)

“...for the development, advancement, management, conservation, and protection of fish and wildlife resources ...” 16 U.S.C. 742f(a)(4) “... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such
acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude...” 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)

“...the conservation of wetlands in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions...” 16 U.S.C. 3921 Emergency Wetland Resources Act of 1986


12. Vision Statement

A vision statement is developed or revised for each individual refuge or WMA unit as part of the CCP process. Vision statements are grounded in the unifying mission of the Refuge System, and describe the desired future conditions of the refuge unit in the long term (more than 15 years), based on the refuge’s specific purposes, the resources present on the refuge, and any other relevant mandates. This CCP incorporates the following vision statement for the WMAs:

“Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas help to conserve an important network of private and public wetland, upland, and riparian habitats in the Central Valley of California. This network protects some of the most important wintering areas for waterfowl in the Pacific Flyway and North America. These lands also protect and enhance habitat for other migratory birds, threatened and endangered species, and resident wildlife.

Through cooperation with landowners and other conservation partners, the Wildlife Management Areas are one of the premier examples in the nation of private land partnerships promoting fish and wildlife conservation.

Environmental education and compatible wildlife-dependent recreation on appropriate Service-owned lands within the Wildlife Management Areas foster a greater understanding and appreciation of Central Valley wetland ecosystems and the National Wildlife Refuge System.”

13. Existing and New Partnerships

In Fulfilling the Promise (USFWS 1999c), the Service identified the need to forge new and non-traditional alliances and strengthen existing partnerships with States, Tribes, non-profit organizations, and academia to broaden citizen and community understanding of and support for the Refuge System. The Service recognizes that strong citizen support benefits the Refuge System. Involving citizen groups in resource management issues and decisions helps refuge managers gain an understanding of public concerns. Partners yield support for refuge activities and programs, raise funds for projects, act as activists on behalf of wildlife and the Refuge System, and provide support for important wildlife and natural resource issues.

A variety of people including, but not limited to, scientists, hunters, farmers, birders, outdoor enthusiasts and students are keenly interested in the management of the WMAs, their fish and wildlife species, and their plants and habitats. This interest is demonstrated by the number of partnerships that have already developed. We will continue to form new partnerships with interested organizations, local

13.1 Central Valley Joint Venture

In 1988, the Central Valley Habitat Joint Venture (CVHJV) was formed to help implement the North American Waterfowl Management Plan (NAWMP). In 1990, the CVHJV partnership developed its first strategic plan, the Central Valley Habitat Joint Venture Implementation Plan (CVHJV 1990), to deliver partnership-based waterfowl habitat conservation. The North Central Valley WMA was established in 1991 to help accomplish the goals of this plan.


14. Geographic Setting

The Central Valley stretches over 400 miles from north to south, and is on average 40 miles wide from west to east. It is bordered by the foothills of the Coast Range on its west and the Sierra Nevada on its east. The Valley consists of two adjoining valleys, each drained by California’s two largest rivers: the Sacramento River in the north and the San Joaquin River in the south. The Sacramento Valley is drained southward by the Sacramento River and the San Joaquin Valley, which forms the southern portion of the Central Valley, is drained northward by the San Joaquin River. The confluence of these two rivers occurs in the Sacramento/San Joaquin Delta, east of San Francisco Bay. These rivers converge in a maze of channels, marshes and islands known as the Sacramento-San Joaquin Delta. These waters eventually reach the San Francisco Bay and empty into the Pacific Ocean (Figure 5).

14.1 Wilderness Review

As part of the CCP process, lands within the boundaries of the Butte Sink, Willow Creek-Lurline, and North Central Valley WMAs were reviewed for wilderness suitability. No lands were found suitable for designation as wilderness as defined in the Wilderness Act of 1964. The majority of the lands within the WMAs are privately owned and under conservation easement. See Appendix P for the Wilderness Review.
Figure 5. Watershed/Ecosystem Setting
Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas

Figure 5. Watershed/Ecosystem Setting
Bolander’s sunflower, Llano Seco Rancho. Photo: USFWS
Chapter 2. The Planning Process

1. Introduction

The CCP for the Butte Sink, Willow Creek-Lurline, and North Central Valley WMAs is intended to comply with the requirements of the Improvement Act and NEPA. Refuge planning policy guided the process and development of this CCP, as outlined in Part 602, Chapters 1, 3, and 4 of the U.S. Fish and Wildlife Service Manual.

Service policy, the Improvement Act, and NEPA provide specific guidance for the planning process, such as seeking public involvement in the preparation of the EA. The development and analysis of “reasonable” management alternatives within the EA include a “no action” alternative that reflects current conditions and management strategies on the WMAs. Management alternatives were developed as part of this planning process and can be found in Appendix A: Environmental Assessment.

The planning process for this CCP began in September 2009 with pre-planning meetings, coordination, and the formation of CCP teams. Initially, members of the Refuge staff and planning team identified a preliminary list of issues, concerns, and opportunities that were derived from wildlife and habitat monitoring, field experience, past management, and history of the WMAs. This preliminary list was expanded during public scoping and then refined and finalized through the planning process to generate the vision, goals, objectives, and strategies for the WMAs.

2. The Planning Process

Part of comprehensive conservation planning includes preparation of a NEPA document. Key steps in the CCP planning process (Figure 6) and the parallel NEPA process include:

- Preplanning and team formation
- Public scoping
- Identifying issues, opportunities, and concerns
- Defining and revising vision statement and Refuge or WMA goals
- Developing and assessing alternatives
- Identifying the preferred alternative plan
- Draft CCP and EA
- Revising draft documents and releasing final CCP
- Implementing the CCP
- Monitoring / feedback (adaptive management)
3. Planning Hierarchy

The Service’s planning hierarchy that determines the direction of the goals, objectives and strategies is a natural progression from the general to the specific (Figure 7). Described as a linear process, the planning hierarchy is, in reality, a multi-dimensional flow that is linked by the WMA purposes, missions, laws, mandates, and other statutory requirements (Figure 8).

In practice, the process of developing vision, goals, and objectives is repetitive and dynamic. During the planning process, or as new information becomes available, the plan continues to develop.

4. The Planning Team

The CCP process requires close teamwork with the staff, planners, and other partners to accomplish the necessary planning steps, tasks, and work to generate the CCP document and associated EA. The planning team is responsible for the CCP’s content and will ensure that when implemented it will achieve the purposes of the WMAs and help fulfill the Refuge System mission.

The planning team is responsible for the initiation and completion of all planning steps, including public involvement and NEPA. Team members are responsible for researching and generating the contents of the CCP document and participating in the entire planning process. The CCP planning team consists of a refuge planner, refuge managers, biologists, and visitor services staff for the Complex (Appendix O). The team meets regularly to discuss and work on the various steps and sections of the CCP. The team members also worked independently in producing their respective CCP sections, based on their area of expertise. Multi-tasking by team members is a standard requirement since work on the CCP occurs in addition to their regular workload.

5. Pre-Planning

Pre-Planning involved forming the planning teams, developing the CCP schedule, and gathering data. The team determined procedures,
work allocations, and outreach strategies. The team also created a preliminary mailing list.

6. Public Involvement in Planning

Public involvement is an important and necessary component of the planning process. Public scoping meetings allow the Service to provide updated information about the Refuge System and the WMAs. Most important, these meetings allow the refuge staff to hear public comments, concerns, and opportunities. These public meetings provide valuable discussions and identify important issues regarding the Refuge and the surrounding region.

The Service hosted public meetings in Colusa, Gridley, and Davis, California in December 2009 (Table 1). Each meeting began with a presentation introducing the WMAs, provided an open forum for public comment, and ended with a breakout session consisting of various tables with Refuge staff and information available to address questions. In addition to comments made by participants and noted on flip charts at the meetings, comments were also received by written comment cards, email, faxes, and letters. These comments were analyzed and used to further identify issues and revise CCP goals, objectives, and strategies (Table 2).

### Table 2. WMA issues identified through public comment.

<table>
<thead>
<tr>
<th>Issue Categories</th>
<th>Number of Comments Received¹</th>
<th>Percentage of Total Comments</th>
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<tr>
<td>Non-breeding waterfowl habitat - Water issues</td>
<td>10</td>
<td>19%</td>
</tr>
<tr>
<td>Non-breeding waterfowl habitat - Easement acreage goals</td>
<td>7</td>
<td>14%</td>
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<tr>
<td>Breeding waterfowl habitat</td>
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<td>14%</td>
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<tr>
<td>Climate change</td>
<td>6</td>
<td>13%</td>
</tr>
<tr>
<td>Crop depredation</td>
<td>4</td>
<td>7%</td>
</tr>
<tr>
<td>Partnerships</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>Law enforcement</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>Landscape protection</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>Other comments and questions</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

¹ Total number of comments received is greater than the total number of people commenting since each of the letters, emails, faxes, comments cards, and flipchart comments received may contain more than one comment.

### Table 1. Public scoping meetings.

<table>
<thead>
<tr>
<th>Meeting Location</th>
<th>Date</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colusa, CA</td>
<td>December 1, 2009</td>
<td>7</td>
</tr>
<tr>
<td>Gridley, CA</td>
<td>December 2, 2009</td>
<td>7</td>
</tr>
<tr>
<td>Davis, CA</td>
<td>December 3, 2009</td>
<td>5</td>
</tr>
</tbody>
</table>

7. Public Outreach

During the planning process, Refuge staff continued to actively participate with the various working groups and agency teams concerning the areas within the WMAs.

Informational letters called “Planning Updates” were also mailed to the public. These periodic publications were created to provide the public with up-to-date planning information and progress on the CCP process, as well as request input throughout the planning process. The Planning Updates are also made available on the Complex’s website, in the visitor center, and at various outreach meetings.
8. Issues, Concerns, and Opportunities

Through the scoping process and team discussions, the planning team identified issues, concerns, and opportunities. During the internal scoping process, issues included urban encroachment, conversion to crops with fewer benefits to wildlife, and uncertainty regarding water availability due to drought and climate change. In undeveloped areas adjacent to existing urban areas, it is reasonably foreseeable that urban encroachment into existing farmlands could occur and crop conversion may continue away from wildlife-friendly crops (small grains, pasture) to permanent crops (orchards, vineyards).

During public scoping, nineteen people attended the three public scoping sessions held in December 2009. Sixteen people/organizations provided 51 comments as of February 2010 (Table 2) for consideration in identifying issues and opportunities for the CCP. The team categorized the comments into eight main areas of interest: non-breeding waterfowl habitat (17), breeding waterfowl habitat (7), climate change (6), crop depredation (4), partnerships (3), law enforcement (3), landscape protection (3), and other questions and comments (8).

Non-breeding waterfowl habitat received the most comments. The category was subdivided into easement acreage goals (7) and water issues (10). One comment about the easement acreage goals stated that the Service should determine the unprotected wetland acreage within the WMA and attempt to protect it with conservation easements. Another comment stated that the Service should use the restoration goals of the Central Valley Joint Venture Implementation Plan (2006) as a minimum for determining easement objectives. Water issue comments included: recommending the Service conduct a water resources assessment for the WMAs, inventory water rights and their quantity and quality, determine whether those rights are sufficient to meet the purposes of the WMAs and secure long-term water supply for the WMAs.

Breeding waterfowl habitat received the second-most number of comments. These comments focused on finding additional partnerships to provide breeding waterfowl habitat and financial incentives for private landowners to provide breeding habitat on easement lands.

Six comments urged the Service to discuss global climate change within the CCP. These comments stated that the CCP should address climate change in the vision statement for the WMAs and through its goals, objectives and strategies related to inventory and monitoring, environmental education and non-climate stressors.

Four comments were received regarding crop depredation issues. These comments urged the Service to consider the impacts and compensate landowners for damage caused to crops by migratory birds.

The importance of maintaining and creating new partnerships received three comments. The need for and support of both State and Federal law enforcement officers in California also received three comments.

Landscape protection also received three comments. These comments urged the Service to find a balance between
providing for wildlife and causing economic stress to farmers and ranchers.

The remaining eight comments in the “other” category ranged in subject matter from inquiries about whether there is a minimum size for an easement to what type of funding is used to acquire the easements. A youth hunt on the Llano Seco Unit of the North Central Valley WMA was also suggested.

In addition to the issues discussed above, additional threats to migratory birds, threatened and endangered species, wetland habitats and other priority conservation targets include: water quality, wildlife disease, agricultural pesticides, mosquito management, altered sediment loads, invasive plants, and human disturbance. Threats and stressors to priority conservation targets are discussed further in Chapter 3, The Refuge Environment, and in the environmental assessment (Appendix A). Strategies to address many of the threats are presented in the goals, objectives, and strategies in Chapter 4.

9. Development of the Refuge Vision

A vision statement is developed for each refuge or complex as part of the CCP process. Vision statements are grounded in the unifying mission of the Refuge System and describe the desired future conditions of the refuge unit in the long term (more than 15 years). They are based on the refuge’s specific purposes, the resources present on the refuge, and any other relevant mandates. Please refer to Chapter 1 for the WMAs’ vision statement.

10. Determining the Refuge Goals, Objectives, and Strategies

The purpose for creating the WMAs is established by law (see Chapter 1). The Improvement Act directs that the planning effort develop and revise the management focus of the Refuges/WMAs within the Service’s planning framework, which includes: the Service mission, the Refuge System mission, ecosystem guidelines, and refuge purposes. This is accomplished during the CCP process through the development of goals, objectives, and strategies.

10.1 Goals

The Service defines a goal as a “descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose, but does not define measurable units” (602 FW 1 of the Service Manual). Goals are a means to achieving refuge purposes. Goals translate to one or more objectives that define these conditions in measurable terms. A well-written goal directs work toward achieving a refuge’s vision and ultimately the purpose(s) of a refuge. Collectively, a set of goals is a framework within which to make decisions.

10.2 Interim Refuge Goals

The 1997 interim goals for Butte Sink WMA, the Willow Creek-Lurline WMA, and the North Central Valley WMA were:

- Provide a diversity of wetland habitats for an abundance of migratory birds, particularly waterfowl and other water birds;
- Provide natural habitat for and management to restore and perpetuate endangered, threatened, or species of special concern;
- Preserve a natural diversity and abundance of flora and fauna;
- Provide opportunities for the understanding and appreciation of wildlife ecology and the human role in the environment; and provide high-quality wildlife-dependent recreation, education, and research.

Through the CCP process these interim goals have been evaluated and revised and are detailed in Chapter 4.

10.3 Objectives, Rationale, and Strategies

Once the WMA goals are reviewed and revised then various objectives, a rationale, and strategies are determined to accomplish each of the goals.
Chapter 2

Objectives: The Service defines an objective as “a concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work” (602 FW 1 of the Service Manual). Objectives are incremental steps we take to achieve a goal. They are derived from goals and provide a foundation for determining strategies, monitoring refuge accomplishments, and evaluating success. The number of objectives per goal will vary, and in some cases an implementation schedule may be developed. All objectives must possess the following five properties: specific, measurable, achievable, results-oriented, and time-fixed.

Rationale: The rationale describes background, history, assumptions, and technical details so that the reader can understand how the objective was formulated. The degree of documentation will vary, but at a minimum, it should include logic, assumptions, and sources of information. This promotes informed debate on the objective’s merits, provides continuity in management through staff turnover, and allows reevaluation of the objective as new information becomes available.

Strategy: The Service defines a strategy as “a specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives” (602 FW 1 of the Service Manual). Multiple strategies can be used to support an objective.

11. Development of the Refuge Management Alternatives

Alternatives are “different sets of objectives and strategies or means of achieving refuge purposes and goals, helping to fulfill the Refuge System mission, and resolving issues” (602 FW 1 of the Service Manual). The development of alternatives, assessment of their environmental effects, and identification of the preferred management alternative are fully described in the EA (Appendix A). Alternatives were developed to represent reasonable options that address the specific WMA issues and challenges. A “no action” or continuation of current management alternative is required by NEPA. A range of other alternatives was studied and are described in the EA (Appendix A).

12. Plan Implementation

This Draft CCP and EA will be provided for public review and comment. Comments received by the Service will be incorporated where appropriate and perhaps result in modifications to the preferred alternative or selection of one of the other alternatives. The alternative that is ultimately selected will become the basis of the ensuing Final CCP. This document then becomes the basis for guiding management over the coming 15-year period. It will guide the development of more detailed step-down management plans for specific resource areas and will also underpin the annual budgeting process for refuge operations and maintenance (Chapter 5). Most importantly, it lays out the general approach to managing habitat, wildlife, and people at the Butte Sink, Willow Creek-Lurline, and North Central Valley WMAs that will direct day-to-day decision-making and actions.

A review of the CCP will take place approximately every five years and the CCP will be updated every fifteen years.
Chapter 3. The Refuge Environment

1. Wildlife Management
   Area Descriptions

1.1 Butte Sink WMA

The Butte Sink WMA was established in 1979 (USFWS 1979a) with the primary purpose of preserving native wetland habitat to perpetuate the migratory waterfowl resource in the Central Valley and the Pacific Flyway. Other objectives of the WMA include assuring adequate water conditions for wintering waterfowl, preserving wetland habitat for a broad spectrum of migratory wildlife, and establishing and maintaining a wildlife sanctuary in the Butte Sink Unit.

Located immediately west of the Sutter Buttes in the lower Butte Basin, the Butte Sink WMA consists of 34 conservation easements protecting approximately 10,236 acres of privately-owned land, and one 733-acre Service-owned property known as the Butte Sink Unit (Figure 2). Managed wetlands comprise approximately 90 percent of the WMA and consist primarily of seasonal wetlands with fewer semi-permanent and permanent wetlands. The wetlands occur in a floodplain and are characterized by a strong riparian forest and emergent vegetation component. Butte Creek and its tributaries meander through the WMA providing a water source for many of the wetlands.

The Butte Sink WMA represents the largest contiguous block of wetlands in the Sacramento Valley and typically supports up to 2 million wintering waterfowl and large numbers of the State-listed threatened greater sandhill crane (USFWS California Mid-winter Waterfowl Survey reports, 1955-2014). These wetlands also support significant populations of breeding herons, egrets, and other waterbirds. Butte Creek and its associated wetlands also support anadromous fish, including Federally-listed as threatened spring-run Chinook salmon and Central Valley steelhead.

Because the easement properties of the Butte Sink WMA are under private ownership, public access is not permitted.

1.1.1 Butte Sink Unit

The Service manages the Butte Sink Unit in 10 individual management cells. Managed wetlands comprise 93 percent of the total acreage, and consist mainly of seasonally flooded wetlands (Figure 9). The remaining acreage is comprised of grasslands and riparian forest habitats. The Butte Sink Unit alone can host wintering waterfowl in excess of 500,000 ducks and 40,000 geese, occasionally reaching a peak population of over one million birds (USFWS 1989-2014, unpublished data).

In accordance with deed restrictions (Grant Deed 15050, Sutter County, CA) “no sport hunting will be permitted” and “the paramount purpose of the United States in acquiring this area is to create a sanctuary for, and protection of, wildlife”, therefore no public use is allowed on the Butte Sink Unit. The Service has access to the Unit via Laux Road extension, through the Colusa Shooting hunt club. Grant Deed 15050 also states that Stack Club has “(i) the right to maintain the existing open area between the West boundary of Parcel “B” and the tree line on the East side of Parcel 3; (ii) the right to maintain the density of trees now existing on the lands described in Exhibit B”; (iii) the right to retrieve dead and crippled migratory waterfowl from the open area described in (i) above”. El Anzar hunt club has access rights to their property through the Butte Sink Unit.

1.2 Willow Creek-Lurline WMA

The Willow Creek-Lurline WMA was established in 1985 (USFWS 1979b) with the primary purpose of preserving wetland habitat
Figure 9. Butte Sink WMA, Butte Sink Unit, Habitat Management
for wintering waterfowl and other wetland-dependent wildlife. Located in the Colusa Basin, the Willow Creek-Lurline WMA consists of two distinct wetland divisions: the Willow Creek Division located between Sacramento and Delevan Refuges, and the Lurline Division located between Delevan and Colusa Refuges. These provide an important corridor of natural and managed wetland habitat connecting Sacramento, Delevan and Colusa Refuges.

In 1978, these lands represented the last private wetlands within the Colusa Basin. They were reduced from 15,000 acres in 1952 to less than 6,000 acres in 1982 (1952 and 1978 maps, Land Ascertainment Report, Land Acquisition Ascertainment Report for the Colusa Basin Wetlands (USFWS 1979b)).

The Willow Creek-Lurline WMA currently consists of 85 conservation easements on approximately 5,859 acres of private lands (Figure 3). The Willow Creek Division consists of 3,707 acres and the Lurline Division consists of 2,150 acres. The approved acquisition objective for the Willow Creek-Lurline WMA is 8,000 acres.

Approximately 85 percent of the WMA consists of managed seasonal, semi-permanent, and permanent wetlands. The remaining acreage is comprised of unmanaged wetlands, alkali meadows, grasslands, riparian willow scrub, and other habitats. These habitats support many species of wintering waterfowl, shorebirds, waterbirds (herons, egrets, ibis, pelicans, etc.), and other wetland-dependent wildlife. Special status species supported by these wetlands include wintering tule greater white-fronted geese and breeding tricolored blackbirds (both California species of special concern – Shuford and Gardali 2008), giant garter snakes (Federally-listed as threatened species), and palmate-bracted bird’s-beak (Federally-listed as endangered species).

1.3 North Central Valley WMA

The North Central Valley WMA was established in 1991 to preserve existing and restored wetlands for waterfowl and other wetland-dependent plants and wildlife. The North Central Valley WMA has an acquisition boundary which includes six basins (Butte, Colusa, American, Sutter, Yolo and Delta) and encompasses most of the Valley floor from the Sacramento-San Joaquin Delta to Red Buff (Figure 1).

Currently, the North Central Valley WMA is active in Butte, Sutter, and Yolo basins, and consists of approximately 1,732 acres of Service-owned lands (Llano Seco Unit) and 28 conservation easements on approximately 14,740 acres of private lands (Figures 4a-c). The North Central Valley WMA has an approved acquisition objective of 55,000 acres (48,750 acres conservation easement; 6,250 acres fee-title).

These easements consist of restored and existing wetlands which annually support hundreds of thousands of migrating and wintering waterfowl, and include some of the most important privately owned waterfowl sanctuaries in the Central Valley. In addition, conservation easements can support tens of thousands migrating and wintering shorebirds, large numbers of greater sandhill cranes, and numerous species of management concern, including long-billed curlews, white-faced ibis, American bitterns and white-tailed kites.

1.3.1 Llano Seco Unit

The Llano Seco Unit is part of the historic Llano Seco Rancho, the last intact Mexican land grant in California (Figure 10). This historic area is bounded by the Sacramento River to the west and is bisected by Angel Slough in the center and Little Chico Creek to the east. This diverse landscape includes riparian floodplains, uplands and wetland basin habitats.

Almost the entire Llano Seco Rancho area is now protected through multiple conservation partnerships involving the Service, California Department of Fish and Wildlife, The Nature Conservancy, and the Northern California Regional Land Trust (Figure 10). This conservation partnership forms, in part, the Llano Seco Joint Management
Chapter 3

Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas

Committee whose goal is to coordinate conservation and management activities.

Henceforth, “Llano Seco Unit” refers to the Service-owned portion. “Llano Seco Ranch” refers to lands that remain under private ownership. The California Department of Fish and Wildlife (CDFW) also has a “Llano Seco Unit,” which is located in the southwestern corner of the historic Rancho. This area will be referred to as “CDFW Llano Seco Unit.” There is obviously potential for confusion among these areas, and Figure 10 identifies their location and ownership.

The Service-owned Llano Seco Unit in the North Central Valley WMA consists of two distinct areas: Sanctuary I (967 acres) and Sanctuary II (765 acres) which are managed by the Service as 30 individual management units (Figure 11). Managed wetlands comprise nearly half of the total acreage, and consist mostly of seasonally flooded wetlands, with some semi-permanent and permanent wetlands. The remaining acreage is comprised of grasslands, vernal pools, and irrigated pasture with some riparian forest habitats. Sanctuary I has no public use and is an inviolate sanctuary. Sanctuary II has non-consumptive wildlife-dependent public use including wildlife observation, photography, environmental education and interpretation. There is a half-mile walking trail and two observation platforms open to the public from one hour before sunrise to one hour after sunset.

The Llano Seco Unit supports large populations of wintering waterfowl, as well as other species such as bald eagle, mountain lion, bobcat; Federal and/or State listed species include greater sandhill cranes, Swainson’s hawks, giant garter snakes, Valley elderberry longhorn beetle, vernal pool tadpole shrimp, and vernal pool fairy shrimp; species of concern include, but are not limited to, California linderiella and Ferris’s milk-vetch.

2. Ecosystem Setting

The Central Valley totals about 10 million acres, or 10 percent of the State, and includes portions of 19 counties. Prior to the mid-1800s, the Valley contained more than 4 million acres of wetland habitat (CVJV 2006). In 2006, just over 205,000 acres of managed wetlands remained in the Central Valley (Figure 12), and of these, two thirds are in private ownership (CVJV 2006).

Most of these wetlands were bordered by grassland and riparian habitats. Many wetlands were seasonal in nature and were filled with rainfall and subsequent over-bank flooding of rivers and streams that inundated large areas of the Valley during winter and spring. Estimates from the 1800s suggest these habitats supported between 20 to 40 million waterfowl annually (CVJV 2006) and other migratory birds, grizzly bear, and vast herds of deer, elk, and pronghorn. Natural habitat was replaced by rice and other crops with the development of agriculture during the late 1800s and early 1900s. Waterfowl consumed some of these crops as a substitute for their original wetland foods, resulting in serious crop losses for farmers.

In its pristine state, the Central Valley was characterized by over 25 plant communities providing habitats for a great diversity of plants and animals (Holland 1986). These communities consisted of various riparian scrubs, forests, woodlands and savannas; perennial grasslands; annual wildflower fields; interior dune lands; vernal pools; alkali sinks, meadows, and scrubs; and fresh and brackish water marshes. Central Valley vegetation and habitats have been altered by human activity more than any other geomorphic province in...
Figure 10. Llano Seco Rancho: Historic Map and Current Conservation Ownership

Map produced by Sacramento NWRC
Projection: UTM Zone 10N
Datum: NAD83
Map current to April 2015
Figure 11. North Central Valley WMA, Llano Seco Unit: Habitat Management 2015-16

This map is representative and may change annually.
The Refuge Environment

Figure 12. Changes in California Central Valley Wetlands, 1900 to 1990

Figure 12. Changes in California Central Valley Wetlands, 1900 to 1990
the State. In 1987, a report for the California Senate (Airola and Messick 1987) depicted that the valley grassland community was more than 99 percent gone, the freshwater marsh community was more than 94 percent gone, and the riparian woodland was about 89 percent gone. In addition, approximately 75 percent of all vernal pools in the Central Valley were lost by 1997 (Holland 1998).

The over-bank flooding that once characterized the Valley is largely gone. Reservoirs and constructed levees now harness rivers for irrigation and flood control, preventing most natural flooding of wetlands. The Valley is now an extensive agricultural area and lands that surround the WMAs consist primarily of irrigated rice lands and orchards. Various row crops, safflower, barley, wheat, alfalfa, and some dairy production are also present. Predominant soil types range from deep loams to poorly drained alkaline clays.

Early losses were primarily related to conversion to agricultural croplands. More recent losses have been a result of conversion from historic cattle grazing lands to more intensive agricultural uses and widespread urbanization (USFWS 2005a).

Non-native invasive plant and animal species now dominate many natural habitats throughout the Central Valley. Agricultural development, urban expansion, alteration of hydrologic regimes, and introduced plants and animals have all contributed to the destruction of native habitats (Gilmer et al., 1982, Katibah 1984). See also Chapter 1, Geographic Setting.

The WMAs represent a small portion of the vast seasonal wetlands, grasslands and riparian forests that once existed in the Sacramento Valley. The remaining intensively managed wetlands and associated agricultural habitats now support an average of 5.5 million waterfowl annually (CVJV 2006). Few places on earth have greater concentrations of wintering waterfowl than the Central Valley.

The WMAs are located within the Sacramento Valley and Sacramento-San Joaquin Delta regions and also fall within the Service’s Central Valley/San Francisco Bay Ecoregion (Figure 5). These regions are extremely important to waterfowl, supporting over 45 percent of the Pacific Flyway’s wintering waterfowl population (USFWS 1955-2014, Collins and Trost 2010).

Seasonal wetlands in these regions play a significant role in supporting wintering and migrating shorebird and waterbird species, with the Sacramento Valley designated as a part of the Western Hemispheric Shorebird Reserve Network (WHSRN) and noted for its importance in both the United States Shorebird Conservation Plan (Brown et al., 2001) and the North American Waterbird Conservation Plan (Kushlan et al., 2002). These regions are also an important breeding area for several species of waterfowl, shorebirds and waterbirds.

On a more local level, these regions support a variety of migratory, resident, and breeding wildlife species, native plants, and their habitats. Some are quite common in the Central Valley, the Flyway, and in North America. These would include a number of egret and heron species, white-faced ibis, black-tailed deer, and a variety of grassland and riparian birds. Other species are quite restricted in range and may be rare, or in some cases listed as Federally- and/or State- listed as endangered or threatened. For example, the tricolored blackbird (California Bird Species of Concern) and giant garter snake (Federally- and State-listed as threatened) are species that occur almost exclusively in the Central Valley.

Similarly, there are seven threatened or endangered species that occur in rare vernal pool or alkali meadow habitats within the WMAs, including three vernal pool invertebrates and four plants. As habitat acres decrease with the expansion of agricultural and urban development, areas such as the WMAs become increasingly important to the conservation of these species. Appendix K provides a list of wildlife and plant species within the WMAs, and describes their migratory and breeding status. Appendix L provides a list of special status species and notes whether they are listed as endangered or threatened.
In summary, the WMAs play a significant, and in some cases, critical role at the ecosystem level. The WMAs support abundance, diversity, or, in some cases, single species conservation. Whether permanent or seasonal wetlands, vernal pools or alkali meadows, simply protecting these habitats is not sufficient to maintain their function in the ecosystem. Proper management of these habitats is required to ensure that the abundance and health of the valued resources they support is maintained and enhanced (see Chapter 3, for current management).

The Service is actively involved in the development and implementation of a number of conservation plans for migratory birds and other fish and wildlife within the ecosystem including the: North American Waterfowl Management Plan (USFWS et al., 1986, 1998, 2012); Central Valley Joint Venture Implementation Plan (CVJV 2006); Pacific Flyway Management Plans, prepared by the Pacific Flyway Council (PFC) for: Cackling Canada Geese (PFC 1999), Aleutian Canada Geese (PFC 2006a), Pacific Flyway Population of Greater White-fronted Geese (PFC 2003), Tule Greater White-fronted Geese (PFC 1991), Wrangel Island Population of Lesser Snow Geese (PFC 2006b), Western Arctic Population of Lesser Snow Geese (PFC 2013), Ross’ Geese (PFC 1992), Western Population of Tundra Swans (PFC 2001), Pacific Flyway Population of Sandhill Cranes (PFC 1983), and Central Valley Population of Greater Sandhill Cranes (PFC 1997); Partners in Flight North American Landbird Conservation Plan (Rich et al., 2004); Riparian Bird Conservation Plan (RHJV 2004); Draft Grassland Bird Conservation Plan (CPIF 2000); United States Shorebird Conservation Plan (Brown et al., 2001), Southern Pacific Shorebird Conservation Plan (Hickey et al., 2002); North American Waterbird Conservation Management Plan (Kuslan et al., 2002); Conservation Plan for the Tricolored Blackbird (Tricolored Blackbird Working Group 2009); Partners in Flight Tri-National Vision for Landbird Conservation (Berlanga et al., 2010); Anadromous Fish Restoration Program and the California Wildlife Action Plan (CDFG 2005c). Regional step-down plans specific to the area are discussed in Chapter 5.

2.1 Butte Sink WMA Ecosystem

Located in the center of the Sacramento Valley, the Butte Sink lies west of the Sutter Buttes and east of the Sacramento River. Prior to 1920, the Butte Sink consisted primarily of grasslands with a few permanently flooded sloughs and wetland basins. Butte Creek and its tributaries meandered through the Butte Sink floodplain, providing riparian and wetland habitats for a host of wildlife, including anadromous fish, waterfowl, and many other migratory birds. Historically, this area received natural flooding between December and March.
from the Butte Creek and Sacramento River drainages (Jones & Stokes 2001). Early land-use consisted of grazing, grain crop farming, and waterfowl hunting. As rice agriculture developed north of the Butte Sink in the early 1900s, agricultural drain water became more prevalent during the summer and fall months. This extended hydroperiod brought about an expansion of managed wetlands and riparian habitats, resulting in a shift in land-use from agriculture to waterfowl hunting. Today this area consists primarily of managed seasonal and semi-permanent wetlands, and associated riparian habitats. The wetlands are characterized by interspersed riparian forest, emergent vegetation, and moist-soil vegetation components.

2.2 Willow Creek-Lurline WMA Ecosystem

In the 1850s and 1860s, the area southeast of Willows, west of Princeton, and north of Colusa (known as the Colusa Plains) was characterized by alkali soil and sparse vegetation (Hinds 1952). These areas were dry most of the year or sometimes for entire seasons, but during major rain and flood events they were inundated and formed shallow lakes. These alkali plains were dotted with vernal pools and lakes of all sizes, and provided feeding and roosting habitat for many wintering waterfowl and other migratory birds. Winter wheat was introduced to the plains in the 1870s. Native pasture and winter wheat provided prime winter and early spring forage habitat for hundreds of thousands of small Canada geese. The development of irrigation systems brought rice agriculture to the Sacramento Valley in the 1910s. The conversion to rice attracted an additional abundance of waterfowl to the plains and dramatically increased waterfowl use during the late summer and fall months. Today, the properties in the Willow Creek-Lurline WMA represent some of the last privately-owned historic wetlands in the Colusa Basin. These lands consist of a mosaic of managed seasonal and semi-permanent wetlands and native uplands surrounded by rice agriculture. Heavy alkali soils influence the wetlands and uplands of this region, often resulting in sparse emergent vegetation and salt-tolerant plant communities.

2.3 North Central Valley WMA Ecosystem

The North Central Valley WMA includes the majority of the Sacramento Valley and the Sacramento-San Joaquin Delta region (Delta), covering an area approximately 200 miles long and 30 miles wide (USFWS 1991). More specifically, the North Central Valley WMA covers the Sacramento Valley floor, from Red Bluff to the Delta, and overlaps the Butte Sink and Willow Creek-Lurline WMAs. The North Central Valley WMA also includes portions of the major watersheds that drain the Central Valley. The Sacramento River and its main tributaries - the Feather, Yuba, and American Rivers - flow from the north through the Sacramento Valley and into the Delta, southwest of the city of Sacramento. The San Joaquin River, which drains the San Joaquin Valley, enters the Delta from the south and joins the Sacramento River at the west boundary of the Delta. The combined waters of the Sacramento and San Joaquin River flow past the Suisun Marsh and into San Francisco Bay.

The Sacramento Valley is mostly flat with a slight drainage gradient from north to south. Its large rivers and tributaries historically formed natural levees of alluvium which were heavily forested. During winter storm events and spring run-off these rivers routinely topped their banks and flowed into numerous basins creating extensive wetlands. In addition to flood basin wetlands, extensive vernal pool/grassland complexes occurred when annual precipitation ponded on basin rims and terraces. Today, flood flows are largely controlled by dams, levees and flood control bypasses, and many of the original wetlands and vernal pool complexes have largely been converted to agricultural crops. Remnant existing and restored public and private wetlands still
exist in the basins and flood bypasses. These are typically managed freshwater emergent wetlands that are owned and managed as wildlife refuges or private hunting properties. Together with adjacent rice lands, managed wetlands provide important habitat for a great diversity and abundance of migratory birds.

The Delta is mostly flat with a slight drainage gradient from east to west. Historically, the Delta consisted of expansive tidal freshwater wetlands that were interspersed with numerous interconnected river and slough channels. In the early 1900s, levees were developed along the river and slough channels creating large islands that were converted from wetlands to agriculture. Today, the Delta consists of a mosaic of interconnected river and slough channels, farmed islands protected by levees, and remnant tidal wetlands dominated by emergent vegetation. Agriculture on the islands consists mainly of corn and other row crops. Much of the harvested corn fields are winter-flooded for waterfowl hunting. Together, managed wetlands and post-harvest flooded corn, on the islands, and remnant tidal wetlands provide important waterfowl, shorebird and waterbird habitat in the Delta region. In addition, restored wetlands, irrigated pasture and small grain crops along the eastern perimeter of the Delta are crucial for sandhill cranes, long-billed curlews and many other migratory birds.

Although the Delta lies at the confluence of the Sacramento and San Joaquin Rivers, the Delta Region is considered separate from the rivers’ watersheds because of its legal status and use as a conveyance system for upstream water. Within the Delta, Federal (Central Valley Project or CVP) and State (State Water Project or SWP) pumping plants move water from the Delta to a system of canals and reservoirs for use by agriculture, communities, and wildlife refuges in the San Joaquin Valley, Bay Area, Central Coast, and southern California (CDWR et al., 2003).

3. Physical Environment

3.1 Climate and Air Quality

3.1.1 Climate

The climate of California’s northern Central Valley is classified as Mediterranean (Köppen climate classification: Csa, McKnight and Hess 2005), with cool wet winters and hot dry summers. The annual average precipitation is 16-18 inches. Fog is common during the winter months, while thunderstorms, hail, and snow are rare occurrences. The mean annual temperature is 61.7°F with extremes of 118°F and 15°F. South winds are associated with storms in the winter and cooling trends in the summer. North winds are usually indicative of dry periods following winter storms, and hot and dry periods during the summer.

The climate in the Sacramento-San Joaquin Delta region is spatially variable, but is also generally characterized as Mediterranean. Climate becomes milder from east to west due to influence from the Pacific Ocean. Summers are hot (average daily highs are in the upper 80s to lower 90s °F) with little precipitation and low humidity. Heat waves are common in summer months during which temperatures can reach near 100oF for consecutive days. The “Delta breeze” often occurs during summer evenings when cool, humid air from the ocean moves on shore and can cool the Delta by up to 7°F (Pierce and Gaushell 2005). Winters are mild (average daily highs in the mid-50s to mid-60s °F) and wet. Approximately 80 percent of annual precipitation occurs between November and March. The primary source of precipitation is seasonal low pressure disturbances.
from the Pacific Ocean. Dense fog is common in the Delta region during winter months.

### 3.1.2 Climate Change

The Intergovernmental Panel on Climate Change has concluded that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC 2007). The U.S. Department of the Interior issued an order in January 2001 requiring its land management agencies to consider potential climate change impacts as part of long-range planning endeavors. The increase of carbon within the earth’s atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered. The U.S. Department of Energy’s report “Carbon Sequestration Research and Development” (USDOE 1999) defines carbon sequestration as “...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere.”

Terrestrial biomes of all sorts – grasslands, forests, wetlands, tundra, perpetual ice and desert – are effective both in preventing carbon emission and acting as a biological “scrubber” of atmospheric carbon monoxide. The Department of Energy’s report notes that ecosystem protection is important to carbon sequestration and may reduce or prevent the loss of carbon currently stored in the terrestrial biosphere. Although climate change is already affecting wildlife throughout the state (Parmesan and Galbraith 2004), and its effects will continue to increase, it has particular significance for this region’s major river and estuarine systems.

The WMAs are located in the Sacramento Valley Ecoregion (PRBO 2011). Snyder and Sloan (2005) projected mean annual temperature in the Sacramento Valley would increase by 2.4°C by the end of the 21st century. The projected impacts of climate change on thermal conditions in the Sacramento Valley will be warmer winter temperatures (PRBO 2011). Local land-use and landcover may interact with climate change to exacerbate changes in local temperatures. In 2011, there was more uncertainty about the precipitation projections for temperature in the Sacramento Valley, but with some evidence for a slightly drier future climate relative to current conditions (PRBO 2011).

### 3.1.3 Air Quality

The WMAs are primarily located in California’s Sacramento Valley Air Basin. The Sacramento Valley Air Basin encompasses 15,043 square miles including Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba counties, the western portion of Placer County, and the eastern portion of Solano County. The Butte County Air Pollution Control District and the Colusa County Air Pollution Control District are the agencies responsible for ensuring compliance with Federal and State air quality standards in the basin where the Service-owned Llano Seco Unit and the Butte Sink Unit are located, respectively. Portions of the WMAs are in two other California Air Basins: San Joaquin County is in the northern portion of the San Joaquin Valley Air Basin. Contra Costa and western Solano Counties are in the San Francisco Bay Air Basin.

The Federal and State governments have each established ambient air quality standards for several pollutants. Most standards have been set to protect public health. However, standards for some pollutants are based on other values, such as protecting crops and materials, and avoiding nuisance conditions. Currently, Sutter County is Federally-classified as a non-attainment area for ground-level ozone. A non-attainment area is defined as any area that does not meet ambient air quality standards for a pollutant. In addition, Glenn, Butte, Colusa, and Sutter, Contra Costa, Placer, Sacramento, San Joaquin, Solano, Tehama, Yolo, and Yuba Counties are classified by the State of California as non-attainment areas for both ozone and particulate matter at the 10-micron level or smaller (PM10) standards. Only three counties in the entire State are not
classified as non-attainment areas for PM10. All counties with WMA lands are in attainment (or are unclassified) for carbon monoxide (CO). Classification as a non-attainment area means that the State must develop an implementation plan to outline methods for reaching identified air quality standards. Permitting, scheduling, and restrictions on some activities may be required. Currently, individual counties require smoke management plans and limit acreage burned on preserved burns conducted easement and service-owned lands.

Ozone, the main component of photochemical smog, is formed through a complex series of chemical reactions between reactive organic gasses (ROG) and nitrogen oxides (NOx). On-road motor vehicles and other mobile sources are the largest contributors to NOx emissions in the Sacramento Valley. On-road motor vehicles, area-wide sources, and stationary sources are significant contributors to ROG emissions. Once formed, ozone remains in the atmosphere for one or two days. As a result, ozone is a regional pollutant and often impacts a large area. Ozone’s main effects include damage to vegetation, chemical deterioration of various materials, and irritation and damage to the human respiratory system.

PM10 is produced by stationary point sources such as fuel combustion and industrial processes; fugitive sources, such as roadway dust from paved and unpaved roads; wind erosion from open land; and transportation sources, such as automobiles. The primary sources of PM10 in the Sacramento Valley are fugitive dust from paved and unpaved roads and agricultural operations, and smoke from residential wood combustion and seasonal agricultural burning. Soil type and soil moisture content are important factors in PM10 emissions. Federal and State PM10 standards are designed to prevent respiratory disease and protect visibility.

Certain land uses are considered more sensitive to air pollution than others. Locations, such as schools, hospitals, and convalescent homes, are labeled sensitive receptors because their occupants are more susceptible to respiratory infections and other air quality-related health problems than the general public. Residential areas are also considered to be sensitive receptors because residents tend to be home for extended periods of time, resulting in sustained exposure to any pollutants present.

### 3.2 Water Supply

Due to drastic changes in natural hydrology, nearly all wetlands in the WMAs are managed wetlands that require water to be artificially applied and maintained. Managed wetland properties within the WMAs receive water from a variety of sources depending on their location and water rights. The most common water sources for wetland properties include: 1) water diverted from adjacent rivers and creeks using riparian water rights, 2) water diverted from non-contiguous water bodies under appropriative water rights deeded to the property, 3) water secured and purchased under contract with an irrigation or water district, 4) agricultural drain water from upstream properties, and 5) groundwater pumped from deep wells.

#### 3.2.1 Butte Sink WMA

Wetlands in the Butte Sink WMA are flooded with a combination of: 1) agricultural drain water, 2) delivered water secured through the 1922 Agreement with Western Canal Water Company, 3) water purchased from adjacent agricultural water districts, 4) water diverted directly from Butte Creek through riparian water rights and 5) water from deep wells.

In the early 1900s, an excess of agricultural drain water from irrigated farmland in the upper Butte Basin was negatively affecting farming and ranching operations in and around the Butte Sink. These conditions led to lawsuits, which eventually required upstream farmers to develop permanent drainage works and enter into a series of agreements, collectively referred to as the “1922 Agreement”, with the Butte Sink landowners. In the 1922 Agreement, Butte Sink landowners gave the upstream farming interests the right to flow agricultural drainwater over their lands, and in exchange, the Butte Sink landowners were provided with water, free of charge, to maintain...
their properties in a flooded condition through the waterfowl hunting season. These agreements also resulted in the construction of water conveyance infrastructure in the Butte Sink including the: Bifurcation Dam, North Weir, Cross Cut Canal, End Weir, and extensions to the Cherokee Canal and 833 Drain.

Today, easement properties which are party to the 1922 Agreement use agricultural drain water diverted from Butte Creek for the initial flooding of their wetlands. Generally, easement properties receive drain water from mid-August through September. Once drain water begins to diminish, a designated representative of the Butte Sink landowners (currently the manager of the Wild Goose Club) will call Western Canal Water District and order the delivery of water to maintain wetland water levels. As a condition of the 1922 Agreement, Western Canal Water District is obligated to deliver up to 200 cubic feet per second (cfs) through December of each year to maintain Butte Sink wetlands.

While the majority of the wetland water supply in the Butte Sink is provided through the 1922 Agreement, there are a variety of other water sources. Some easement properties receive water through other agricultural water districts, including Reclamation District 1004 which services many wetland properties west of Butte Creek. Many properties which are adjacent to Butte Creek maintain riparian rights and will occasionally use low lift pumps to divert water for wetland purposes. Finally, Butte Sink properties which don’t have water rights and are not party to the 1922 Agreement generally depend on deep wells to flood their wetlands.

3.2.1.1 Butte Sink Unit

The Butte Sink Unit’s primary water supply is received as part of the 1922 Agreement described above in section 3.2.1. This water typically becomes available from the Sacramento Outing Club to the north and is initially received in late August or early September. Typically, by March or April, inflow has stopped and, if water levels in Butte Creek allow, the Unit is drawn down. Water is also sometimes available in the spring for wetland irrigations.

In addition to the 1922 Agreement, the Service has two water rights on Butte Creek (Water Right IDs: A014316 and A012437, State Water Resources Control Board, Division of Water Rights). Both have a diversion season of May 1 through September 1, and the maximum direct diversion rates are 2.40 and 4.46 cfs, respectively. Total diversions for these water rights are 590.3 and 1,097 acre-feet. There is a lift pump on Butte Creek located near the southwest corner of the unit to allow for exercising these rights.

3.2.2 Willow Creek-Lurline WMA

The majority of easement properties within the Willow Creek Division are members of Willow Creek Mutual Water Company (WCMWC) which supplies water to easement wetlands. WCMWC has limited water rights and has historically depended on “surplus” water purchased from Provident Water District, agricultural drain water, and water pumped from deep wells to flood easement lands. In recent years, WCMWC has become more active in pursuing a reliable surface water supply. Their actions helped lead to a long-term agreement (25 years, with the option to renew) signed in 2007 that conveyed 1,470 acre-feet of pre-1914 water rights owned by BLM to the Service for use on easement properties within the WCMWC. Additionally, in 2010 WCMWC entered into a short-term agreement (3 years) with BOR to annually purchase up to 3,000 acre feet of water for easement properties. Despite these accomplishments, water shortages remain a real concern for Willow Creek easement properties and securing a reliable water supply is a high priority.

Within the Willow Creek Division, there are several easement properties which are not serviced by the WCMWC. These properties generally receive their water through Glenn-Colusa Irrigation District or pump ground water using deep wells.

Most easement properties within the Lurline Division belong to Maxwell Irrigation District (MID), which supplies water to easement wetlands. MID has secure water rights and
diverts water directly from the Sacramento River. Properties which are not supplied by MID rely on a combination of agricultural drain water pumped from adjacent drains and groundwater pumped from deep wells.

3.2.3 North Central Valley WMA

With easement properties located throughout the Sacramento Valley, the water supply for North Central Valley WMA wetlands is diverse and varied. The most common water sources for easement wetlands include: 1) water diverted from adjacent rivers and creeks using appropriative and riparian water rights, 2) water secured under contract with an irrigation or water district, 3) agricultural drain water from upstream properties and 4) groundwater pumped from deep wells.

While easement properties do rely on a variety of water sources, there are some general trends in wetland water supply based on property location. For instance, properties located in the Butte Basin (adjacent to the Butte Sink WMA) are generally members of and are supplied water by local irrigation districts. Properties located in and around the Sutter Bypass generally rely on appropriative and riparian rights and pump water out of the east or west toe drains of the Sutter Bypass. Similarly, properties located in the Yolo Bypass generally rely on appropriative and riparian rights and pump water out of the Yolo Bypass Toe Drain and or other adjacent drains.

3.2.3.1 Llano Seco Unit

The Llano Seco Unit receives water through an existing system of canals, ditches, and siphons that have been operating since the late 1800s. The water delivery system has two primary water sources. A majority of the water is pumped via riparian water right from the Sacramento River near the mouth of Big Chico Creek. Now known as the M&T Chico Ranch/Llano Seco Rancho Fish Screen and Pumping Facility (Facility), this pump station originated on Big Chico Creek during the 1920s and was relocated from Big Chico Creek to the Sacramento River in 1997. The current Facility is located downstream of the confluence of Big Chico Creek and the Sacramento River, on the east bank of the Sacramento River just south of the Bidwell-Sacramento River State Park at river mile (RM) 193, approximately six miles southwest of the City of Chico. It provides a reliable water supply to approximately 15,000 acres of farm and conservation lands, including over 4,000 acres of wetlands and associated habitats owned or managed by the Service and CDFW. The relocation was part of an effort to reduce the risk of mortality to native anadromous salmonids, including special-status species within the Sacramento River Basin.

The relocated diversion was designed with a state-of-the-art fish screen system, which supplies private ranches, the Service’s Llano Seco Unit and CDFW Llano Seco Unit with a total conveyance capacity of 150 cfs. As part of the relocation, the M&T Chico Ranch/Llano Seco Rancho agreed to not divert 40 cfs of their water right from Butte Creek (October 1 through June 30) to support Butte Creek fisheries as long as replacement water would be guaranteed from the Central Valley Project at the new facility on the Sacramento River. A second water source comes from a “foreign water re-diversion” off of Butte Creek and conveyed through Crouch Ditch and Edgar Slough to the M&T Ranch. From the M&T Ranch, the Butte Creek water comingles with Sacramento River water and is distributed through the canal system to the Llano Seco Rancho and ultimately the Service’s Llano Seco Unit.

Since 2001, USFWS, CDFW, M&T and Llano Seco Ranches have been investigating alternatives to address Sacramento River sediment deposition in the immediate vicinity of the Facility intake. An upriver gravel bar adjacent to the Bidwell-Sacramento River State Park continues to migrate toward the vicinity of the fish screened diversion and the Chico Waste Water Treatment Plant (WWTP) outfall, and the deposition and subsequent meander of the River threatens the operation of the Facility. The intake screens (fish screens) could potentially be covered by sediment, which could cause a reduction in approach and sweeping velocities across the screens, and ultimately
impact the screens’ ability to prevent fish from being harmed by the Facility operation. As a result, a reduction in approach or sweeping velocities would render the screens out of compliance with the National Marine Fisheries Service and CDFW fish screen criteria. In addition, immediately downstream of the Facility, the City of Chico WWTP outfall diffusers also are threatened by the ongoing sediment deposition associated with the upriver gravel bar and river migration (USFWS and CDFW 2013). Several alternatives were studied and will be analyzed in a separate environmental document (USFWS and CDFW 2013).

Some other components of the water conveyance system are in disrepair. There are two Redwood Siphons located on the north end of the Llano Seco Rancho that are critical structures along the main “arteries” of the water conveyance and distribution system for the Llano Seco Rancho, the Service’s Llano Seco Unit and the CDFW-Llano Seco Unit. The Redwood Siphons were constructed in 1926, and according to an engineering evaluation completed by Sverdrup Civil, Inc. (prepared for the Service) in 1997, are in need of repair/replacement. Llano Seco Rancho, Ducks Unlimited, and the Service have conducted additional evaluations of the condition of the siphons, and identified several “breeches” in the siphons that threaten both the capacity to convey designed flows as well as a complete failure of the system. Several alternatives are currently being studied and evaluated, and will be considered in a separate Environmental Document once the studies have been completed.

### 3.3 Contaminants and Water Quality

The water quality of the Sacramento River and its major tributaries supports beneficial uses, including drinking and irrigation water, recreation, and protection of fish and other aquatic life. Most of the water in the Sacramento River and its major tributaries, such as the Feather and American Rivers, is derived from melting snow that enters the rivers by managed discharges of water from reservoirs. Because the snow is pure, much of the Sacramento River and its large tributaries have low concentrations of dissolved minerals. Although water quality of the Sacramento River is good most of the year, seasonal events, such as agricultural runoff or runoff from historical mining operations, may affect this quality. Variable climatic conditions and variation in amounts of rainfall, coupled with competing demands for water uses, affect the aquatic ecology of this basin.

Due to the lack of a secure water supply, easement properties in the Sacramento Valley often utilize drain water from surrounding agricultural lands to flood and maintain wetland habitats. Even delivered water from local irrigation districts can be previously used “upstream”, most commonly for growing rice.

The California Department of Fish and Wildlife (CDFW) initiated a selenium verification study in 1985 and concluded that selenium concentrations in water and fish occurred at less than harmful levels in the Sacramento Valley (White et al., 1987). Fish kills in the Colusa Basin Drain during the early 1980s indicated high concentrations of molinate and the herbicide thiobencarb (associated with rice farming practices) in fish and water samples collected throughout the agricultural drains and in the Sacramento River downstream of drain inflow. California’s Department of Pesticide Regulation implemented the Rice Pesticide Program in 1983, which established performance goals for molinate and thiobencarb in 1990 and the insecticides methyl parathion and malathion beginning in 1991. County agricultural commissioners, with the use of restricted materials permits, implemented program requirements for molinate, thiobencarb, methyl parathion, and malathion in 2001.

Water quality and potential contaminants were also a concern on the Complex. To further address these concerns, a collaborative study was conducted by the U.S. Geological Survey, U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation entitled “Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in the Sacramento National Wildlife
Refuge Complex, California, 1988-89” (Dileanis et al., 1992). The report concluded, “…there is some degradation of water quality related to agricultural drainage in the region, and elevated concentrations of some chemical constituents were detected in water, sediment, and biological samples. These elevated concentrations were only slightly greater than Service guidelines for possible effects on wildlife.” Of greatest interest were the DDT family of organochlorine compounds detected in all bottom-sediment samples from canals containing drain water; the DDE (byproduct of DDT) content of white-faced ibis and black-crowned night herons (Colusa Refuge); and the thiocarbamate herbicide molinate (rice field use) that was detected in all 21 samples (one exceeding the State of California guideline for the protection of aquatic habitat) timed to coincide with peak spring water releases.

In addition, a number of ground water wells, both those already in existence in the 1980s (especially at Sutter Refuge) and BOR exploratory test wells completed in the early 1990s (Sacramento Refuge), documented levels of arsenic, cadmium, mercury, and boron that exceeded recommended limits.

Local mosquito and vector control districts (MVCD) conduct mosquito control activities on certain areas of the Complex annually. MVCDs treat both Refuge and WMA lands with a variety of pesticides to kill adult and larval mosquitoes generally between the months of April to October to reduce public health risk and severe nuisance in accordance with Service policy. In some areas, mosquito larvae are controlled by directly applying methoprene, Bacillus sp., larvicidal oil or other pesticides to wetlands. Pyrethroid and organophosphate compounds are applied with ultra-low volume sprayers via ground or air for adult mosquito control (adulticides). In some cases, applications are made to widespread areas, such as the Butte Sink. These applications are designed to drift over wetlands and other habitats to target adult mosquitoes; however, some of the material is deposited into aquatic areas (Lawler et al., 2008). The Complex staff works with the MVCDs to minimize chemical treatments, use the least toxic products, and avoid or buffer sensitive areas whenever possible. However, some of these pesticides are toxic to aquatic organisms in very small quantities, and contamination of wetlands and impacts to non-target species from mosquito control continues to be a concern.

In 2003, the Central Valley Water Quality Control Board made it a requirement that all managed wetlands which drain into waters of the State obtain a discharge permit or a Conditional Waiver from waste discharge requirements. Managed wetlands, including Service’s fee-title and easement properties, were able to obtain a Conditional Waiver by participating in the Sacramento Valley Water Quality Coalition. Beginning in 2005, the Refuges and most Easement properties began membership/participation in three groups (Colusa Basin Subwatershed Program, Solano-Yolo Water Quality Coalition and Butte-Yuba-Sutter Water Quality Coalition) of the Sacramento Valley Water Quality Coalition. These groups provide water quality monitoring required by the Central Valley Regional Water Quality Control Board’s Irrigated Lands Conditional Waiver Program. The program requires anyone owning lands that have irrigation return water and/or storm water runoff leaving their lands to complete water quality monitoring. To date, no water quality problems related to Service-owned fee-title or easement lands have been documented.

Methyl mercury associated with seasonal wetlands has also become an increased concern in some areas within the Central Valley (Domagalski 1998).

3.3.1 Butte Sink WMA

Overall water quality in Butte Creek is considered to be good to excellent in the upper portions of the watershed (i.e. upstream of Chico), and degrades in quality lower in the system. Water quality can vary seasonally, corresponding to precipitation and diversions. It can also vary year to year depending on dry or wet conditions. Large storm events can
influence water quality, increasing turbidity and mobilizing pollutants and salts. Similarly, low flows can reduce water quality by concentrating contaminants and increasing water temperatures, particularly in the late summer.

As indicated in section 3.2.1, managed wetlands in the Butte Sink WMA are partly flooded with agricultural drain-water, most notably as they are initially filled in the late summer and early fall.

The majority of the Butte Sink WMA is typically treated three to six times in the fall for adult mosquitoes. There is concern with adulticides being deposited in wetlands due to their potential effects on non-target invertebrate and fish resources. Deposition of compounds or their byproducts has been documented in water or sediment samples at Butte Sink WMA (Central Valley Water Quality Coalition 2005, 2006) and at nearby Colusa NWR (Lawler et al., 2008).

In a potentially related issue, there has been a dramatic increase in waterfern (Azolla Mexicana, A. filiculoides), a native aquatic plant in the Butte Sink, in the last ten years. An initial investigation indicates that the primary weevil species that typically controls this plant has seen a significant population reduction, which may have resulted in the plant’s expansion and subsequent negative effects on the wetland community (Carruthers and Grewell, unpublished data). One hypothesis for the increase in Azolla is that pesticide applications for mosquito control (which has intensified since 2003 when West Nile Virus appeared in California) may be negatively impacting weevil populations. Other hypotheses involving water quality include the possibility that agricultural pesticides in drain water and/or increased water temperatures of drain water may be negatively impacting weevil populations. A combination of the above conditions is also a possibility.

### 3.3.1 Butte Sink Unit

The Butte Sink Unit is subject to the same water quality and contaminant issues as the rest of the Butte Sink WMA. In most years, all water that is used to flood the Butte Sink Unit arrives via upstream easement wetlands per the 1922 Agreement.

### 3.3.2 Willow Creek-Lurline WMA

Easement lands within the Willow Creek Division flood their wetlands with a combination of delivered water from the Sacramento River, drain water from upstream agricultural lands, and ground water from deep wells. While the overall quality of water from the Sacramento River is good, there are potential concerns with the quality of agricultural drain water and groundwater. A variety of pesticides and fertilizers are used on neighboring agricultural lands, and while recent annual water quality monitoring results show few problems (Sacramento Valley Water Quality Coalition 2014) there have been issues with some pesticides in the past (Dileanis et al., 1992). While the quality of the groundwater has not been monitored in the Willow Creek Division, Bureau of Reclamation tests on groundwater from nearby wells on Sacramento Refuge exhibited elevated levels of arsenic, cadmium, boron and mercury (Sacramento/Delevan CCP, USFWS 2009).

While most easement properties within the Lurline Division flood their wetlands with good quality water delivered from the Sacramento River, there are a few properties which depend solely on agricultural drain water. Very few Lurline properties use deep wells to flood their properties, and the quality of ground water in this area is not well documented.

The Willow Creek-Lurline WMA is not in the immediate boundaries of local MVCDs, and as a result the area has rarely received chemical treatment for mosquitoes.

### 3.3.3 North Central Valley WMA

In 2004 through 2006, a Contaminant Assessment Process (CAP) was conducted for the North Central Valley WMA. In summary, contaminant issues for the WMA include pesticide drift, run-off and discharge from municipalities. Water quality and contaminants issues on easement lands vary throughout the North Central Valley WMA based on location.
Most easement properties in the Butte Basin flood their wetlands with delivered water from the Sacramento and Feather rivers. The water quality from these rivers is generally good within the Butte Basin. Many easement properties in the Sutter Basin depend on water pumped from the toe drains of the Sutter Bypass. Water in the Sutter Bypass toe drains generally consists of a mixture of Butte Creek water and agricultural drain water.

Similar to the Sutter Basin, easement properties in the Yolo Basin largely flood their lands with water pumped from the Yolo Bypass toe drain. Located in the north Delta, the water in the Yolo Bypass toe drain consists of a mixture of agricultural drain water and natural flows which are tidally influenced. In addition to concerns regarding agricultural chemicals in the toe drain there are also concerns regarding legacy mercury which enters the system as result of old mining practices on lower Sacramento River tributaries. It is suggested that this mercury source is leading to elevated levels of methyl mercury in some seasonal wetlands (Wood et al., 2008).

Almost all easement properties in the North Central Valley WMA fall within the jurisdiction of local MVCDs. Accordingly, most of these properties are chemically treated for mosquitoes on an annual basis. While chemical type and application methodology varies among individual MVCDs, larvicide and adulticide pesticides are generally applied to wetlands between April and October using aerial and or ground spraying equipment. There are concerns regarding how these pesticides affect non-target invertebrate and aquatic resources on easement wetlands.

3.3.3.1 Llano Seco Unit

Water delivered to the Llano Seco Unit wetlands comes from two direct sources. A majority of the water comes directly from the Sacramento River via the M&T Chico Ranch/Llano Seco Rancho Fish Screen and Pumping Facility, with the remainder being supplied through a diversion on the upper end of the Butte Creek drainage via the Parrott-Phelan Diversion Dam. None of the water utilized is a secondary use (i.e., no agricultural drain water or runoff). A discussion of overall water quality in Butte Creek is provided in section 3.3.1 above.

The Parrott-Phelan Diversion Dam is located in the lower portion of Butte Creek Canyon, near the mouth of the canyon. Here, riparian vegetation acting as a canopy over the stream begins to diminish as the creek channel has a broad cross-sectional shape and vegetation is often quite far from the stream. Direct solar exposure and slow moving water (due to a lower gradient) combine to raise water temperatures. June records from 1991 and 1992 show no minimum daily temperatures above 70° Fahrenheit (°F), with maximum temperatures of 72.5°F and 78.8°F respectively. The highest temperatures recorded during 1990 data collection were 80.6°F on both August 8 and 9. July 30, 1991 marked the highest recorded temperature for the study, 81.5°F (Butte Creek Draft ECR) (CSUC 1998).

Mosquito control is relatively infrequent at the Llano Seco Unit. Fall flooding of seasonal wetlands typically does not start here until early October, when temperatures are cooler and mosquito production is reduced; however, some larval mosquito control is conducted annually.

3.4 Geology, Hydrology, and Soils

The area between Red Bluff and Sacramento is underlain by sedimentary and volcanic deposits associated with the Tehama, Tuscan, Red Bluff, and Riverbank formations. On top of these formations lie younger fan deposits of the Modesto formation, as well as basin, marsh, and floodplain alluvial deposits associated with the Sacramento River, North Coast Range, southern Cascade and northern Sierra Nevada streams (Harwood and Helley 1982; Helley and Harwood 1985).

The North Central Valley WMA covers a large area, from Red Bluff to Sacramento and it includes areas in the Delta. Soils in this area are associated with the Sacramento Valley’s river floodplains, basins, basin rim, low alluvial
fans, low remnant terraces, and organic soils of the Delta. This area also includes soils landscapes of the Willow Creek-Lurline WMA, Butte Sink Unit and Llano Seco Unit. Soils described for these areas come from the most detailed soil survey information, the Soil Survey Geographic Database (SSURGO) which compiles soil survey data at a scale of 1:12,000 to 1:24,000 (Appendix D, Table D-1). This scale is useful for habitat restoration and management planning efforts. The U.S. General Soil Map (STATSGO) interprets soil survey data at a scale of 1:250,000, which provides sufficient detail for a general description of the North Central Valley WMA and is useful for large scale planning efforts (Appendix D, Table D-2).

3.4.1 Butte Sink WMA

The Butte Sink WMA is located at the southern end of the Butte Basin and lies within the Butte Sink. This area drains Butte Creek and is characterized by low gradient sloughs and ponds consisting of basin marsh deposits (fine-textured soils high in organic matter) which historically supported emergent and willow scrub vegetation. Areas of higher elevation on better drained soils supported grassland and Valley oak. See Appendix D (Table D-2) for descriptions of the soil associations and their characteristics.

3.4.1.1 Butte Sink Unit

Soils consist almost entirely of Capay silty clay. These soils are located on the basin floor, frequently flooded (slopes between 0 and 2 percent), moderately well drained, and non-saline. The top 36 inches consist of silty clay, with clay loam occurring below to 60 inches. Minor soil components include Clear Lake clay, frequently flooded, poorly drained soils composed of clay to a depth of at 60 inches. These are wetland soils associated with a high water table. (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx).

3.4.2 Willow Creek-Lurline WMA

Willow Creek–Lurline WMA is located in the Colusa Basin. Here WMA soils are located at the higher elevations of the basin (i.e., the top end of the basin) where they are predominately strongly saline-alkali Willows clay, Willows silty clay, and Riz silty clay loam (Begg 1968). These are wetland soils associated with a high water-table, and are subjected to occasional to frequent flooding. See Appendix D (Table D-2) for descriptions of the soil associations and their characteristics. A variety of salt-tolerant wetland plants naturally occur in this arid, alkali landscape (Oswald and Silveira 1995). These soils are of limited agricultural productivity, but support rice agriculture through maintenance of summer water, which translocates salts deep into the soil profile.

Prior to land reclamation and flood control, the Colusa Basin flooded at occasional to frequent intervals. Because of the WMA’s Basin Rim location, flood waters quickly receded into the natural troughs and sloughs, which eventually drained into the Sacramento River or large freshwater wetland sinks (Holmes et al., 1915). This once extensive marshland habitat supported abundant and diverse native fish and wildlife.

Most floodwater was off the Basin Rim during the growing season, resulting in a barren, alkali, and windswept plain (Silveira 2000, 2001). A relatively dense aggregation of large intermittent lakes, vernal pools, mima mounds, and alkali sinks and flats characterized the Colusa Basin (Holmes et al., 1915), and were historically known as the “Colusa Plains”. These natural wetlands filled with winter rains, providing abundant waterfowl and shorebird habitat. In the springtime, an expanse of wildflowers carpeted the Colusa Plains (Hanson 1944; Silveira 2000, 2001).

3.4.3 North Central Valley WMA

As explained in section 3.4, the North Central Valley WMA covers a large and geographically diverse landscape. Accordingly, this area includes a wide range of soil landscapes with equally diverse soil characteristics, which influence potential natural vegetation and restored/created habitats. Soils of the WMAs are presented in Appendix D (Table D-2). Identifying
soil characteristics is among the first steps in planning habitat conservation projects.

3.4.3.1 Llano Seco Unit

The Llano Seco Unit of the North Central Valley WMA is located at the northwest end of the Butte Basin. This area is characterized by uplifted basin deposits in Sanctuary I and basin marsh deposits in the eastern half of Sanctuary II. Sanctuary I is bisected by Angel Slough, an ancient channel of the Sacramento River. The southwestern corner of Sanctuary II lies within the Little Chico Creek floodplain.

Soils of the Llano Seco Unit are diverse and vary within and across the geologic landscape, and with the natural and managed hydrology, create equally diverse patterns of vegetation and wildlife habitats (Appendix D - Soils, Table D-1; Appendix K - Wildlife and Plants).

The potential natural vegetation for Sanctuary I would be Valley oak/elderberry savanna, perennial grasslands, and vernal pool annual grasslands. The potential natural vegetation for Sanctuary II would be annual vernal pool grassland at the western half and freshwater emergent marsh at the eastern half (Burkett and Conlin 2006, Oswald and Ahart 1996, Silveira 2006, Silveira et al., 2003).

Much of the Llano Seco Unit is comprised of Dodgeland silty clay loam soils and Lofgren-Blavo Complex soils that were converted to rice agriculture in the second quarter of the 20th century. In the early 1990s, rice fields were converted to managed freshwater wetland habitats by the Refuge since these soils contain properties consistent with ponding water (fine texture and poor drainage).

4. Habitat

4.1 Vegetation

The lands of the North Central Valley WMA, Willow Creek-Lurline WMA, and Butte Sink WMA consist mostly of managed wetlands with much smaller amounts of unmanaged wetlands, vernal pools, grasslands, riparian forest, and other riparian and floodplain habitats. Figure 9 (Butte Sink Unit) and Figure 11 (Llano Seco Unit) show the habitat types managed for on the Service-owned units within the WMAs. Representative quantities of habitat types on Service-owned lands are listed in Table 3. Descriptions of the habitats and their associated plant and wildlife species follow. A comprehensive list of plant species occurring in these habitats can be found in Appendix K.
### 4.1.1 Wetlands

The Sacramento Valley has lost 90 to 95 percent of its original wetlands that existed in the late 1800s (Holland 1978; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). Many of the original wetlands occurred along rivers and creeks, where over-bank flooding seasonally inundated large expanses of wetlands during major rain events and spring runoff. In areas farther away, isolated vernal pools were also filled directly from precipitation, creating significant wetland landscapes.

When first explored by the Spanish, the Sacramento/San Joaquin Delta was a vast freshwater tidal marsh with significant stands of hard-stemmed bulrush (see Appendix K for listing of scientific names of all species). By the end of the Gold Rush, levees were built to reclaim the land for farming. Beginning in the early 1900s, much of the natural overland flooding was lost due to the construction of the flood control and bypass systems along the Sacramento/San Joaquin Rivers and their tributaries. Because the large Federal and State water conveyance projects altered the nature of California’s hydrology, nearly all of the remaining wetlands in the Sacramento Valley and Delta are managed, including those on the WMAs. For the most part, managed wetlands are artificially created and maintained, with the majority having at least some perimeter and interior levees, water control structures, and water delivery and drainage canals. Most of the water used to flood these wetlands is delivered to individual property boundaries via local irrigation districts. In some instances, deep wells are also utilized to provide water to managed wetlands, where delivered surface water is either insufficient or not available (see section 3.2, Water Supply, for further details). The majority of the lands within the WMAs are utilized as waterfowl hunting properties. Their wetland habitats are intensively managed to maximize resources to directly support the annual abundance of migratory waterfowl, but they also indirectly benefit other migratory birds, endangered and threatened species, as well as many other wetland-dependent wildlife species.

Many easement and Service-owned lands in the WMA have been restored from agricultural lands to managed wetlands. Many of these lands had previously been farmed to rice or other crops, and were leveled to promote higher yields. In order to restore them to wetlands, techniques for de-leveling rice fields were developed (Strong et al., 1990) and have since been modified to enhance existing managed wetlands. Restoration and enhancement efforts often involve the excavation of swales and potholes throughout the pond bottoms in order to establish a variety of water depths, vegetation types, and open water areas. Other restoration and enhancement techniques include planting and establishing native wetland and riparian vegetation, and creation of islands.

Although agriculture and managed wetlands have replaced much of the historic “plains” landscape in the Sacramento Valley, significant areas of vernal pool and alkali meadow habitats, and some remnant sloughs and ponds still persist. They are important habitats in their natural state for waterfowl, shorebirds, and a number of rare and endemic species, especially in late winter and spring. Therefore, these areas are not intentionally flooded, drained, or irrigated. Early attempts were made to farm or flood some of these areas, but most failed due to high soil alkalinity.

#### 4.1.1.1 Seasonal Wetlands

Seasonal wetland is the most common habitat on the WMAs, comprising 85-90 percent of the total managed wetlands on Service-owned lands (Table 3). Seasonal wetlands provide the greatest quantity and diversity of food and cover for waterfowl and other migratory birds. Consequently, they support the greatest abundance and diversity of wildlife species over the course of a year. During the non-breeding season (September-April), seasonal wetlands can support up to three times the average waterfowl densities of semi-permanent wetlands and 10 times that of permanent wetlands (M. Wolder; unpublished data).
wetlands are intensively managed, with the timing and depths of water and vegetation manipulated to meet resource management objectives. In general, they are wet from fall through spring and dry during the summer.

Characteristic plants include emergent species, such as hard-stemmed bulrush, cattail, alkali bulrush, tuberous bulrush, and river bulrush. Annual moist-soil plants (species that provide the most waterfowl food resources) which commonly occur on seasonal wetlands include swamp timothy, smartweed, and watergrass. The ratio of open water to emergent plants often determines the species that will use a particular area. For example, northern pintail (pintail), northern shoveler (shoveler), American wigeon (wigeon), most geese, and shorebirds are attracted to wetlands which have more open water and less emergent cover; while mallards, wood ducks, rails, bitterns and other secretive marsh birds prefer wetlands with more emergent vegetation and less open water. When seasonal wetlands are dry during the summer, bulrushes and other vegetation function as habitat for some ground-nesting birds.

**Irrigated Seasonal Wetlands**

A large percentage of seasonal wetlands are irrigated during the spring or early summer, and are referred to as irrigated seasonal wetlands. Seasonal wetlands are often irrigated to optimize the growth and seed production of moist-soil plants such as smartweeds and watergrass. They typically contain a high density of moist-soil plants that produce large volumes of seeds and support high numbers of aquatic invertebrates that are sought-after by waterfowl. Along with other seasonal wetlands, irrigated seasonal wetlands play a major role in providing food resources to replenish waterfowl energy reserves for migration, feather molt, and winter survival. In addition, these wetlands provide an alternate food resource in the early fall to help alleviate crop depredation on private agricultural lands.

**4.1.1.2 Semi-permanent and Permanent Wetlands**

Semi-permanent and permanent wetlands provide wetland habitat during all or part of the summer, as well as most of the rest of the year. Semi-permanent and permanent wetlands comprise up to 15 percent of the total managed wetlands on easement lands and up to 10 percent of Service-owned lands (Table 3). Vegetation includes an abundance of perennial emergents (cattails and bulrushes), floating-leaved submergents such as burhead (*Echinodorus cordifolius*) and arrowheads (*Sagittaria* sp.), etc., and submerged aquatics such as sago and horned pondweeds (*Potamogeton pectinatus* and *Zannichellia palustris*, respectively). Semi-permanent and permanent wetlands provide important breeding habitat for waterfowl and many other wetland-dependent species including egrets, bitterns, ibis, grebes, rails, tricolored blackbirds, giant garter snakes, and northwestern pond turtles. They are also important water sources for all wildlife during the summer, when most seasonal wetlands within the WMAs are dry.

**4.1.1.3 Unmanaged Wetlands**

Wetlands, other than vernal pools, that are largely natural and have little or no artificial water management capabilities are referred to as “unmanaged wetlands.” These include oxbow lakes, sloughs, and other watercourses. They are typically permanent or semi-permanent wetlands that are heavily vegetated. The limited acres of unmanaged wetlands provide habitat for giant garter snakes, western pond turtles, wood ducks, and other species. Unmanaged wetlands generally make up a very small percentage of the total wetlands.

**4.1.1.4 Vernal Pools/Alkali Meadows**

Vernal pools are seasonally flooded depressions found on ancient soils with an impermeable layer (duripan) such as a hardpan or claypan that perches rainwater above the water table. They are generally filled and maintained with rainwater in the winter and early spring, and then evaporate as temperatures warm and north winds blow in late spring. While temporary wetlands such as vernal pools occur throughout the world, those of California are unique due to a Mediterranean (winter
wet–summer dry) climate; thus the flora and some of the fauna of vernal pools are unique to California (Holland and Jain 1988). Since vernal pools support a significant amount of endemic and rare flora and fauna, they add significantly to the biotic diversity of WMA lands (Silveira 2000, Eriksen and Belk 1999, Thorpe and Leong 1995); as a result, they are a high conservation priority. A sample of vernal pool endemics occurring or potentially occurring within the WMAs include: Fremont’s goldfields (*Lasthenia fremontii*) and alkali goldfields (*Lasthenia platycarpha*), Scribe’s popcornflower (*Plagiobothrys scriptus*), Hoover’s downingia (bella) and folded downingia (*Downingia ornatissima*), vernal pool saltbush (*Atriplex persistens*), Hoover’s spurge (*Chamaesyce hooveri*), cleistogamous spike primrose (*Epilobium cleistogamum*), tiny mouse-tail (*Myosurus minimus*), Colusa grass (*Neostapfia colusana*), hairy Orcutt grass (*Orcuttia pilosa*), Green’s tuctoria (*Tuctoria greenii*), Solano grass (*Tuctoria mucronata*), California clam shrimp (*Cyzicus californicus*), California fairy shrimp (*Linderiella occidentalis*), Conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*Branchinecta lynchi*), and vernal pool tadpole shrimp (*Lepidurus packardi*).

As winter rains fill the pools, a variety of crustaceans and other invertebrates emerge, develop, and reproduce, completing their entire life cycle in a single wet season. Vernal pools provide habitat for the greatest diversity of fairy shrimp on earth, and most of these species are endemic to California (Eriksen and Belk 1999). Vernal pools and their surrounding plant communities provide important habitats for a variety of migratory birds, including waterfowl and shorebirds (Bogiatto and Karnegis 2006, Bogiatto et al., 2009, Wolder et al., 1999, Silveira 1998).

As water evaporates in the spring, flowering plants produce the brightly colored concentric rings of flowers for which vernal pools are famous. Host-specific native bees nest in the plant communities, and pollinate pool flowers; many of these native pollinators are endemic species (Thorpe and Leong 1995).

Aquatic insects and crustaceans produce cysts and eggs, and plants produce seeds which are all buried in the muddy pool bottom and then remain dormant in the dry pools until they are flooded again the following winter. In their dry phase, vernal pools are really “banks” full of resting seeds, cysts, and eggs that are adapted to survive through summer, and even through extended droughts.

Alkali and salt tolerant vegetation grows on Basin Rim landforms, which are elevated slightly above the Valley or basin floor. Here, the plant rooting zone and soil surface is near the water table, so salts are carried to the rooting zone or to the surface forming white-crusted alkali scalds and “fluffs.” Alkali meadows are characterized by halophytes (salt-tolerant plants) and form a unique habitat, which is sparsely vegetated and relatively short. Alkali meadows are often found in association with vernal pools. While they do not pond water like vernal pools, the soil becomes completely saturated with winter and spring rainfall. Similar to vernal pools, they support a variety of native endemic plant and animal species that are uniquely adapted to their environment. Examples of California alkali meadow/vernal pool endemics include: papoose spikeweed (*Hemizonia parryi*), Heckard’s pepper-grass (*Lepidium latipes*), heart-scale (*Atriplex cordulata*), brittlescale (*Atriplex depressa*), Ferris’s milk-vetch (*Astragalus*).
On easement and Service-owned lands, vernal pools are known to occur at the Llano Seco Unit (Table 3) and the Llano Seco Ranch easement. Llano Seco vernal pools are within the Northeastern Sacramento Valley Vernal Pool Region. Vernal pools in this region have duripans which perch water. These include basalt and mudflow bedrock contact on the table lands and mudflows, iron-silica pans on the high and low terraces, and clay-silica pans on the low terraces and uplifted basins. Other vernal pool regions within the boundary of the North Central Valley WMA include the Northwestern Sacramento Valley, Solano–Colusa, and Southeastern Sacramento Valley vernal pool regions, Vernal pools are technically wetlands, but have been historically considered part of the overall “uplands” habitat group.

4.1.2 Grasslands

Annual grasslands are generally dominated by introduced non-native grass species such as annual rye-grass (Lolium multiflorum), wild oats (Avena fatua), soft chess (Bromus hordeaceus), ripgut brome (Bromus diandrus), medusa-head (Taeniatherum caput-medusae), foxtail barley (Hordeum jubatum), and fescues (Vulpia sp.). Other species include forbs such as dock (Rumex sp.) and aster (Aster sp.). Perennial grasslands include remnant patches of native grasslands, restored native grasslands, and introduced non-native species such as tall wheatgrass (Elytrigia pontica) and Harding/perlagrass (Phalaris aquatica) (Silveira et al., 2003). Typical native grass species used for restoration include local ecotypes of creeping (or alkali) rye-grass (Levymus triticoides), blue wild-rye (Elymus glaucus), purple needle-grass (Nassella pulchra) and meadow barley (Hordeum brachyantherum). Other species used include Santa Barbara (or basket) sedge (Carex barbarae), clustered field sedge (Carex praegracilis), Great Valley gumplant (Grindelia camporum), Bolander’s sunflower (Helianthus bolanderi), and sky lupine (Lupinus nanus). Other spring and summer wildflowers (forbs) are currently being tested for use in grassland restoration projects, such as, tarweeds, phacelias, blue curls and other lupines. Perennial and annual grassland cover provides important nesting habitat for ducks, ring-necked pheasants, western meadowlarks, burrowing owls, northern harriers, American bitterns, savanna and grasshopper sparrows, and other grassland species. Preliminary monitoring of native grass restoration work at Colusa Refuge indicated comparable duck nest densities with other off-refuge areas, but with overall higher nest success (Loughman et al., 2004). During the winter and spring, grasslands provide green browse for geese, wigeon, and American coots (coots). These areas also support significant numbers of insects, rodents, and reptiles, which, in turn, are important forage items for raptors and other birds. Many of the non-native grass species are invasive and pose a threat to alkali meadow vegetation and the rare, endemic, and native species that grow there. As a result, they are controlled in some areas. Annual and perennial grasslands represent a relatively small proportion of Service-owned lands with the WMAs (Table 3).

Vernally wet grassland is another type of grassland that exists solely at the Llano Seco Unit and consists of annual grassland which is flooded during late winter and early spring. This is described further in section 4.4.1.

4.1.3 Riparian Habitats

Riparian habitats comprise a relatively small proportion of the WMAs, though they are more prevalent in the Butte Sink WMA. Riparian habitats within the WMAs include willow-scrub, cottonwood-willow, mixed riparian forest, Valley oak riparian forest, and Valley oak woodland.

Willow-scrub consists of open-to-dense shrubby willow-dominated thickets with little to no understory vegetation (Holland 1986). It is characterized by Goodding’s black willow (Salix gooddingii), Arroyo willow and narrow-leaved willow (Salix exigua).

Cottonwood-willow is forested habitat containing open-to-dense stands
co-dominated by willows and Fremont’s cottonwood (Populus fremontii).

Mixed riparian forest consists of later successional species (Holland 1986; Holland and Roye 1989); in this habitat type, Valley oak accounts for less than 60 percent of the canopy coverage with black walnut and Oregon ash also present; willow and cottonwood may also be present in relatively low abundance; the dense understory often consists of Oregon ash, box elder, poison oak, and wild grape; California wild rose is also a common understory plant and blue elderberry grows in light gaps and at the edges of the canopy.

Valley oak riparian forest is dominated by Valley oak (Quercus lobata) and includes an understory of box elder (Acer negundo), wild rose (Rosa sp.), poison oak (Toxicodendron diversilobum), and alkali (creeping) ryegrass (Holland 1986; Holland and Roye 1989). Valley Oak Woodland is dominated by Valley oak, poison oak, Santa Barbara sedge, and blue elderberry.

Willow-scrub and cottonwood-willow occur within managed wetlands. Along with mixed riparian forest and Valley oak riparian forest, they also occur along the creeks, sloughs, and canals throughout the WMAs, sometimes forming large contiguous patches of riparian habitat. The Llano Seco Rancho easement (North Central Valley WMA) contains impressive remnant stands of Valley oak woodland and savanna; some Valley oak woodland has been restored there as well.

Riparian habitats provide breeding, wintering and migration stop-over habitats for many species of landbirds. They are used by a great variety of resident and neotropical migratory bird species, both cavity and open cup nesters with diverse foraging guilds including tree swallow, brown creeper, yellow-billed cuckoo, yellow-rumped warbler, black phoebe, black-headed grosbeak and spotted towhee. Because of their close proximity to water, riparian habitats attract a large array of wetland-dependent species, such as the northwestern pond turtle, great blue heron and great egret, wood duck, common yellowthroat, song sparrow, beaver, black-tailed deer and river otter. This habitat supports multiple nesting rookeries of great blue herons, great and snowy egrets, black-crowned night-herons, and double-crested cormorants.

4.1.4 Agricultural Croplands

Irrigated cereal grains (primarily rice and corn), alfalfa, and pasture provide important foraging habitat for waterfowl, shorebirds and waterbirds within and around the WMAs. There are approximately 500,000 acres of rice annually grown within the WMAs, and it is estimated that up to 350,000 acres of this rice has been winter flooded for straw decomposition and migratory bird habitat since burning rice stubble has been phased out during the last two decades. An additional 200,000 acres of corn is annually planted within the WMAs, with approximately 30,000 acres winter flooded in the Delta Basin for waterfowl habitat. Significant acreage within the WMAs is also planted to alfalfa and irrigated pasture. Agricultural foraging habitat is threatened by a number of factors including urbanization, water availability, water sales, conversion to permanent crops such as orchards and vineyards, and other changing agricultural practices.
Waterfowl in the project area depend heavily on harvested grain fields (primarily rice and corn) for winter food, with agriculture providing almost 70 percent of all waterfowl food resources in the Central Valley (CVJV 2006). The 2006 CVJV Implementation Plan assumes that waste rice and corn in harvested fields will still provide up to 50 percent of the food needs for wintering ducks and geese when wetland habitat objectives are met. Waste grain in these fields also provides crucial food for wintering lesser and greater sandhill cranes. Similarly, winter flooded rice fields provide abundant invertebrate foods for numerous wintering shorebirds and waterbirds. In addition to providing crucial wintering habitat, rice fields provide important habitat for breeding waterfowl, shorebirds, and waterbirds during the growing season.

Irrigated pasture and alfalfa also provide important wintering habitat for migratory birds. New growth grasses provide an essential, late winter, protein source for grazing waterfowl such as geese and wigeon, while wintering and migrating shorebirds forage on invertebrates in irrigated or shallowly flooded pasture and alfalfa. Irrigated pasture and alfalfa also provide essential foraging habitat for wintering sandhill cranes within the project area.

While generally not allowed to grow commercial crops, many wetland easement owners plant agricultural food plots for wildlife on their lands. Easement owners are allowed to plant up to 5 percent of their easement acreage to agricultural food plots as long as it is contained in existing upland areas and they receive written authorization from the Easement Manager prior to establishment. The majority of food plots consist of one to five-acre stands of safflower, milo or corn which is planted to provide foraging habitat for upland game.

In addition to food plots on wetland easement lands, there are three agricultural easement properties where various commercial crops are grown for the benefit of wildlife. Commercial crops grown on these lands include corn, beans, wheat, rice, and irrigated pasture.

Rice farming historically occurred on the original 440-acre portion of the Butte Sink Unit when it was established in 1979. This was pursuant to a deed restriction, which permitted farming to continue for a period of ten years after the Unit was purchased. This was a cooperative operation that required 25 percent of the crop (mostly rice) to be left unharvested for waterfowl use and allowed the farmer to harvest the remainder. When the deed restriction expired in 1989, farming ended and those fields were converted to managed wetlands (USFWS 1937-1995), years 1980-1989. Grain crops have not been cultivated on the Service’s Llano Seco Unit since it was acquired by the Service. Commercial farming, which historically took place on Sacramento, Delevan, Colusa and Sutter NWRs, was phased out during the 1980s (USFWS 2009).

4.2 Butte Sink WMA

The majority of the habitat found in the Butte Sink WMA consists of managed seasonal and semi-permanent wetlands with smaller components of permanent wetlands, grasslands and riparian habitats. Wetlands within the Butte Sink WMA are dominated by thick stands of emergent vegetation, such as cattail, hard-stemmed bulrush and river bulrush, as well as moist soil plants like smartweed, watergrass. Undesirable species include Bermuda grass (*Cynodon dactyton*) and cocklebur (*Xanthium strumarium*). Mature groves of riparian forest, made up of Fremont cottonwood, black willow, sandbar willow, Valley oak, box elder, Oregon ash and button willow (*Cephalanthus occidentalis*) can be found throughout the wetlands and along the many sloughs, channels, and canals located within the Butte Sink WMA. Understory riparian species common to the WMA include, poison oak, mugwort (*Artemisia douglasiana*), California wild rose, California grape and Himalayan blackberry (*Rubus discolor*). Grasslands within the Butte Sink WMA are predominantly made up of perennial native grasses such as creeping rye-grass, blue wild-rye, meadow barley and Santa Barbara sedge with smaller amounts of non-native annual grasses making up the remainder.
4.2.1 Butte Sink Unit

The Service-owned land of the Butte Sink WMA consists mostly of managed wetlands with a much smaller amount of unmanaged wetlands, grasslands, and riparian forest habitats (Figure 9, Table 3).

The Butte Sink Unit is bounded on its west side by Butte Creek, with the topography generally sloping from the northwest corner towards the southeast corner. There is also some fall from the southwest corner to the north and northeast. Along the west boundary are annual grasslands that gradually slope down into the wetlands. This area is characterized by short to medium stature forbs and non-native grasses such as dock, marsh aster, foxtail barley, annual rye-grass, prickly lettuce (Lactuca serriola) and perennial pepperweed (Lepidium latifolium).

The majority of the Butte Sink Unit is comprised of seasonal wetlands, with smaller portions that have been infrequently managed as semi-permanent wetlands. These wetlands are typified by moderate to dense cover intermixed with areas of open water. Primary cover species include medium-stature emergent plants such as river bulrush, perennial smartweed, black willow, and hard-stemmed bulrush. Common moist soil plants include annual smartweeds, watergrass, and swamp timothy. Bermudagrass, jointgrass (Paspalum distichum), and cocklebur are common undesirable species. Other less abundant wetland plants include sweet clover (Melilotus sp), sticktight (Bidens frondosa), and sprangletop (Leptochloa sp).

The perimeter of the Butte Sink Unit is characterized by a band of mixed riparian forest and stands of cottonwood-willow, which intermingle with the wetlands in the northeast and southwest corners of the property. These habitats are densely vegetated by a mixture of trees, shrubs and vines such as black willow, cottonwood, sandbar willow, Oregon ash, Valley oak, box elder, wild grape, poison oak, and wild rose.

4.3 Willow Creek-Lurline WMA

The habitats found within the Willow Creek-Lurline WMA consist mostly of managed permanent, semi-permanent and seasonally flooded wetlands (irrigated and non-irrigated seasonally flooded). The alkalinity of the soils within the Willow Creek-Lurline WMA results in wetlands that are more open in nature and less dominated by emergent cover and riparian vegetation. Common emergent plants found in the wetlands of the Willow Creek-Lurline WMA include hard-stemmed bulrush, cattail and alkali bulrush. While smartweed and watergrass are present throughout the WMA, swamp timothy and pricklegrass (Crypsis vaginiflora) comprise the majority of the moist soil plant community. Infrequent stands of black willow, arroyo willow and cottonwoods dot the otherwise treeless landscape and are generally located along canals and ditches. The small area of uplands found in the Willow Creek-Lurline WMA include alkali meadows, annual grasslands, remnant native perennial grasslands and introduced non-native perennial grasslands. The various grasslands are dominated by saltgrass (Distichlis spicata), Bermuda grass, annual ryegrass, creeping ryegrass, tall wheat grass and perla grass.

4.4 North Central Valley WMA

Due to the large geographic area in which it covers, the habitats throughout the North Central Valley WMA are extremely diverse. While the habitats in the aforementioned Butte Sink and Willow Creek-Lurline WMAs are indicative of the habitats found on easement lands in the Sacramento Valley, the North Central Valley WMA also encompasses the northern portion of the Delta region. Habitats within the Delta region are generally made up of managed permanent, semi-permanent and seasonally flooded wetlands (irrigated and non-irrigated seasonally flooded), with a notable difference of being under tidal influence. Although the majority of the wetlands in this area are considered managed wetlands, small portions are subject to daily freshwater and brackish tide cycles. Vegetation in the Delta
region varies from dense stands of emergent and moist soil plants typical to the rest of the WMA, to a more saline tolerant plant community within the brackish tidally influenced areas. Dominant vegetation within these tidal freshwater emergent wetlands is made up of big leaf sedge (Carex amplifolia), redroot nutgrass (Cyperus erythrorhizos), tules, cattails, common reed (Phragmites australis) and watergrass (CDWR et al. 2003). Vegetation found in the saline emergent areas of the Delta include brass buttons (Cotula coronopifolia), fat hen (Atriplex triangularis), pickleweed (Salicornia virginica), cordgrass (Spartina sp.), glasswort (Salicornia depressa) and saltwort (Batis maritime) (CDWR et al., 2003).

The remaining habitats within the North Central Valley WMA are comprised of unmanaged wetlands, alkali meadows, vernal pools, grasslands, and riparian habitats.

### 4.4.1 Llano Seco Unit

The Service-owned lands of the North Central Valley WMA consist mostly of managed wetlands and grasslands (including irrigated pasture), with much smaller amounts of unmanaged wetlands, vernal pools, riparian habitats, and other floodplain habitats (Figure 11, Table 3).

The Llano Seco Unit lies within the flood basin just west of the Sacramento River’s active floodplain. The west half of Sanctuary I is comprised of perennial grassland and Valley oak savanna, which are bounded to the east by the riparian habitat of Angel Slough. East of Angel Slough, annual grassland and irrigated pasture gradually slope southeast down towards the wetlands. Sanctuary II lies to the east of Sanctuary I, and is comprised of annual grassland, vernal wet annual grassland, vernal pools, and managed wetlands.

The perennial grasslands here are characterized by creeping rye-grass, blue wild-rye, purple needle-grass, meadow barley, sedges and gumplant. Annual grasslands are characterized by short to medium stature forbs/non-native grasses and forbs such as foxtail barley, annual ryegrass, soft chess, rip-gut brome, wild oats, medusa-head grass, yellow star-thistle, dock species, and prickly lettuce. Within Sanctuary II, the annual grasslands are dotted with 11 restored vernal pools.

<table>
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<th>WMA Unit</th>
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<th>Managed Wetlands</th>
<th>Unmanaged Wetlands</th>
<th>Vernal Pool</th>
<th>Grasslands</th>
<th>Riparian Forest</th>
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<td>16</td>
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<td>0</td>
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<td>31</td>
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</table>

1 Official WMA acres.


3 Includes irrigated and non-irrigated seasonally-flooded wetlands.

4 Includes creeks, oxbows and sloughs.

5 Includes annual and perennial grasslands, vernaly wet annual grasslands, and irrigated pasture.

6 Includes mixed riparian forest, cottonwood willow, willow scrub, and valley oak riparian forest.

7 Includes roads, facilities, and other miscellaneous areas.
200 acres of irrigated pasture on the Llano Seco Unit is managed to provide short grass foraging habitat for sandhill cranes, waterfowl, and shorebirds. The vernally wet grassland found in Tract 17 is a former irrigated pasture which reverted to annual grassland when the previous landowners and managers ceased to irrigate it. A levee was constructed downslope at the end of the old pasture and a water control structure was installed at the southwest corner. The water control structure is managed to provide shallow ponding on about 25 percent of the pasture during late winter and early spring. This has resulted in abundant use by wintering waterfowl, especially wigeon, green-winged teal, Canada, white-fronted, lesser snow, Ross’s and cackling geese, sandhill cranes, shorebirds, and bald eagle. Additionally, after the first managed water cycle, Ferris’ milk-vetch was observed at the toe of the worn checks in the saturation zone above the shelves.

The Valley oak savanna that is found in the northwest corner of Sanctuary I consists of a native grass understory (purple needle-grass, creeping rye-grass, blue wild-rye) and open canopy of Valley oak, box elder, blue elderberry, and California rose.

The majority of the managed wetlands in the Llano Seco Unit are seasonal, with a few ponds being managed as semi-permanent, permanent, and irrigated seasonal wetlands. These wetlands are typified by moderate cover intermixed with areas of open water. Areas of moderate cover are composed of medium stature emergent and moist soil plants such as smartweeds, redstem ammania (*Ammannia coccinea*), watergrass, river bulrush, spikerush (*Eleocharis* sp.), Bermuda grass, jointgrass, and cocklebur. Areas of open water are commonly dominated with short stature moist-soil plants such as swamp timothy/pricklegrass spike primrose (*Epilobium pygmaeum*), loosestrife (*Lythrum hyssopifolium*), and popcorn flowers. Other common but less abundant plants include cattail, hard-stemmed bulrush, and white sweet clover. There are some scattered black willows and Fremont’s cottonwoods that occur in interior areas.

The mixed riparian forest of Angel Slough are densely vegetated by a mixture of trees, shrubs and vines such as black willow, cottonwood, sandbar willow, Oregon ash, valley oak, box elder, wild grape, poison oak, wild rose, and Himalayan blackberry.

### 4.4.2 Agricultural Easements

While production of commercial agriculture crops on easement lands is generally prohibited, it has been allowed on three easement properties in the North Central Valley WMA to support specific wildlife resources. The 594-acre Rancho Caleta agricultural easement was purchased in 2004 to maintain wildlife friendly crops to support migrating and wintering Aleutian Cackling Geese. This easement requires that a majority of the easement acreage be planted to corn, beans, winter wheat or rice to provide foraging habitat for geese. Greater sandhill cranes also use these lands regularly. Similarly, the Llano Seco Ranch easement allows a portion of the property to remain in irrigated pasture to provide foraging and or roosting habitat for migrating/wintering greater sandhill cranes and geese.
This agricultural practice was in place when the easement was purchased and is seen as important in maintaining roosting and foraging habitat for greater sandhill cranes and geese. Lastly, in 2010 the Birdhaven Ranch donated a 126-acre agricultural easement on rice lands it owns to help protect and complement wetland habitat on the ranch.

5. Habitat Management

Habitat management on the WMAs is relatively intensive, especially on managed wetlands. Many of the same vegetation and water management techniques used on Service-owned wetlands are also used on easement lands, although to varying degrees depending on the location. Maintaining biological productivity, controlling invasive species, and providing optimal water levels at proper times of the year requires regular “hands-on” management and physical manipulation of the ground, vegetation, and water.

On easement lands, habitat management is conducted largely by private landowners and their managers or caretakers. While the Service does not engage in active habitat management on easement lands, it does provide technical assistance, offers annual landowner workshops, and engages in research and monitoring to provide information related to habitat restoration, enhancement, and management issues. The Service is also responsible for reviewing and providing written authorization for certain habitat management activities that may affect the wetland character and migratory bird use of easement properties.

The primary management activities requiring Service authorization include wetland enhancement and restoration projects that involve the mechanical movement of earth, the removal or installation of water control structures, and the planting of vegetation not included on the current approved plant list (See Appendix C-U.S. Fish and Wildlife Service, Grant of Easement). When reviewing and authorizing management activities, the Service works closely with easement owners to ensure that projects meet the needs of owners and the habitat within the legal framework of the Grant of Easement. In addition, the Service also conducts annual easement compliance flights to ensure private lands are being managed in accordance with easement requirements.

The Service also helps facilitate habitat restoration and enhancement on easement lands through cost-share programs, habitat incentive programs, or other funding sources. Examples of programs active within the WMAs include North American Wetlands Conservation Act Grant Program (NAWCA), Partners for Fish and Wildlife Program, USDA-Wetland Reserve Program, and the CDFW California Waterfowl Habitat Program.

On Service-owned lands within the WMAs, wetlands and other habitats are managed by Sacramento National Wildlife Refuge Complex staff. There are approximately 40 separate management units on the Llano Seco and Butte Sink Units (USFWS 1988–2014). Intensively managed wetlands comprise the majority of those units, with lesser acres of grasslands, irrigated pasture, vernal pools, and riparian forest. Neither the Llano Seco Unit nor the Butte Sink Unit are hunted, however the Llano Seco Unit has a public use program including two observation platforms and a half-mile walking trail.

To more effectively maintain, manage, and monitor these units, a habitat management system was implemented in the early 1980s (Mensik and O’Halloran 1990). Refuge management is determined, guided, and tracked by an annual habitat management planning process (USFWS 2002a; USFWS 1988–2014, USFWS 2009). The annual cycle of this process starts in the spring with the generation of an Annual Habitat Management Plan (Appendix H) for each Refuge. Refuges are toured by staff in the late winter, during which each management unit is visited and evaluated. Staff on these tours includes the refuge manager, biologist, work leader, irrigator, outdoor recreation planner, fire management officer, and law enforcement officer. Each unit is evaluated based upon what was planned the previous year compared to what actually was accomplished in terms of management activities (such as water...
regimes, vegetation control, visitor service improvements), repairs (i.e., levees or replacement of water control structures), and the resulting habitat condition, wildlife use, or other resource data. Data and observations collected during the year are presented and discussed. Nearly all of this data is collected by unit, so it can be compared and evaluated. Examples include vegetation species composition, wildlife survey data, disease mortality, wetland drawdown and flood-up dates, vegetation control measures conducted (i.e., prescribed burning, disking), quality of visitor service opportunities (i.e., wildlife observation, hiking), and law enforcement issues. Annual Habitat Management Plans (Appendix H) are then generated for each of the Butte Sink and Llano Seco Units with participation, input, and review from the above staff. This process also involves a number of other considerations including, but not limited to, refuge purposes, Service management directives (i.e. Improvement Act), historic habitat conditions, other regional habitat plans (i.e., Central Valley Joint Venture Implementation Plan), Flyway management plans, endemic species conservation, endangered species recovery plans, and specific resource needs.

Data, reports, and documents that are used in the plan are stored and generated in a computer database. These plans identify individual management units that consist of tracts of land which have common management constraints, conditions, and visitor service activities. The habitat management plan identifies physical attributes of the unit, habitat objectives, specifies management activities to make any necessary repairs or improvements; emphasizes positive results from previous years; and notes special management considerations (i.e., presence of special status species or other significant wildlife use). It also prioritizes management activities and projects based on the overall condition and functionality of the unit, water management regimes (i.e., flood-up and drawdown schedules), and available resources such as manpower and funding. Examples of management activities include facilities maintenance (e.g., levees, water control structures, roads, fire breaks, fences, gates, boundary signs), vegetation management (e.g., herbicide application, prescribed fire, grazing, mowing and disking, irrigation), biological surveys, habitat restoration, research, visitor service monitoring and facilities maintenance, and law enforcement issues.

The result is a document that is distributed to all staff members for reference and to serve as a place to keep notes on their respective programs and responsibilities. Their information is then used to help assess implementation of the current year and generate the following year’s plan. In summary, the habitat management plan facilitates the adaptive management process. It allows for modification within or between years based on changing conditions, serves as a place to input current data from all Refuge programs to be considered together, and helps to ensure that informed management decisions are made.

### 5.1 Habitat Restoration

Many of the easement and Service-owned lands acquired within the WMAs are former
agricultural lands which require habitat restoration. When planning habitat restoration for specific properties a number of factors are taken into consideration, including: 1) the natural or historic hydrologic conditions, 2) the current availability of water, 3) the soil capabilities, 4) the location of the property with respect to existing habitat, and 5) the management objectives of private landowners and the Service. Since most easement and Service-owned lands are located in historic flood plains, have hydric soils, and have a migratory waterfowl management objective, wetlands are the primary habitat type restored. While the majority of properties are restored to wetlands, riparian forest and native upland habitats are also restored where appropriate and can be significant components of some restoration projects.

Since the natural wetland hydrology of the region has been severely altered, most properties have been restored to managed wetlands where wetland managers largely control the water management. Restoration of managed wetlands differs from natural wetlands in many respects, and generally includes the following practices: 1) removing unneeded levees, roads and water control structures; 2) constructing a water delivery and drain system to provide efficient and independent water management capabilities for each wetland; 3) excavating potholes and interconnecting swales within wetlands to create diverse wetland topography and enhance water management capabilities; 4) constructing perimeter levees, upland peninsulas, loafing islands and submerged berms within wetlands; 5) installing flash-board riser or screwgate water control structures in wetlands for precise and independent water control; 6) where appropriate, transplanting hard-stemmed bulrush to provide emergent cover for migratory birds and other wetland dependent species; 7) where appropriate, planting native cottonwood and willow tree cuttings throughout the wetland; and 8) where appropriate, planting native grasses on levees, peninsulas and islands. While other practices are often incorporated into wetland restoration projects the above activities represent the foundation of managed wetland restoration.

Riparian forest habitat is often incorporated into habitat restoration when properties have loam soils and are located near existing waterways/riparian habitat. In areas where the natural hydrology has been significantly altered, supplemental irrigation and weed

Table 4. **Approximate number of acre-feet of water required monthly for each acre of wetland habitat on Service-owned lands.**

<table>
<thead>
<tr>
<th>HABITAT</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Yearly</th>
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<tr>
<td>Seasonal wetland</td>
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<td></td>
<td></td>
<td>0.50</td>
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<td>2.00</td>
<td>1.00</td>
<td>0.75</td>
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<td>0.25</td>
<td>0.25</td>
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<tr>
<td>Irrigated seasonal</td>
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<td>1.00</td>
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<td>Permanent wetland</td>
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<td>13.25</td>
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</tbody>
</table>

1 This amount can vary widely based on weather and soils.
control during a three year establishment period is essential for successful restoration. Riparian forest restoration generally consists of: 1) disking and grading restoration area to prepare for planting; 2) installing an irrigation system to water plantings during the three year establishment period; 3) planting appropriate native trees and shrubs (see Approved Plant List in Appendix C for list of potential trees and shrubs); 4) installing tree protectors on each planting to protect from herbivores; 5) reducing weed competition through mechanical and or chemical control prior to and during the three year establishment period; and 6) removing irrigation system at the end of three year establishment period.

Lands that are out of the flood plain and/or cannot receive supplemental water are often restored to native uplands. Similar to riparian forest restoration, native uplands require weed management over a three year establishment period to ensure success. Native upland restoration generally consists of: 1) disking and grading restoration area to prepare for planting; 2) controlling non-native weeds (through mechanical and chemical methods) for at least one year prior to planting to decrease weed competition; 3) planting appropriate native grasses and forbs using a native grass no-till seed drill (see Approved Plant List in Appendix C for list of potential native grasses and forbs); and 4) controlling weeds by mowing or herbicide treatment during the three year establishment period.

5.2 Wetland Enhancement

The infrastructure of managed wetlands periodically needs to be enhanced or repaired to maintain productivity and management capabilities. A survey of resource professionals conducted by the CVJF indicated that the infrastructure of managed wetlands in the Central Valley should undergo some level of enhancement every 10 to 15 years (CVJF 2006). In addition to repairing and enhancing wetland infrastructure, there are a number of management activities that simply enhance the wildlife value of existing wetland habitat. Some of the more common wetland enhancement practices which help maintain wetland infrastructure and enhance wildlife values include: 1) replacing or installing new water control structures to enhance water delivery and water level management; 2) rebuilding or constructing new perimeter levees to safely and efficiently pond water; 3) rebuilding or constructing new islands and submerged berms to maintain loafing, nesting, and foraging habitat; 4) re-excavating or constructing new interconnected swales and potholes to diversify wetland topography, improve water delivery and improve wetland drawdown capabilities; 5) planting native emergent wetland vegetation to diversify vegetative structure and provide cover for wildlife (see Approved Plant List in Appendix C for list of potential emergent wetland plants); and 6) planting native riparian tree species to diversify vegetative structure and provide cover for wildlife (see Approved Plant List in Appendix C for list of potential trees and shrubs).

5.3 Water Management

Proper water management is considered essential to maintaining high quality wetlands and meeting the purposes, goals, and objectives of the WMAs. This includes maximizing benefits for wildlife, and enhancing feeding and resting areas for wintering waterfowl and other migratory birds.

Water management is the most important tool for vegetation production and control in wetlands. The water management regime, specifically the timing, depth, and duration of inundation, is often the greatest contributor to the resulting wetland vegetation, whether desirable or undesirable (Mensik and Reid 1995). Spring drawdown dates largely determine the species that germinate in seasonal wetlands (Strong et al., 1990). If drawdowns are conducted too early, less desirable cool season emergent vegetation and upland grasses will dominate. Conversely, if conducted too late, pond bottoms dry too quickly and wetland plant germination and survival may be poor. Water level management is also critical to providing
available foraging to a diversity of wildlife throughout the year (Helmers 1992; Isola 1998).
For example, providing a variety of shallow water levels from 0.3 to 13.4 inches (0.8 to 34 cm) offers attractive foraging habitat for most dabbling ducks (Heitmeyer and Raveling 1988) and shorebirds (Isola 1998). Conversely, deeper wetlands are needed to support diving birds, such as diving ducks, grebes, cormorants, and pelicans. Managed wetlands typically provide a range of shallow to deep-water areas, but restoration and enhancement techniques (Strong et al., 1990) are used to create and maintain this diversity in previously leveled sites.

Most managed wetlands are maintained as man-made impoundments, using water that is delivered through local irrigation districts, pumped from adjacent waterways or pumped from deep wells. Most wetlands are flooded up and drawn down with near complete control through inlet and outlet structures. Adequate flows of water through wetland units are maintained to promote good water quality and, at Butte Sink WMA and portions of the North Central Valley WMA, to provide passage for migrating juvenile salmonids. On Service-owned lands, flooding regimes are designed to mimic historic wetland patterns as closely as possible, given water availability. Easement wetlands have a similar pattern, but fall flood-up schedules are often determined by the opening of waterfowl hunting season (typically mid-October).

The approximate amount of water needed each month to manage various wetland habitat types is based upon when they are flooded and how long they are maintained over the course of a year (Table 4).

5.3.1 Seasonal Wetlands

During the fall and winter months, water levels in most seasonal wetlands are kept relatively shallow (≤12 inches), with portions of some units up to 36 inches. In the spring, water levels in individual seasonal wetlands are slowly drawn down to mostly mudflat, ideally over a period of 10 to 20 days. These drawdowns are staggered over the period of March-May, with peak drawdown acres occurring in April to coincide with the spring shorebird migration and when conducive to moist soil plant germination conditions. As water is removed, migrating shorebirds and other waterbirds utilize the shallow water areas and mudflats to feed on invertebrates, fish, and other food items that are concentrated in the receding water. Seed-producing moist-soil plants germinate and grow to maturity on the moist pond bottoms during the spring and then remain dry for most or all of the summer. During this dry period, any prescribed vegetation management such as disking or mowing will be conducted. In the fall, seasonal wetlands are flooded between late August and November, making wetland habitat available to fall migrating birds and other wildlife as their numbers increase. Flood-up and drawdown schedules on Service-owned management units are generally coordinated, where private wetlands are more independent of each other; however, they do occur at the same general time as Service-owned lands.

5.3.2 Irrigated Seasonal Wetlands

An irrigated seasonal wetland is simply a seasonal wetland that receives late spring or summer irrigation as part of the management regime. Irrigated seasonal wetlands are usually drawn down between March and May to germinate moist-soil plants such as smartweed and watergrass. Typically a single irrigation is applied sometime between May and early July, depending on weather patterns and phenology (stage of growth) of target beneficial plant species (Mensik 1993b) or target pest plant species (Mensik and Reid 1995). Rapid irrigations are desirable, ideally lasting 7-10 days (Olson in draft) to minimize both mosquito production and the growth of undesirable plant species such as jointgrass or Bermuda grass (Kwasny et al., 2004). Properly timed irrigation can also be an effective tool to control cocklebur, as small plants cannot withstand extended flooding (see more in section 5.2.5).

During irrigation and drawdown periods, these wetlands are readily used by duck broods, long-legged waterbirds and shorebirds (e.g., egrets, herons, ibis, long-billed
curlews, black-necked stilts), and giant garter snakes, among other species, for foraging and cover. Following irrigations, wetlands remain dry until flooded up in the fall, sometime between August and November. During this dry period, any prescribed vegetation management such as disking or mowing will be conducted. These habitats provide abundant seed food resources for wintering waterfowl, help to reduce fall crop depredation on surrounding agricultural crops, are used extensively by white-faced ibis for night roosts, and support good numbers of secretive waterbirds such as American bitterns and rails.

On Service-owned lands, irrigated seasonal wetlands currently comprise approximately 10-15 percent of all managed wetlands. While no accurate survey exists, we estimate that over 70 percent of the seasonal wetlands on easement properties may receive annual spring and or summer irrigations to promote the production of moist-soil vegetation.

5.3.3 Semi-permanent and Permanent Wetlands

Semi-permanent wetlands are kept flooded into the summer and then drawn down in mid-July to mid-August, after the breeding season of most migratory birds. Staggered drawdowns on these units during this time attract and support shorebirds during important fall migration periods (CVJV 2006). Newly available and concentrated prey created during these drawdowns also provide significant foraging for breeding and post-breeding herons, egrets, ibis, and a variety of other waterbirds. The units are then re-flooded during mid-to-late fall.

Permanent wetlands are flooded and maintained throughout the year. They may be maintained for up to five years or more. Without periodic drawdowns however, their productivity decreases over time. In addition, emergent vegetation grows relatively fast, and its density can become a problem. Excessive carp populations can also become detrimental to aquatic vegetation and light penetration. As a result, these wetlands are typically drawn down every three to five years to recycle nutrients, discourage carp populations, and conduct any required infrastructure maintenance or vegetation control.

Semi-permanent and permanent wetland water depths range from 12 to 48 inches. Water levels are maintained at consistent levels, to the extent possible, to minimize negative impacts to birds that build their nests over the water, growth of undesirable vegetation, and mosquito production. A flow-through of water is also desirable to maintain water quality, reduce potential for avian botulism outbreaks, and help control some undesirable species (e.g., *Azolla* sp.). During the non-growing season (i.e., November-April, varies with year), both semi-permanent and permanent wetlands can be drawn down to shallower water levels to encourage use by wintering waterfowl and other wildlife. This strategy is common on both easement and Service-owned wetlands.

Rotation of wetland water regimes in managed wetlands may be employed periodically to encourage growth of emergent or other desirable plants in sparsely vegetated units. For example, a seasonal wetland may be converted to a semi-permanent or permanent wetland for a season to encourage additional bulrush or cat-tail to enhance certain wildlife use or diversity.

5.3.4 Vernal Pools and Alkali Meadows

Management of vernal pool and alkali meadow habitat is much less intensive than managed wetlands. Water management on vernal pools/alkali meadows is not artificially manipulated and, in fact, special emphasis is made to restore and maintain natural hydrology as much as possible (Silveira 2007; USFWS 1999b; Ducks Unlimited 2005a, 2005b, 2008). These areas are allowed to flood and dry naturally, based on precipitation or natural flood events and evaporation. This cycle is what helps maintain the abundance and variety of rare and endemic plant and animal species that exist on these sites. Prescribed grazing, burning, and some spot herbicide treatments may be used to control non-native vegetation and enhance native species. Methods
that result in excessive soil disturbance (i.e. disking), even for fire breaks, are avoided.

Within the WMAs, vernal pools are only known to currently exist at the Llano Seco Unit and the Llano Seco Ranch Easement. Alkali meadow habitat is present but uncommon in the Willow Creek-Lurline WMA.

5.3.5 Water Management on Easements

Water management on easement properties is largely controlled by the landowner and the Service has little direct involvement on individual easement properties. However, the Service does provide technical assistance to easement landowners regarding water management and does encourage easement properties to enroll in various incentive programs (California Waterfowl Habitat Program, Conservation Reserve Program, etc.) that require landowners to follow wetland/water management plans.

Currently, 90 percent of the habitat acreage enrolled in the Service easement program is considered managed wetlands (CVJV 2006). While water management on these areas can change on an annual basis, it is estimated that 90 percent of easement wetlands are managed as seasonal wetlands and 10 percent are managed as semi-permanent or permanent wetlands (CVJV 2006).

While the Service is not directly involved with water management, we reserve the right to flood easement properties to historic levels (using any of the properties water resources) from October 1 to March 1, if the landowner fails to do so. To this end, enough water must be maintained with easement lands to flood the wetlands during this time period. While this amount of water will differ by property, it is generally assumed that it will take approximately 4 acre-feet per acre to flood wetlands during this time period. To date, this right has not been implemented, and it would be at the Service’s expense if executed.

5.3.6 Water Management on Service-owned Lands

Sacramento NWR Complex staff has responsibility for water management on Service-owned lands, including the Butte Sink and Llano Seco Units. Because water management is the most critical element to maintaining wetland quality, there are dedicated irrigators on staff for both Llano Seco and Butte Sink Units.

At the Butte Sink Unit, there is not much control over when water is available in the fall. Per the 1922 Agreement (sections 3.2.1 and 3.2.1.1), agricultural drainwater is used to flood upstream private wetlands, and when it reaches the Butte Sink Unit, it must be taken. Service-owned wetlands are flooded, and the water is allowed to flow through onto the Colusa Shooting Club, which is also part of the Agreement. Depending on flows, all of the managed wetlands are flooded on the Butte Sink Unit within 2-3 weeks. Wetlands will remain flooded until March or April, then drawn down. Precipitation, run-off, and subsequent natural flood events may alter planned water schedules, and in some
wet years natural flood events may keep the
majority of the Butte Sink flooded until May or
June. Occasionally, one of the smaller units may
be maintained as semi-permanent into the sum-
mer using the lift pump located on Butte Creek.

At the Llano Seco Unit, water is typically
applied to managed wetlands in the fall begin-
ing October 1. This water regime is about one
month later than most other Service-owned
wetlands on the Complex, with the primary
intention to help minimize mosquito produc-
tion and subsequent pesticide applications by
the local mosquito and vector control district.
Most of these wetlands remain flooded until
spring, and typically 1-2 units will be main-
tained as semi-permanent into the summer
to improve marsh vegetation structure and
provide food, cover and breeding habitat for
waterfowl and other waterbirds. In addition,
one unit is maintained as irrigated pasture
and grazed by cattle to provide waterfowl/
waterbird habitats; it is irrigated by Llano Seco
Ranch under a Cooperative Land Management
Agreement a number of times over the summer.

5.4 Vegetation Management

Vegetation management is relatively com-
mon on the WMAs, and is used to control
the abundance/distribution of certain plant
species and to enhance desirable plant spe-
cies (Mensik 1990; Mensik and Reid 1995).
A number of invasive species (Appendix F)
occur throughout the WMAs’ habitat types
and infrastructure (e.g., canals, levees,
roads), requiring different levels of control.
The Central Valley’s mild climate creates a
year-round growing season that results in
the germination and expansion of a variety
of undesirable species throughout the year.

Reasons for vegetation management include
maintaining biodiversity, maintaining desirable
proportions of emergent vegetation and moist
soil food plants in wetlands, enhancement of
desirable species, reduction of invasive and
other undesirable species, preparation for
habitat restoration projects, reducing mos-
quito breeding habitat, and maintenance and
safety around facilities including protecting

5.4.1 Prescribed Burning

Prescribed burning is used in wetland, vernal
pool/alkali meadow, and grassland habitats to
remove hazardous fuel loads, control non-nat-
ive invasive species, as well as to enhance and
maintain habitat values. Burning in wetland
areas is generally used to reduce perennial
vegetation that has expanded to a point that
decreased wildlife use and overall productivity
has resulted. Examples include wetlands where
expansion of hard-stemmed bulrush (tule) and
cattail growth have exceeded the optimum pro-
portion of emergent vegetation and open water,
or where invasive Bermuda grass or jointgrass
has replaced the majority of desirable annual
moist soil food plants, thus reducing the use by
many wildlife species (Mensik 1990). Prescribed
burns can also serve to break up large stands
of continuous fuel beds that can result in larger
more destructive wildfires. Prescribed burns
can be applied to managed wetlands during
different times of the year, depending on con-
ditions and habitat objectives. Both dry and
overwater burning can be successful. Fire lines
are created around the burn area and around
any sensitive areas to be saved. The firing pat-
ttern allows for an avenue or direction of escape
for wildlife. Follow-up disking is often used after wetland burns to ensure that roots of target species (e.g., hard-stemmed bulrush, cattail, jointgrass) are killed and enhance germination of desirable species (Mensik 1990; Mensik and Reid 1995). The objective is a desirable mix of vegetation species, stature, and distribution; a recycling of nutrients; and a successional stage that is more productive and reduces the risk to life and property from larger more destructive wildfires. The frequency of burning wetland units depends on habitat type, vegetation species composition, soil type, and tendency for growth. In some cases, this may be as often as once every five years.

Prescribed burns in grasslands, alkali meadows, and vernal pools are used to reduce invasive species and stimulate native plant species (Pollak and Kan 1998; Wight 2002). Resource benefits include maintaining biodiversity (especially native plant communities and the wildlife they support), providing browse for waterfowl, and general maintenance of habitat for short grass wildlife species (e.g., sandhill crane, meadowlark, Swainson’s hawk, burrowing owl). These burns also reduce the risk of large unwanted wildfires by reducing the accumulation of hazardous fuels and establishing a mosaic of fuel loads. Burns may occur at any time of year, depending on specific objectives and condition of the habitat. Fall or winter burns are usually used when sensitive plants are present because they are dormant at that time. For optimal control of non-native annual grasses, it is most effective to burn in the late spring/early summer, when seeds remain on the plants and can be easily consumed by the fire.

More information about prescribed fire policy and use on Service-owned lands is provided in section 5.2.9.

5.4.2 Disking

Disking is an important management tool that has a variety of uses. It is commonly used in managed wetlands to reduce vegetation that has exceeded beneficial quantities or distributions required for wildlife use objectives. By itself, or in combination with burning, spraying or grazing, disking helps control bulrushes, cattails, Bermuda grass, jointgrass, water primrose (*Ludwigia* sp.), and other perennial plant species (Mensik 1990; Mensik and Reid 1995). In addition to controlling undesirable plants, disking also creates a seedbed conducive to both increased germination and seed production of desirable moist soil plants in seasonal wetlands (Naylor 2002). Caution must be exercised in some wetlands, where disking can enhance or spread invasive species, such as cocklebur and perennial pepperweed. Disking is often used in thick vegetation to create openings that facilitate increased bird use, disease monitoring and carcass removal, and enhanced wildlife viewing opportunities. Loafing areas can be greatly enhanced by disking vegetation on islands or interior levees. As the use of prescribed burning has declined due to local air quality restrictions, disking has become a more frequent vegetation control option. Disked fuel breaks are used in appropriate areas to protect life and property from the spread of wildfire off of and onto the Service-owned lands.

Disking is typically conducted during late spring, summer or early fall months when wetlands are dry. Target species/areas may be disked one or more times to ensure that roots are dead, reducing the need for more frequent treatments. Vegetation succession is set back in disked areas, and typically desirable moist soil plants and open water areas replace the species that are removed. Multiple disk passes are sometimes necessary.
to break up large clods and prepare a seed bed for optimal moist-soil plant germination.

Circumstances dictate how much of an area will be disked. In most cases, a mosaic pattern is created, leaving equal proportions of emergent cover plants and open areas with annual moist soil plants. The amount left undisked may be altered if special needs for certain species are identified (Mensik and Reid 1995). Examples include leaving more emergent vegetation in units that have historical use by colonial nesting birds, such as tricolored blackbirds or white-faced ibis, or leaving less vegetation in units that support large numbers of open water species, such as pintails or shorebirds. In cases of widespread problem vegetation, sometimes the most cost-effective treatment is for the majority of a unit to be disked, realizing that the benefits will last a minimum of 3 to 5 years (Mensik and Reid 1995).

**5.4.3 Mowing**

Mowing is used to control a variety of invasive species, enhance wetlands, reduce fire risk, and accomplish general weed maintenance around facilities. It is usually conducted with a tractor pulling a large mowing implement, but may also be accomplished with smaller equipment, such as push mowers or weed eaters.

Mowing is a common technique used to create an optimal mosaic of open water to emergent vegetation that attracts migratory birds. It is also used for keeping islands and selected sections of levees clear of vegetation for optimal loafing and resting sites for waterfowl, shorebirds, and other wildlife. In wetlands, mowing is a primary tool for controlling cocklebur, an invasive species that can overtake seasonal wetlands and crowd out more desirable species (Mensik and Reid 1995). By mowing prior to the plants setting seed, cocklebur can be kept under control, resulting in a greater diversity of desirable species, while reducing the need to use herbicides.

Invasive vegetation in upland habitats can also be managed with mowing, although burning or grazing are preferred in most cases. Yellow star-thistle and non-native grasses such as annual ryegrass can be significantly reduced by mowing, but timing is critical (Thomsen et al., 1997).

Roads, levees, and areas around buildings and other facilities are mowed during the spring and summer to minimize risk of wildfires by allowing safer access to complete habitat management tasks (i.e. checking water control structures), conduct biological surveys, and perform general maintenance.

**5.4.4 Spraying**

There are situations where herbicide treatments are the most effective, efficient, and least disturbing method to control unwanted vegetation. Other methods listed in this section such as mowing, disking, burning, or grazing will not work to control all species, may not be appropriate to use in some areas, may cause more weed problems due to soil disturbance, may not be cost effective, or otherwise may be inefficient. There are a variety of herbicides available to treat invasive or otherwise undesirable plant species to improve habitat quality. Herbicides can be used to control a wide range of perennial and annual plants. Most formulations are only for use on terrestrial (dry) areas, but there are also some that are approved for use around water for aquatic species such as invasive water primrose. There are also herbicides that are selective for certain broadleaf plants that will not harm grass or bulrush species. Products such as 2-4,D can be effective in controlling yellow star-thistle, black mustard, and a host of other broadleaf plants in native grass restoration sites without harming the grasses. There are also a number of ways herbicides can be applied to precisely target certain species. For example, a cut-stump application (cutting the stem and “painting” the stump) may be the most effective way to achieve control on some non-native trees such as Eucalyptus species.

**5.4.5 Water Management (for vegetation control)**

As described in section 5.1, water management is the most important tool for vegetation enhancement and control in wetlands. The
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Timing, depth, and duration of flooding can be manipulated to enhance desirable moist soil plants and reduce certain undesirable species. Short-term irrigations (7-10 days) conducted in the spring and summer can greatly increase the amount of moist soil plant seed production (Naylor 2002) and vegetative stature in seasonal wetlands. One irrigation is typically all that is necessary to bring seedling plants to maturity.

Cocklebur, a common invasive species in seasonal wetlands, is particularly susceptible to control by flooding (sometimes referred to as "scalding") at a critical point in its life cycle. As with many desirable species, such as watergrass or smartweeds, cocklebur seedlings also germinate on seasonal wetland pond bottoms as they dry in spring. To control cocklebur, re-flooding the wetlands for one to two weeks at the right time can kill young cocklebur plants, while at the same time encouraging the growth of desirable species. This technique can also be used on white sweet clover, another common undesirable species in managed seasonal wetlands.

While irrigations can be used effectively for vegetation control and enhancement, prolonged or too frequent irrigation can cause problem species such as Bermuda grass or jointgrass to rapidly encroach, resulting in decreased overall productivity for wildlife and potentially unacceptable levels of mosquito production.

5.4.6 Vegetation Restoration

Where appropriate, and depending on the habitat and wildlife objectives, native vegetation is restored on the WMAs using a variety of grasses, forbs, shrubs, or tree species. Planting seeds, plugs, and cuttings are the most common methods for establishing native vegetation. The use of the most local genetic stocks for any plantings helps to increase the chance of success. Native species are used exclusively for restoration plantings on Service-owned lands. For easement lands, the Service provides and attaches to the Grant of Easement documentation a list of approved plant species, which includes both native and wildlife-friendly non-native species that landowners can plant without Service authorization.

5.4.7 Prescribed Livestock Grazing

Historically, grazing by native wildlife species has shaped the botanical and zoological resources of the California landscape (Edwards 1992, 1996). Currently, well managed livestock grazing is an important method of vegetation management (Barry 2003; Griggs 2000) on the Complex. The grazing program provides many benefits for vegetation and wildlife habitat management, such as the reduction of thatch and standing dead plant materials and the reduction of non-native invasive weeds (Thomsen et al., 1993). Native plants, including special status plant taxa, increase due to reduced competition for sunlight and reduced competition with non-native annual grasses for water and nutrients (Coppoletta and Moritsch 2001; Davis and Sherman 1992; Menke 1992; Muir and Moseley 1994). Grazing increases primary production which also increases plant biomass (McNaughton 1985). Cattle grazing increases native vernal pool flora and prolongs the hydroperiod (time inundated), which is beneficial to vernal pool macro-invertebrates (Marty 2005; Pyke and Marty 2005). With the reduction of non-native annual grasses, flowering plants increase and evapotranspiration decreases and this increases both terrestrial and aquatic macro-invertebrate populations—specifically native pollinators of native vernal pool and grassland plants and invertebrate prey items for refuge wildlife such as migratory birds. Grazing provides optimal shorebird and sandhill crane foraging habitat by reducing grass height and contributing organic matter for the prey base (Colwell and Dodd 1995; Knopf and Rupert 1995) and also provides short, nutritious grasses for grazing migratory waterfowl (Buchsbaum et al., 1986) and local deer. Aquatic invertebrates, insects, and special status species associated with vernal pool and vernal pool/alkali meadow complexes benefit from grazed herbaceous habitats (Bratton 1990; Bratton and Fryer 1990; Panzer 1988; Germano et al., 2001), especially cattle grazing (Marty 2004, 2005; Wingo 2009). Grazed areas support
increased numbers of primary burrowing mammals such as the California ground squirrel and secondary burrowing animals, such as burrowing owls and various snakes. Periodic grazing can also lessen the threat of wildfire near rural structures and agricultural industrial facilities.

Grazing also has the potential to negatively impact some habitats and wildlife, including reducing nesting cover for ground nesting waterfowl and songbirds, (Kirsch 1969; Krueper 1993), as well as for the northern harrier and American bittern. Grazing in wetlands could also reduce moist-soil seed production and seed availability to waterfowl (reference). Mammals which burrow through thatch, such as California meadow vole, would likely decrease with grazing. However, these impacts would be short-term due to seasonal grazing rotations associated with the Refuge grazing program (Appendix B, Grazing Compatibility Determination). Grazing plans are developed annually for the Llano Seco Unit. The plan, which is developed by the wildlife refuge manager, wildlife biologist and grazing cooperator, provides grazing targets and prescriptions for each tract and includes specific projects associated with plan implementation.

5.4.8 Vegetation Management on Easements

Vegetation management on easement properties is largely controlled by the landowner and the Service has little direct involvement in managing vegetation on individual easement properties. Easement landowners are allowed to use a number of vegetation management practices on their properties including: disk- ing, mowing, spraying, burning and grazing. These practices can be used to control woody and herbaceous vegetation that encroach on wetlands and interfere with the use of easement lands as waterfowl and migratory bird habitat. While not directly involved, the Service does provide technical assistance to easement landowners regarding vegetation management and does encourage easement properties to enroll in various incentive programs (California Waterfowl Habitat Program, Conservation Reserve Program, etc.) that require landowners to implement various vegetation management practices. Responsibility for prescribed fire remains with private property owners and local fire departments unless a specific fire management agreement transfers that responsibility to the Service.

The most common vegetation management techniques used on easement lands are disk- ing, mowing and spraying. These practices are commonly used to control invasive species, set back the seral stage of wetlands, promote the growth and production of beneficial most-soil plants, and to provide open water habitat for waterfowl and other migratory birds. Another common practice on easement wetlands is to discourage cocklebur growth through extended irrigations in spring/summer (water management). Once very popular, this vegetation practice has fallen from favor in some areas because of mosquito production concerns. While some easement properties use prescribed burns to control emergent vegetation, most easement owners are discouraged by the liability and air quality issues associated with burning. Finally, while a few easement properties graze cattle to control vegetation, most properties do not have the infrastructure necessary for managed grazing and many easement owners feel cattle compete directly with wildlife for food and cover.

5.4.9 Vegetation Management on Service-owned Lands

On Service-owned lands, vegetation management is a primary component of the Annual Habitat Management Plans, where control and enhancement objectives are identified and treatments are prescribed to achieve them. Prescribed fire, mowing, disk- ing, spraying, water management, and vegetation restoration are all techniques used for vegetation management on both the Butte Sink and Llano Seco Units (see sections 5.2.1-5.2.6). The Complex has an Integrated Pest Management (IPM) Plan (USFWS 2009) that identifies the most effective and environmentally friendly strategies and techniques to control certain vegetation species on Service-owned lands.

To date, grazing (section 5.2.7) has only been used on the Llano Seco Unit, which has
implemented an annual grazing plan for more than 20 years in order to control invasive species, enhance native plants, and maintain short-grass habitat. Grazing is facilitated through the Cooperative Land Management Agreement (CLMA) or Refuge Special Use Permit (SUP) with a private cooperator. Benefits of the CLMA program are the cooperator’s shared responsibilities in maintaining corals, fences, gates, cattle water systems, conducting pasture irrigations, and vegetation management/invasive weed control.

On Service-owned lands, prescribed burns are conducted in accordance with both Department of the Interior and Service Fire Management Policy (621 FW 1-3 of the Service Manual). Use of prescribed burns for habitat management and hazardous fuel reduction is consistent with both the approved habitat and Fire Management Plans for the Complex (USFWS 2009, Appendix J). All prescribed burns will be planned, implemented, and managed in accordance with all applicable policy, guidance, and standards including:

- Prescribed Fire Complexity Rating System Guide (NWCG, NFES 2474, PMS 424)
- Prescribed Fire Smoke Management Guide (NWCG, NFES 1279, PMS 420-1).
- NWCG PMS 310-1 Wildland Fire and Prescribed Fire Qualifications System Guide.

A total of 509 acres have been treated with prescribed burning at the Llano Seco Unit from 2000 to 2009, with a range of 0-413 acres burned annually. To date, prescribed burning has not been used at the Butte Sink Unit.

### 5.5 Control of Invasive, Exotic, or Pest Species

It is necessary to control certain plant and animal species that have undesirable effects on WMA wildlife, plants, and their habitats or that pose a health risk. Invasive plant species compete with desirable plants for space, sunlight, nutrients, and water. They have detrimental effects on the distribution and abundance of plants that are important to wildlife as food, shelter, and nesting areas. In some cases, certain plants may be desirable in modest proportions, but can be detrimental to diversity and productivity if they become dominant.

#### 5.5.1 Control of Invasives on Easements

Landowners are not required to control invasive species on their easement lands; however it is generally in the best interest of the habitat to do so. To this end, the Service provides technical assistance, and, in some cases, cost-share funding to help easement owners control invasive species on their properties.

The most common invasive plant species occurring on easement wetlands include Bermuda grass, jointgrass, cocklebur, water primrose and water fern (*Azolla mexicana* and *A. filiculoides*). Bermuda grass, jointgrass and cocklebur are most commonly found in managed seasonal wetlands where they can out-compete more beneficial moist-soil plants and emergent wetland vegetation. These plants can generally be controlled using wetland management techniques such as disking and water manipulation. Water primrose and waterfern are primarily found in semi-permanent wetlands, permanent wetlands and irrigation ditches, but can also invade seasonal wetlands. They are aquatic weeds that can cover wetlands and ditches, out-competing beneficial vegetation and impeding water management. Being aquatic in nature, these species are harder to control,
but there has been some success with water manipulation (occasionally drying impacted areas) and chemical treatment with herbicides certified for overwater use. There are currently ongoing studies to investigate management and control of water primrose in the Sacramento Valley (Grewell et al., in draft) and waterfern in the Butte Sink (USFWS 2010).

The most problematic invasive plants occurring on easement uplands are yellow star-thistle and perennial pepperweed. Yellow star-thistle most often dominates dry upland habitats that receive little flooding, while perennial pepperweed often invades upland habitats located in active flood plains. The immediate control of these plants is generally achieved with the application of chemical herbicides, while the long-term control is often accomplished by restoring native perennial grasses which out compete the invasive weeds. The Service often cost-shares with easement landowners to restore native grasses in upland areas impacted by these invasive plants. Herbicide use is not controlled by the Service on easement lands, but applicators must comply with product labels and standard Federal and State regulations.

5.5.2 Control of Invasives on Service-owned Lands

On Service-owned lands, when plants or animals are considered a pest, they are subject to control if the pest organism represents a threat to human health, well-being, or private property; the acceptable level of damage by the pest has been exceeded; State or local governments have designated the pest as noxious; the pest organism is detrimental to primary Refuge objectives; and the planned control program will not conflict with the attainment of Refuge objectives or the purposes for which the Refuge is managed (7 RM 14.2 of the Refuge Manual). All of the same techniques that are described for use in vegetation management in section 5.2 (fire, mowing, disking, spraying, water management, restoration, grazing) are also used to control invasive species.

The Service Pest Management Policy goal (30 AM 12.1 of the Administrative Manual) is to eliminate the unnecessary use of pesticides through the use of Integrated Pest Management (IPM). IPM uses a combination of biological, physical, cultural, and chemical control methods (30 AM 12.5 of the Administrative Manual). This approach notes environmental hazards, efficacy, costs, and vulnerability of the pest. An Integrated Pest Management Plan has been developed for the Complex (USFWS 2009) to control invasive, exotic, or pest plant species. This plan applies to Service-owned lands, but the information is shared with private landowners where appropriate and applicable.

When mechanical or biological methods are ineffective or impractical, herbicides may be used for invasive plant control. All herbicide use is reviewed and approved through the same Pesticide Use Proposal (PUP) process (7 RM 14 of the Refuge Manual). A PUP is prepared for each material used. It identifies target species; reason for application; application rate, timing, and method; sensitive areas and species that may be affected and measures to avoid impacts to them. PUPs are reviewed and can be approved by the refuge manager, regional office, or Washington office, depending on the type of material used. For more information, see the Integrated Pest Management (IPM) Plan for the Complex (USFWS 2009).

The most common invasive species controlled on Service-owned lands are similar to those on easement lands (section 5.3.1), but the Complex’s IPM Plan (USFWS 2009) identifies a more comprehensive list of invasive species of concern that are controlled on Service-owned lands (Appendix F). Specifically on the Butte Sink Unit, Bermuda grass and cocklebur are continuous problem species. The high water table and annual re-supply of new seeds and rhizomes of these species during flood events results in annual efforts to keep them under control. Bermuda grass and cocklebur are also common species at the Llano Seco Unit, with the addition of water primrose. A combination of burning, mowing, disking, spraying, and water management
are generally used to control these wetland pest species. At the Llano Seco Unit, upland species are abundant, and there is comparatively more emphasis on controlling upland pest species such as yellow star-thistle, milk thistle (*Silybum marianum*), and perennial pepperweed. A combination of burning, spraying, vegetation restoration, and grazing are effective in managing upland pest species.

### 5.6 Mosquito Management

Local mosquito and vector control districts have identified a need to conduct mosquito monitoring and, if necessary, control activities on easement and Service-owned lands in order to protect the public from mosquito borne diseases. While mosquitoes are considered a nuisance because of their biting, some species are known vectors of serious diseases in California. There are primarily four mosquito species of concern that are potentially produced or harbored on easement and Service-owned lands: *Culex tarsalis*, *Aedes melanimon*, *A. nigromaculis*, and *A. vexans*.

Although 15 mosquito-borne viruses are known to occur in California, only West Nile virus (WNV), western equine encephalomyelitis virus (WEE) and St. Louis encephalitis virus (SLE) are significant causes of human disease (California Dept. of Public Health et al., 2015). *Culex tarsalis* is the main vector identified in the transmission of these diseases. The other mosquito species listed above can also potentially transmit WEE, SLE, and WNV, but are less competent vectors compared to *C. tarsalis*. Historically, *Aedes melanimon*, a common floodwater mosquito, played a role in a secondary transmission cycle of WEE involving rabbits. Additional mosquitoes such as *Aedes vexans* could be important bridge (i.e. bird to mammal) vectors in transmission (California Dept. of Public Health et al., 2015). Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of WNV across the United States, and its detection in California in 2003.

The Service’s 2009 CCP for the Sacramento, Delevan, Colusa and Sutter NWRs includes an IPM Plan for Service-owned lands. The IPM Plan outlines a risk-based, hierarchical approach to mosquito management (USFWS 2009). This approach uses an understanding of mosquito biology and ecology whereby intervention measures depend on continuous monitoring of mosquitoes.

The IPM approach ensures legitimate human, fish, and wildlife health concerns are addressed. It incorporates a combination of using best management practices (BMPs) in managed wetlands (Kwasny et al., 2004), biological controls, and a select group of pesticides, if warranted. Treatment thresholds (i.e., adult and larval mosquito population levels, and disease activity) and appropriate corresponding responses are identified in the compatibility determination for mosquito monitoring and management (Appendix B). Under this program, if mosquito monitoring and disease surveillance indicate that human health thresholds are exceeded, the use of larvicides, pupacide, and/or adulticides may become necessary. In some cases, emergency actions may be required.

The Service understands that mosquitoes are a natural component of wetlands, but we also recognize that they may pose a threat to human and/or wildlife health. NWRS policy allows native mosquitoes to exist unless they pose a specific wildlife and/or human health threat. The Refuge Complex staff works cooperatively with the local mosquito and vector control districts (MVCD) to manage mosquito populations on the Service-owned lands within the WMAs. The Refuge Complex is striving to responsibly address risks to public health and safety and to protect trust resources from mosquito-borne diseases and the impacts of mosquito pesticides on wildlife and the ecosystem. Currently, there are varying levels of mosquito control that occur; depending on location, annual conditions, such as weather and detection of disease. Depending on the local MVCD, larvicides or adulticides may be the preferred control method if wetland management techniques are unsuccessful. Adulticide use is particularly
common in the Butte Sink WMA, with aerial applications made regularly in the fall. In the upper Butte Basin, larvicide use is more common. The level of mosquito control activities in other parts of the WMAs is largely unknown and not regulated by the Service. Impacts to non-target species are still a major concern, particularly to aquatic invertebrates and anadromous fish in the Butte Creek system.

5.6.1 Mosquito Management on Easements

Mosquito control is conducted by local MVCDs on easement lands within the WMAs in accordance with the California Health and Safety Code (CDPH 2012). Under this process, landowners may be charged for mosquito control activities by the MVCDs. While easement owners retain responsibility for managing mosquitoes on their lands, the Service does not have the authority to control these activities; however, it works cooperatively with landowners and MVCDs to provide technical assistance to help reduce mosquito production on easement properties. In 2004, Refuge Staff and the CDFW worked with the Mosquito and Vector Control Association to produce the “Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands of California”. This document was published by the Central Valley Joint Venture (Kwasny et al., 2004) and distributed to all easement properties. The goal of this publication was to provide wetland management options and techniques that minimized mosquito production while maintaining productive wetlands. In addition to the publication, Refuge staff and MVCD representatives have given multiple presentations on mosquito control and best management practices at the Refuge’s annual landowner workshops.

The Service coordinates with local MVCDs in planning wetland restoration and enhancement projects within their jurisdiction and provides them with the opportunity to comment on project plans. The Service has also met in the field with easement landowners and MVCD representatives to cooperatively address specific mosquito control issues on easement properties.

The Butte Sink WMA is within the jurisdiction of the Butte County MVCD and the Colusa Mosquito Abatement District. The Butte County MVCD is responsible for the northern portion of the Butte Sink WMA which lies in Butte County, while the Colusa Mosquito Abatement District (MAD) is responsible for the southern portion which lies in Colusa and Sutter Counties. Both districts promote the use of best management practices to reduce mosquito production on wetlands, however when mosquito population thresholds are exceeded they will use chemical pesticides to control mosquito production. Both Butte County MVCD and Colusa MAD annually apply chemical pesticides to easement wetlands at the cost of the landowner. Butte County MVCD has traditionally treated easement wetlands during summer irrigations and fall flood-up with larvicides, while Colusa MAD has aerially applied adulticides during the fall flood-up.

Given its large size, the North Central Valley WMA falls within the jurisdiction of many different MVCDs. Generally, easement lands in the Butte Basin are covered by the Butte County MVCD, lands in the Sutter Basin are covered by the Sutter-Yuba MVCD, and lands in the Yolo Basin are covered by the Sacramento-Yolo MVCD. While the MVCDs promote the use of best management practices, they will treat easement wetlands with chemical pesticides if mosquito production thresholds are exceeded. The type of pesticides used and associated cost to landowners will vary between years and MVCDs involved.

Easement lands within the Willow Creek-Lurline WMA may be subject to mosquito control by local MVCDs under certain circumstances. Historically, there have not been significant issues with mosquito production on easement wetlands in this area, and they have rarely been treated with chemical pesticides.

5.6.2 Mosquito Management on Service-owned Lands

The Service has developed an IPM Plan for the Complex, which applies to all Service-owned lands including Service-owned lands in the
WMAs (Butte Sink and Llano Seco Units). The IPM Plan is included in the appendices to the CCP for the Sacramento, Delevan, Colusa, and Sutter NWRs (USFWS 2009). The IPM Plan advocates a process to control mosquitoes, when necessary, using the least toxic methods first (i.e., wetland management techniques, biological controls) and only using chemical pesticides if less aggressive methods are ineffective. A significant component of the plan is the implementation of best management practices for minimizing mosquito production and mosquito control, which includes a variety of techniques for water and vegetation management and design features for managed wetlands (Kwasny et al., 2004).

The Service policy (7 RM 14 of the Refuge Manual) dictates that Pesticide Use Proposals (PUP) must be developed and reviewed prior to the application of any pesticide on Service-owned lands. PUPs are developed annually on the Complex with input from the Districts. A PUP is prepared for each material used. It identifies target species; reason for application; application rate, timing, and method; sensitive areas and species that may be affected and measures to avoid impacts to them. Depending on the type of material used, PUPs are reviewed and can be approved at the refuge manager, regional office, or Washington office level. All PUPs are reviewed by the refuge manager for consistency with Departmental, Service, regional, and State policies.

The Butte Sink Unit is typically treated by the Colusa Mosquito Abatement District during September and October annually (along with much of the rest of the Butte Sink WMA), primarily using aerial adulticide. Naled has been the primary pesticide used here in recent years, after mosquitoes became resistant to malathion in the late 1990s. Potential impacts from mosquito control on anadromous fish in Butte Creek continue to be a concern.

At the Llano Seco Unit, mosquito control is comparatively light. In some years, the Butte County MVCD makes several small applications of larvicides on seasonal wetlands in October. *Bacillus thuringiensis* var. *israelensis* (Bti) and a single-brood granular formula of methoprene have been the most commonly used products. Seasonal wetlands do not start flooding here until October 1, which minimizes mosquito production and need for chemical control. Some applications have also been made on the irrigated pasture in Tract 2 following irrigations.

Refuge staff works cooperatively with the local MVCDs in the appropriate management of mosquitoes on the Service-owned lands within the WMAs. They continue to work with the MVCDs to use wetland management BMPs (Kwasny et al., 2004), minimize adulticide use, and look for additional ways to conduct mosquito control that are less toxic, such as using biological larvicide alternatives. Cost is often the reason MVCDs cite that larvicides are not more commonly used, and continues to be a major factor in trying to further implement their use.

### 6. Fish and Wildlife

Given the variety of habitats on the WMAs, a great diversity of animal and plant species occur here. While many species are common year-round, others are here only during migration, for the winter, or during the spring and summer months to breed. An overview of wildlife use of the WMAs follows, and Appendix K contains a complete list of fish and wildlife species that occur or potentially could occur there.

#### 6.1 Waterfowl

The Central Valley of California has always been a major wintering area for Pacific Flyway waterfowl. Populations have fluctuated over the last century, with some species experiencing significant declines, others showing dramatic recoveries, and still others that have shifted their distribution away from California. During the 1970s, California mid-winter waterfowl populations, as indexed by the Mid-winter Survey, routinely estimated between four and six million ducks and five to six hundred thousand geese. At that time, pintails comprised the majority of ducks, outnumbering all other species combined.
Following the 1970s, extended droughts in the Canadian prairie breeding areas caused significant declines in breeding ducks and production. These declines were also reflected in wintering numbers in California’s Central Valley. Comparatively, in the last 25 years, wintering ducks in California (of which most are in the Central Valley) have fluctuated between two and four million ducks, including only about one to one and a half million pintails (USFWS 1955-2014, Figure 13).

However, when the droughts in the prairies ended in the 1990s, most other duck species showed significant increases, but pintails showed only modest increases. There is evidence that changes in agricultural practices in the Canadian prairies initiated in the 1970s have negatively impacted the early nesting habitats of pintails and are thought to be the primary reason for their lagging recovery (Miller et al., 2003, Guyn 2004).

Despite declines in historic waterfowl numbers and habitat, millions of waterfowl still concentrate in the Central Valley of California. In the Sacramento Valley these birds are largely supported by a combination of wetlands and post-harvest flooded rice (CVJV 2006). The primary waterfowl use of the WMAs is by wintering ducks and geese, accounting for over 95 percent of all waterfowl use-days. Ducks breeding in areas to the north (mostly from Alaska, other Western states, and Western Canada) start migrating into the Sacramento Valley in August, and by early October, hundreds of thousands of both ducks and geese are present. Many birds arrive via the Klamath Basin, one of the most important migration staging areas in the Pacific Flyway (Gilmer et al., 2004). Many birds also migrate through the Great Salt Lake and along the Pacific Coast to reach the Central Valley.
The Llano Seco Unit and Llano Seco Ranch easement wetlands together have peaked at over 450,000 ducks. The most common wintering duck species include northern pintail, mallard, American wigeon, green-winged teal, gadwall, northern shoveler, and ring-necked duck. The most common goose species include lesser snow, Ross’s, and Pacific and tule greater white-fronted goose.

In general, goose populations have undergone some significant changes and shifts in the last thirty years. White-fronted and cackling goose (cackler) populations reached their lowest levels in the early 1980s, due mainly to over harvest on both wintering and arctic breeding areas. Following the implementation of more restrictive harvest regulations, both of these populations have rebounded dramatically. Although cackler populations have increased to a level of 150,000-200,000 birds, very few still winter in California. Historically, about 90 percent wintered in the Central Valley and 10 percent in the Willamette Valley, Oregon. Today, this distribution has essentially reversed, largely due to turf agriculture in Oregon attracting the majority of wintering cacklers. Figure 14 shows population trends of arctic-nesting geese in California.

Pacific greater white-fronted goose populations have increased tremendously in recent years to 784,000 birds in 2010, as indexed by the Flyway-coordinated special fall whitefront survey. At certain times of the fall and winter, the majority of the Flyway’s portion of the population of Pacific greater white-fronted geese will be present in the Sacramento Valley (USFWS
Most of these geese nest on the open tundra of the Yukon-Kuskokwim Delta in Alaska. However, within that overall whitefront population exists the tule greater white-fronted geese (tule geese). Tule geese are a subspecies of whitefronts that nest in river valleys (often forested) including those in Alaska’s Susitna River drainage off the Cook Inlet. They are much less numerous than their Pacific relatives, and more difficult to estimate their population; CDFW has employed an indirect survey method using radio neck collars, that has resulted in an estimate of 10,000-12,000 tule geese (CDFW 2014). Sacramento, Delevan, and Colusa Refuges, the Willow Creek-Lurline WMA, and ricelands in the immediate vicinity comprise the core wintering area for tule greater white-fronted geese (Hobbs 1999).

Aleutian cackling geese (Aleutian goose) represent another successful recovery story. On the brink of extinction with only about 800 birds in 1975, Aleutian goose populations have rebounded to over 120,000 today (USFWS 2010). This has largely been the result of removing non-native predators and repopulating geese on their key breeding areas in the Aleutian Islands (Pacific Flyway Study Committee 1999; USFWS 1982). Once on the endangered species list, they were delisted in 2001.

Large wintering populations of lesser snow (snow) and Ross’s geese (collectively “white geese”) also winter in the Central Valley. Most of these snow goose nest in the western Canadian Arctic, Banks Island having the largest colonies, with a significant number also on Wrangel Island, off the coast of Siberia, Russia. Ross’s geese nest primarily in the central Canadian Arctic, with the largest colonies located in the Queen Maud Gulf area. White goose (snow and Ross’s combined) populations in the Pacific Flyway have been increasing, with recent surveys indicating 800,000 to one million birds. While the Pacific Flyway’s portion of the populations has increased, they have not (yet) shown the dramatic increases in white geese that have occurred in most other North American white goose populations (USFWS 2001). The most recent species ratio estimate shows that lesser snow geese comprise approximately 69-80 percent of white geese in California (Weaver 2009, 2012).

Tundra swans are also common, with the majority of the Pacific Flyway population wintering in the Central Valley within the Sacramento Valley and Delta regions. Since 1999, mid-winter survey estimates have typically ranged between 60,000 and 100,000 birds. While wintering in the Central Valley, swans occur most commonly on flooded agricultural habitats (rice and corn), and use wetlands here to a much lesser extent.

Waterfowl use of the WMAs’ habitats varies by species and includes many factors including level of human disturbance, water depth, ratio of open water to emergent vegetation, food availability, access to loafing sites, and tradition. Over 95 percent of the waterfowl that occur on the WMAs are dabbling ducks and geese, which all prefer relatively shallow water. Only one to 5 percent are diving duck species, which prefer deeper water. Pintail, wigeon, green-winged teal, shovelers, and other species prefer more open water, whereas mallards and gadwall will use wetlands with denser cover (Heitmeyer and Raveling 1988).

Managed seasonal wetlands contain abundant seeds, vegetative food items (leaves, stem, tubers), and invertebrates preferred by foraging waterfowl. They are diverse in the amount and distribution of emergent vegetation (bulrushes, cattails) they provide, and also contain bare islands, levees, and open shorelines that provide excellent waterfowl loafing sites. Not surprisingly, the majority of wintering waterfowl select this habitat type above all other wetlands (Table 5). Waterfowl survey data collected on the Complex indicates that managed seasonal wetlands support significantly greater waterfowl densities.
compared to semi-permanent and permanent wetlands (M. Wolder, unpublished data).

Vernal pools are also heavily used by waterfowl once they fill during the winter and spring, especially by mallards, wigeon, green-winged teal and shovelers (Bogiatto and Karneige 2006, Silveira 1998). In addition, geese and wigeon will readily forage in alkali meadows and short grass uplands as soon as green browse is available in the fall (Silveira 1998, USFWS 1955-2014).

Table 5. Average duck densities (per acre with sample size in parentheses) by habitat type on managed wetlands at Llano Seco Unit of the North Central Valley WMA and the Butte Sink Unit of the Butte Sink WMA.

<table>
<thead>
<tr>
<th>Wetland Type</th>
<th>Llano Seco Unit</th>
<th>Butte Sink Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent Wetland</td>
<td>53.5 (1284)</td>
<td>NA</td>
</tr>
<tr>
<td>Semi-permanent Wetland</td>
<td>32.0 (40)</td>
<td>NA</td>
</tr>
<tr>
<td>Irrigated Seasonal Wetland</td>
<td>158.1 (1376)</td>
<td>225.3 (64)</td>
</tr>
<tr>
<td>Seasonal Wetland</td>
<td>97.4 (4087)</td>
<td>183.9 (1396)</td>
</tr>
</tbody>
</table>

Human activity plays a significant role in the distribution of waterfowl on the Refuges. Disturbance from auto tour routes, walking trails, hunting areas, and adjacent off-refuge activities can significantly affect bird use patterns (Heitmeyer and Raveling 1988; Wolder 1993). For example, green-winged teal are particularly sensitive to human disturbance. Despite the fact that they are one of the most common wintering duck species, they are very uncommon along auto tours and walking trails, tending to choose the most isolated areas within the sanctuaries (closed areas). Conversely, shovelers are less sensitive to disturbance relative to other species, and are more common in disturbed areas, including hunting areas (Heitmeyer and Raveling 1988). Other species tend to fall in the middle in terms of their sensitivity to human disturbance. Pintails, the most common waterfowl species on the WMAs, are less abundant as human disturbances increase, and show strong differences in use patterns (densities and disturbance reactions) among units adjacent to auto tour routes, hunting units, and undisturbed units on Refuges within the Complex (Wolder 1993). Waterfowl compensate for this, in part, by feeding at night in areas (i.e., rice fields, hunted wetlands) that are disturbed during the day. Some waterfowl also tend to use denser habitats during the hunting season, presumably because they feel more secure due to the heavier vegetation that buffers both the sight and sounds of human activity (Heitmeyer and Raveling 1988; Wolder 1993).

Tradition is an important, but somewhat subjective factor of habitat use, and is most apparent with geese, especially with roosting sites. Some areas are used year after year by species such as tule greater white-fronted geese. Large numbers of pintail, wigeon, and other species have developed traditional use patterns at specific undisturbed wetlands in the Butte Sink and Llano Seco Units.

6.2 Breeding Waterfowl

A small percentage of ducks relative to wintering populations remain in the Central Valley through the spring and summer months to nest. Overall, California is a significant breeding area for mallards (McLandress et al., 1996). The estimated long-term average size of the mallard breeding population for the state is about 368,000; on average, the Sacramento Valley and Delta regions account for about 134,000 and 9,000 breeding mallards, respectively.

In addition to mallards, the most common breeding waterfowl include cinnamon teal, gadwall, wood duck, western Canada goose, redhead, and ruddy duck. On the WMAs, these species nest in a variety of uplands and wetlands. Most are ground-nesting species that nest in grasslands, drawn-down seasonal wetlands, or islands in semi-permanent and permanent wetlands. Redheads and ruddy ducks nest over water in permanent
or semi-permanent wetlands. Wood ducks are exclusively cavity nesters, with most nesting in human-made wood duck boxes located along rivers and streams, canals or wetlands. Permanent and semi-permanent wetlands provide crucial brood rearing and molting habitat for locally nesting waterfowl. Some waterfowl broods also take advantage of seasonal wetlands that are in the spring drawdown phase or receiving spring/summer irrigations.

6.3 Shorebirds
Shorebirds are present on the WMAs year-round, but as with most other migratory waterbirds, the greatest numbers are present during the non-breeding portions of the year. Surveys of the Central Valley in the mid-1990s indicated that the greatest numbers occur during winter and spring, when they are using a combination of flooded harvested rice fields and managed wetlands (Shuford et al., 1998). Shorebirds typically peak on the WMAs during spring as most pass through to their northern breeding grounds in the arctic tundra of Alaska. During this period, seasonal wetlands and vernal pools provide abundant shallow water habitat that the birds use to feed on aquatic invertebrates. During dry years, managed wetlands on the WMAs can be particularly important for spring migrants based on habitat conditions in other parts of the Valley (Wolder et al., 1999). The most common migrants and wintering birds include western and least sandpipers, dunlin, long-billed dowitchers, long-billed curlews, and greater yellowlegs. A few shorebird species will stay through the spring and early summer to breed on the WMAs, including killdeer, black-necked stilts, and American avocets.

6.4 Waterbirds-Wading Birds/Diving Birds/Secretive Marsh Birds
Many wading, diving and secretive marsh birds are present on the WMAs year-round, utilizing several different habitats for foraging, roosting, and nesting. Great blue heron, great egret, and double-crested cormorant rookeries exist in riparian forests at various locations throughout the WMAs. Other rookeries occur in permanent and semi-permanent wetlands, where species including white-faced ibis, snowy and cattle egrets, and black-crowned night-herons nest in hard-stemmed bulrush and cattail patches. Other breeding species include American and least bitterns, green herons, Virginia rails, soras, common moorhens, American coots, and pied-billed and western grebes. All of these species will also forage and roost in WMA wetlands during the non-breeding season. American white pelicans can be present in significant numbers, but they currently do not breed in the Central Valley. White-faced ibis have been of particular interest because of their relatively recent increases in abundance. Extremely rare in the Sacramento Valley as of the 1970s, the white-faced ibis has increased dramatically, with tens of thousands of birds now present.
using the area, and significant breeding colonies and wintering birds on the WMAs. Seasonal wetlands provide large communal night roost areas for ibis during the non-breeding season.

6.5 Waterbirds-Gulls/Terns

Ring-billed and herring gulls are the most common gulls, occurring primarily during fall and into spring. Forster’s and Caspian terns are often seen migrating in small numbers during the spring and fall. Black terns are present during the summer and nest in some areas of the Sacramento Valley, mostly in rice fields, and occasionally in wetlands.

6.6 Birds of Prey

A wide variety of raptor species use the WMAs throughout the year. The most common breeding species include red-tailed, red-shouldered, and Swainson’s hawks, osprey, northern harriers, American kestrels, and common barn and great horned owls. Overall raptor abundance is greatest in the winter. Raptors gather because of the abundant prey base of waterfowl, other wintering birds, and rodents. With the exception of Swainson’s hawks and osprey, all of the breeding species are also present during the winter in greater numbers, especially red-tailed hawks and northern harriers. Other regular wintering species include American bald eagle, turkey vulture, white-tailed kite, peregrine falcon, and Cooper’s hawk. Occasionally, small numbers of golden eagles, rough-legged and ferruginous hawks, prairie falcons and merlins are also seen during the wintering period.

6.7 Upland Game Birds

Upland game birds occupy various habitats on the WMAs. California quail, ring-necked pheasants, and wild turkeys are resident species that use a variety of grassland, riparian, and wetland habitats throughout the year. Grasslands are used for nesting and foraging, and riparian forest and wetlands provide roosting sites and escape cover. Mourning doves and Wilson’s snipe (a shorebird, formerly “common” snipe) are technically migratory birds, but are also classified as upland game birds in the California hunting regulations. Mourning doves occur year-round, as a common nester in forested areas during the spring and summer, and a less common winter resident. Wilson’s snipe is primarily a migrant species and is most common in fall through spring in shallow wetlands. Eurasian collared doves have recently expanded their range into the Sacramento Valley, and continue to increase in abundance. They are considered an upland game bird, although their harvest has been significantly liberalized in hunting regulations due to their invasive status.

6.8 Other Landbirds

The WMAs provide a variety of habitats for a great diversity of migratory and resident landbirds (Gilmer et al., 1998) (Appendix K). Habitat diversity, structural complexity, and proximity to wetlands are important habitat features. The Sacramento Valley is an important migration corridor that provides stopover resting and feeding habitat for landbirds that breed in the nearby foothills and mountains. It also contains important breeding and wintering area for a variety of migratory and resident songbirds and other landbirds. Many of these species are priority or focal species in conservation plans or on Federal or State priority species lists.

One particular species of concern is the tricolored blackbird, a mainly California endemic species (Shuford and Gardali 2008). These colonial birds occasionally nest in wetlands on the WMAs and feed in grasslands and seasonal wetlands. They will readily use upland areas grazed by livestock. Colonies periodically occur on all the WMAs and, in some years, large colonies have occurred on wetlands in the Willow Creek-Lurline WMA (south of Delevan NWR) and wetlands in the Yolo Bypass. Tricolored blackbirds are itinerant breeders, with birds breeding in the San Joaquin Valley early in the season around April, then moving up to the Sacramento Valley around late May to early June to breed again if conditions are conducive (Hamilton 1998).

Non-native European starlings, house sparrows, and Eurasian collared doves are common
and often compete with native species for nesting sites. In addition, several native North American species whose populations have grown or expanded considerably, including American crow, common raven, and great-tailed grackle, are of concern because of their potential predation impacts on other species.

### 6.9 Mammals

Many mammalian species are year-round residents of the WMAs. Wetlands and associated waterways support beaver, mink, and river otter. Other native species include the broad-footed mole, ornate shrew, big brown bat, Brazilian free-tailed bat, California myotis, Townsend's big-eared bat, black-tailed jackrabbit, desert cottontail, California vole, deer mouse, Botta's pocket gopher, California ground squirrel, western harvest mouse, coyote, long-tailed weasel, raccoon, striped skunk, and black-tailed deer. Other large carnivores, including mountain lion, bobcat, and black bear occur in smaller numbers, with most observations being in riparian forested areas along larger waterways (Derugin 2013). Non-native species include muskrat, Virginia opossum, black rat, Norway rat, house mouse, feral pigs and feral house cat.

### 6.10 Amphibians and Reptiles

Reptiles are common residents on the WMAs, and include common and giant garter snake, gopher snake, western yellow-bellied racer, California kingsnake, western fence lizard, western pond turtle, and red-eared slider (a non-native species). These reptiles mostly occur in upland habitats; however, the giant garter snake (a Federally-listed threatened species) and western pond turtle are wetland-dependent and occur commonly in permanent wetlands, sloughs and canals. The Pacific treefrog and American bullfrog (a non-native species) are the only amphibians known to occur on the WMAs.

### 6.11 Fish

Fish species are present in the WMAs throughout the water delivery systems, drainage ditches, natural creeks and rivers. These areas are all part of the Sacramento River watershed and share many of the same species (Appendix K). Most fish are non-native warm water resident species. Native anadromous fish include steelhead and four distinct runs of Chinook salmon. Three of the four Chinook salmon runs are considered unique Evolutionary Significant Units (ESU). These include the Sacramento River winter-run ESU, Central Valley spring-run ESU, and Central Valley fall-run and late-fall-run ESU Chinook salmon. The Central Valley ESU steelhead is also a unique race. Anadromous fish are migratory, using the open ocean, bays, estuaries, deltas, main river channels, floodplains, and tributaries. Anadromous fish spawn in freshwater environments and spend their adult life in marine environments.

During periods of high flows in the Sutter and Yolo Bypass, significant numbers of Chinook salmon and steelhead can migrate through inundated wetlands of the Butte Sink WMA and the North Central Valley WMA. Likewise, adult Chinook salmon and steelhead pass through the Butte Sink WMA to spawning areas in upper Butte Creek, while migrating juveniles pass back through the area en route to the Pacific Ocean. Screened diversions and adequate flows of water through the wetland units within the Butte Sink are maintained to minimize entrapment and facilitate passage of migrating juvenile and adult salmonids when they are present (Jones & Stokes 2001). For more information on salmonids and other listed fish species, refer to sections 6.13.24 to 6.13.29.

The above fish resources support a wide array of fish-eating birds and mammals, including pelicans, grebes, cormorants, bald eagles, osprey, and river otters.

### 6.12 Invertebrates

Invertebrates present on the WMAs are an important resource based on their contribution to biotic diversity and their vital function in the food chain for many fish and wildlife species. They occur in all habitat types, both aquatic and terrestrial. Some are abundant, such as many species of zooplankton and midges, while others are quite rare, such as some vernal
pool shrimp. A variety of endemic species occurs in vernal pool/alkali meadow habitats in association with endemic plant species.

In combination with seeds and other vegetation, aquatic invertebrates are an essential part of many waterbird diets at various times of the year; as they provide a balance of amino and fatty acids to facilitate fat and protein storage (Euliss and Harris 1987; Miller 1987; Heitmeyer and Raveling 1988). Invertebrates provide energy for migration, protein to replace molted feathers, and calcium for the production of eggs. Central Valley wetlands support a wide variety of aquatic invertebrates, including water fleas, snails, clams, dragonflies, damselflies, water boatmen, backswimmers, beetles, midges, mosquitoes, worms, clams, snails, crayfish, fairy shrimp, and various species of zooplankton (Severson 1987, Sefchick 1992, Lawler et al., 1997, Silvera 1998, Eriksen and Belk 1999). While many of these species’ larvae occur in wetlands, the adult stages are often aerial and provide an important food source for landbirds and bats. Terrestrial invertebrates are also an important food base for many migratory and resident bird species, and include numerous species of grasshoppers, beetles, butterflies, moths, ants, spiders, and other insects. In addition, many of these invertebrates play key roles in plant pollination, including many rare and endemic species that have been documented on the Sacramento NWR Complex (Thorpe and Leong 1995).

6.13 Threatened and Endangered Species

The WMAs provide habitat for a number of Federal and State threatened and endangered species and species of special status. Special status species and their presence on the WMAs are presented in Appendix L. This section includes species accounts for species Federally-listed as threatened or endangered, or proposed for listing that are known to occur or may occur within the WMAs’ program areas, which include portions of Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Yolo and Yuba counties. We have identified areas within the 8 counties with habitats that are suitable for wetland or agricultural conservation easements (wetlands and lands with historic hydric [wetland] soils). These habitats are not suitable for the following Federally-listed species (although suitable non-wetland habitat may exist elsewhere in the counties), nor is there suitable habitat for these species within the WMA program areas: Lange’s metalmark butterfly (Apodenmia mormo langei), Ione manzanita (Arctostaphylos myrtifolia), Stebbins’s morning glory (Calystegia stebbinsii), Pine Hill ceanothus (Ceanothus roderickii), western snowy plover (Charadrius alexandrinus nivosus), Ione buckwheat (Eriogonum apricum var. apricum), Irish Hill buckwheat (E. a. var. prostratum), Contra Costa wallflower (Erysimum capitatum ssp. angustatum) and its critical habitat, El Dorado bedstraw (Galium californicum ssp. sierra), Antioch dunes evening primrose (Oenothera deltoids ssp. howellii) and its critical habitat, Lahontan cutthroat trout (Oncorhynchus clarki henshawi), coho salmon (O. kisutch), northern California steelhead and its critical habitat (O. mykiss Northern California DPS), California clapper rail (Rallus longirostris obsoletus), mountain yellow legged frog and its proposed critical habitat (Rana sierrae), salt marsh harvest mouse (Reithrodontomys raviventris), California least tern (Sternula antillarum) (=Sterna albifrons) browni), northern spotted owl and its critical habitat (Strix occidentalis caurina), Least Bell’s vireo (Vireo bellii pusillus), and San Joaquin kit fox (Vulpes macrotis mutica).

Plant names in the CCP are based on the taxonomic nomenclature of The Jepson Manual, Higher Plants of California, First Edition, 1993. Species lists and Federal Endangered Species Act compliance documentation will be provided in Appendix M of the Final CCP.
Plants

6.13.1 Fleshy (=succulent) Owl’s-Clover (\textit{Castilleja campestris} ssp. \textit{succulenta}) and its critical habitat

Fleshy owl’s-clover, also known as succulent owl’s-clover (Federal-listed threatened and State-listed endangered species) is in the figwort family. It has intricate flowers which can occupy more than half the plants height. It is similar in appearance to field owl’s-clover (\textit{C. campestris} ssp. \textit{campestris}), but has thick, fleshy easily broken leaves near the top of the stem, while those of field owl’s-clover are thin and flexible.

Succulent owl’s-clover has 92 occurrences in Madera, Merced, Stanislaus, and San Joaquin counties, and one possibly extirpated occurrence in Fresno County. Threats to past and present populations include activities associated with land conversions to agriculture and urbanization, and competition from invasive species (USFWS 2005a). Habitat loss and fragmentation is the single largest threat to the survival and recovery of fleshy owl’s clover among other listed species addressed in its Recovery Plan (USFWS 2005a).

Since the final listing rule, an additional threat to fleshy owl’s clover is that many of its populations are small in number. A small population size makes a population more vulnerable to extirpation from chance events as noted in the 2005 Recovery Plan (USFWS 2005a, USFWS 2011).

Of the 8 counties within the proposed easement acquisition area, fleshy owl’s clover is believed to occur in Sacramento County (USFWS 2014) (http://ecos.fws.gov/ecos/home.action).

6.13.2 Hoover’s Spurge (\textit{Chamaesyce hooveri}) and its critical habitat

Hoover’s spurge (Federal-listed threatened species) is a prostrate, tap-rooted, annual herb in the spurge family. It forms mats from a few inches to a few feet across. The flowering structure in Hoover’s spurge has petal-like glands that are red to olive in color. Blooms appear in July. This species is readily distinguished from other species of Chamaesyce by characteristics of growth habit, plant color, and leaf shape.

Hoover’s spurge grows in relatively large, deep vernal pools among the rolling hills, remnant alluvial fans, and depositional stream terraces at the base of the Sierra Nevada foothills in Tulare, Merced, Stanislaus, and Butte counties (Southern Sierra foothills and Northeast Sacramento Valley vernal pool regions), and the base of the Cascade foothills in Tehama County (Northeast Sacramento Valley Vernal Pool Region). It also occurs in the saline-alkali Basin Rim vernal pools in Glenn and Merced counties (Solano–Colusa and San Joaquin Valley vernal pool regions). The main remaining area of concentration for Hoover’s spurge is in the northeastern Sacramento Valley. The Vina Plains of Tehama and Butte counties contains 14 (53.8 percent) of the 26 known extant occurrences (USFWS 2005a). One other site in the same region is near Chico in Butte County. Seven of the extant occurrences are in the Southern Sierra Foothills, including five in the Visalia-Yettem area of Tulare County and two in the Hickman-La Grange area of Stanislaus County. Three other occurrences are on the Sacramento Refuge in Glenn County (Silveira 1992-2006b). The one other extant occurrence is on the Bert Crane Ranch in Merced County (USFWS 2005a). Threats to past and present populations include activities associated with land conversions to
agriculture and urbanization, and competition from invasive species (USFWS 2005a). The plant is also threatened by grazing, agriculture, and non-native plants (CNPS 2014).

Designated vernal pool critical habitat for Hoover’s spurge, Unit 2, is in Butte County, along the west side of State Highway 99, north of Durham Dayton Highway (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.3 Soft Bird’s-beak (*Cordylanthus mollis* ssp. *mollis*)

Soft bird’s-beak (Federal-listed endangered and State-listed rare species) is an annual herb in the figwort family (*Scrophulariaceae*). Molecular phylogenetic analysis separates certain members of the genus *Cordylanthus* (*C. maritimus, C. mollis* and *C. palmatus*) into the genus *Choropyron* (Tank et al., 2009). The revised Jepson manual will reflect these taxonomic changes however recovery plans associated with these species will retain old nomenclature (USFWS 2010).

The plants are 4-12 inches tall and highly branched. The stems and leaves are grayish green with small pale whitish flowers, ½-inch to 1 inch long, are arranged in dense clusters (spikes) and densely surrounded by herbaceous leaf-like bracts. Like other *Cordylanthus* species, the petals are divided into two lips. The upper one is shaped like a bird’s-beak, leading to the common name of the genus. Seedlings grow in late March or April. Flowers bloom from late spring through summer. Palmate-bracted bird’s-beak is partially parasitic (hemiparasitic) on the roots of other plants, including salt grass.

Palmate-bracted bird’s-beak (Federal and State-listed endangered species) is an annual herb in the figwort family (*Scrophulariaceae*). Molecular phylogenetic analysis separates certain members of the genus *Cordylanthus* (*C. maritimus, C. mollis* and *C. palmatus*) into the genus *Choropyron* (Tank et al., 2009). The revised Jepson manual will reflect these taxonomic changes however recovery plans associated with these species will retain old nomenclature (USFWS 2010).

The plants are 4-12 inches tall and highly branched. The stems and leaves are grayish green with small pale whitish flowers, ½-inch to 1 inch long, are arranged in dense clusters (spikes) and densely surrounded by herbaceous leaf-like bracts. Like other *Cordylanthus* species, the petals are divided into two lips. The upper one is shaped like a bird’s-beak, leading to the common name of the genus. Seedlings grow in late March or April. Flowers bloom from late spring through summer. Palmate-bracted bird’s-beak is partially parasitic (hemiparasitic) on the roots of other plants, including salt grass.
Palmate-bracted bird’s-beak grows on seasonally flooded, saline-alkali soils in lowland plains and basins at elevations of less than 500 feet (Mason 1957). Within these areas, it grows primarily along the edges of channels, drainages, and vernal pools with a few individuals scattered in seasonally wet depressions, alkali scalds (barren areas with a surface crust of salts) and grassy areas.

Historically, the species is known from scattered locations in Fresno and Madera counties in the San Joaquin Valley, San Joaquin, Yolo, and Colusa counties in the Sacramento Valley and the Livermore Valley area of Alameda County. It is currently known to occur in seven locations including Sacramento, Delevan, and Colusa Refuges (Silveira 1992-2006a), the Woodland area, Springtown Alkali Sink near Livermore, western Madera County, and the combined Alkali Sink Ecological Reserve and Mendota Wildlife Management Area. The total occupied surface area over the seven locations is estimated at less than 741 acres (CFDG 2005a). Palmate-bracted bird’s-beak was included in one of the first ecosystem recovery plans by the Service (USFWS 1998). Populations on Delevan and Colusa Refuges currently comprise the majority of the entire population of this species. Populations also likely persist on easement properties in the Lurline Division of the Willow Creek-Lurline WMA. The plant is threatened by agriculture, urbanization, vehicles, altered hydrology, grazing, and development (CNPS 2014).

6.13.5 **Contra Costa Goldfields (Lasthenia conjugens)**

Contra Costa goldfields (Federal-listed endangered species) is in the sunflower family. The flower heads occur singularly and like most goldfields are daisy-like consisting of central disc flowers and surrounding ray flowers. Contra Costa goldfields are closely related (and resemble) Burke’s goldfields (*L. burkei*) and Fremont’s goldfields (*L. fremontii*) and are distinguished in hand, by the relative lengths of their (freed and fused) phyllaries and presence or lack of a pappus on the disc flowers.

Contra Costa goldfields historically occurred in seven vernal pool regions (Central Coast, Lake–Napa, Livermore, Mendocino, Santa Barbara, Santa Rosa, and Solano–Colusa). There are 31 documented occurrences throughout its historic range, except for the Santa Barbara Vernal Pool Region. The largest aggregation of occurrences is in the Solano–Colusa Vernal Pool Region, especially east of Fairfield, with 11. Threats include activities associated with urbanization, including urban expansion, discing and grading, filling, ditch construction, urban runoff and competing from invasive species, especially annual ryegrass (*Lolium multiflorum*) (USFWS 2005a).

Vernal pools, which are suitable habitat for Contra Costa goldfields, are present in multiple counties in the WMAs. There is no designated vernal pool critical habitat for Contra Costa goldfields within the WMAs’ 8-county action area (Federal Register Vol. 71 No. 28 February 10, 2006).
6.13.6 Butte County (Shippee) Meadowfoam (Limnanthes floccosa ssp. californica) and its critical habitat

Butte County meadowfoam is Federally- and State-listed as endangered. Butte County meadowfoam is found at 165-1,167 feet in elevation (CNDDB 2007). In 2008, the Service found that the range of the subspecies lies entirely within Butte County, California (USFWS 2008b). Butte County meadowfoam is found primarily on the margins of vernal swales and to a lesser extent on the margins of vernal pools located on alluvial terraces in annual grasslands with mima mound topography. Mima mounds are soil mounds of unknown origin that are a few feet high. The species is restricted to a narrow 28-mile strip along the eastern flank of the Sacramento Valley from northwestern to central Butte County. During the 5-year review in 2008, the Service found the range of the species remained largely unchanged (USFWS 2008b). At this writing, Butte County meadowfoam is believed to also occur in Glenn and Tehama counties (USFWS 2014). The bloom period for this annual herb is March through May. The plant is threatened by urbanization, road construction, grazing, non-native plants, vehicles, and agriculture (CNPS 2014).

Designated vernal pool critical habitat for Butte County meadowfoam, Units 1-4, are in Butte County, along the east side of State Highway 99, mostly north of Highway 32; and on the west side of Highway 99 north of Highway 70 (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.7 Colusa Grass (Neostapfia colusana) and its critical habitat

Colusa grass (Federal-listed threatened and State-listed endangered species) is in the tribe Orcuttieae of the grass family. Colusa grass occurs in vernal pools in Merced, Stanislaus, Solano and Yolo counties, representing the Southern Sierra Foothills, San Joaquin Valley and Solano–Colusa vernal pool regions. The type specimen was collected in Colusa County in 1898; however, this species has apparently been extirpated from Colusa County (USFWS 2005a). Currently, about 45 populations (occurrences) remain extant. Threats to past and present populations include activities associated with land conversions to agriculture and urbanization (USFWS 2005a).

Historic accounts of this species (and its name) indicate that it likely occurred on or near Sacramento, Delevan, and Colusa Refuges, perhaps in the large vernal lakes that occupied this portion of the Colusa Basin prior to agricultural conversions to winter wheat, then rice. As a result, there is a possibility Colusa grass could potentially still be present in small amounts. Monitoring of other rare endemic plant species on the Refuges indicate that there is a significant amount of variability in their occurrence from year to year and, in fact, certain species may not occur in some years or for a period of years (Silveira 1992-2006b). The plant is threatened by agriculture, development, overgrazing, flood control, non-native plants, and habitat fragmentation and loss (CNPS 2014).

Designated vernal pool critical habitat for Colusa grass, Unit 1, is in Yolo County, south of Interstate 80, east of the intersection of Tremont Road and Road 104/Mace Boulevard (Federal Register Vol. 71 No. 28 February 10, 2006).
6.13.8 Hairy Orcutt Grass (*Orcuttia pilosa*) and its critical habitat

Hairy Orcutt grass (Federally- and State-listed endangered species) is in the tribe Orcuttieae of the grass family. It inhabits vernal pools in rolling topography on remnant alluvial fans and stream terraces in the Central Valley—Tehama, Glenn, Stanislaus, Merced, and Madera counties. It is found on both acidic and saline-alkaline soils. It is a small (6-8 inches tall) annual in the grass family. Foliage is grayish with soft, straight hairs. Hairy Orcutt grass flowers from May through September.

The historical range includes the eastern margins of Sacramento and San Joaquin Valleys from Tehama County south to Stanislaus County and through Merced and Madera counties. Only 27 of 40 historically known populations exist, including a new population in Merced County found in 2001 and a transplant population (CDFG 2005a). More than one third of the remaining populations occur in Tehama County. Others are in Butte, Glenn, Madera and Stanislaus counties. Populations of hairy Orcutt grass are found at the Sacramento Refuge in Glenn County (Silveira 1992-2006b).

Conversion of vernal pool habitat to irrigated agriculture, vineyards, or orchards, or to urban uses has been the primary factor leading to the decline of this species (CDFG 2005a; USFWS 2005a). California Native Plant Society considers this plant to be seriously threatened by agriculture, urbanization, overgrazing, non-native plants, and trampling (CNPS 2014).

Designated vernal pool critical habitat for hairy Orcutt grass, Unit 2 is in Butte County, along the west side of State Highway 99, north of Durham Dayton Highway (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.9 Slender Orcutt Grass (*Orcuttia tenuis*) and its critical habitat

Slender Orcutt grass (Federally- and State-listed endangered species) is in the tribe Orcuttieae of the grass family. It inhabits vernal pools in Sacramento, Lake, Tehama, and Shasta, Lassen, and Plumas counties, primarily of volcanic ashflow and mudflow origin. It appears similar to hairy Orcutt grass, but has narrower stems and leaves, larger spikelets which are not crowded, larger seeds, a differed number of chromosomes and flowers earlier.

Populations are still present throughout its historical range, totaling 79, of which 73 are presumed extant. The largest concentration (28 populations; 43 percent) of slender Orcutt grass occurs in the vicinity of Dales, Tehama County. Conversion of vernal pool habitat to irrigated agriculture, vineyards, or orchards, or to urban uses have been the primary factor leading to the decline of this species, and in addition off-road vehicle use is threats the Redding and Modoc Plateau populations (CDFG 2005a; USFWS 2005a). California Native Plant Society considers this plant to be seriously threatened by agriculture, residential development, grazing, trampling, vehicles, recreational activities, logging, fire, and non-native plants. Species management guidelines have been

Vernal pools, which are suitable habitat for slender Orcutt grass, are present in multiple counties in the WMAs. Unit 6 of the designated vernal pool critical habitat for slender Orcutt grass is in Sacramento County, northeast of the intersection of Excelsior Road with Highway 16 (Federal Register Vol. 71 No. 28 February 10, 2006). Designated critical habitat Unit 6 is more than 20 miles from and separated by urban areas from potential easement acquisitions (from willing sellers) where easements would be most beneficial in Sacramento County, as buffers to the existing Stone Lakes NWR.

6.13.10 Sacramento Orcutt Grass (*Orcuttia viscida*) and its critical habitat

Sacramento Orcutt grass (Federally- and State-listed endangered species) is in the tribe Orcuttieae of the grass family. It is endemic to vernal pools in the Southeastern Sacramento Valley Vernal Pool Region occurring only in Sacramento County. The plants are very viscid, beginning while young, and are densely tufted, bluish-green, and hairy.

Eight of nine historic occurrences are extant. Five occurrences contain over 70 percent of the occupied habitat in an area of about 2.3 square miles east of Mather Field in Rancho Cordova. Threats are similar to those for hairy Orcutt grass and slender Orcutt grass, but activities and factors associated with urbanization are the primary threats. These include runoff from lawns, ball fields and roads, landscape waste dumping, invasion of garden plants and non-native manna grass (*Glyceria* spp.), horseback riding, off road vehicle use, vandalism. Small populations are subject to extinction from random, catastrophic events (CDFG 2005a; USFWS 2005a). California Native Plant Society considers this plant to be seriously threatened by agriculture, urbanization, overgrazing, and trampling (CNPS 2014).

6.13.11 Hartweg’s Golden Sunburst (*Pseudobahia bahiifolia*)

Hartweg’s golden sunburst is an annual herb that is Federally- and State-listed as endangered. It grows in clay, often acidic soils and its blooming period is March through April. Habitat for Hartweg’s golden sunburst includes cismontane woodland and Valley and foothill grassland. It grows in parts of Fresno, Madera, Merced, Stanislaus and Tuolumne counties, but is presumed extirpated or unknown in the Yuba City quadrangle (primarily northeast of Yuba City), in Yuba County. Many occurrences of Hartweg’s golden sunburst are very small.

Hartweg’s golden sunburst occurs almost entirely in non-native grasslands. The majority of the occurrences (regions of distribution) are associated with mima mound topography. The plants are nearly always found on the north or northeast-facing slopes of the mounds with highest plant densities on the upper slopes where grass cover is minimal. The species was first collected in 1847 at the present-day site of Marysville in Yuba County (Stebbins 1991). Hartweg’s golden sunburst is now known from 19 extant occurrences (USFWS 2007). California Native Plant Society considers this plant to be seriously threatened by seriously threatened by development, agriculture, overgrazing, and trampling (CNPS 2014).

6.13.12 Keck’s Checker Mallow (*Sidalcea keckii*)

Keck’s checker mallow, also known as Keck’s checkerbloom (Federally-listed endangered species) is an annual herb in the mallow family. While it is endemic to grassy slopes of the Sierra Nevada foothills, its habitat also includes Valley and foothill grassland. Of the 8 counties within the proposed easement acquisition area, Keck’s checker-mallow is known to or believed to occur in Colusa County (in Manor Slough quadrangle, which extends into the Valley and others outside the easement acquisition area), Sacramento County, and Yolo County (in
Monticello Dam quadrangle, which extends into the Valley). Additional portions of the range for the species within California still need to be refined (USFWS 2014) (http://ecos.fws.gov/ecos/home.action); therefore, it may occur in other counties within the proposed easement acquisition area. It is threatened by agricultural and urban land conversions, non-native invasive plant species, and random events, which can extirpate local populations (USFWS 2011).

6.13.13 Greene’s Tuctoria (Tuctoria greenei) and its critical habitat

Greene’s tuctoria (Federally-listed endangered and State-listed rare species), which is also known as Greene’s Orcutt grass, is in the tribe Orcuttieae of the grass family. It is a small, tufted annual which has several to many stems 2 to 6 inches tall, each ending in a spike-like inflorescence that may be partly enfolded in the upper leaf. The genus Tuctoria is distinguished from the closely related Orcutt grasses, by the spiral arrangement of the spikelets (flowers) and other characteristics of its flower parts.

Greene’s tuctoria is restricted to small or shallow vernal pools or the early drying sections of large, deep vernal pools in the Central Valley. Its historical range included parts of Shasta, Tehama and Butte counties in the northern Sacramento Valley, and extended from San Joaquin County to Tulare County in the San Joaquin Valley. About half of the approximately 40 known occurrences of Greene’s tuctoria have been extirpated through habitat conversion to irrigated agriculture and intensive cattle grazing (CDFG 2005a). The species apparently no longer occurs in Fresno, Madera, San Joaquin, Stanislaus, and Tulare counties. The remaining populations are in Shasta, southern Tehama, Butte, Glenn, and eastern Merced counties (USFWS 2005a). Populations of Green’s tuctoria are found on Sacramento Refuge. Refuge surveys (Silveira 1992-2006b) have not detected Greene’s tuctoria since 1996, a trend found throughout the species range. Greene’s tuctoria is known to occur on Colusa, Delevan, and Sacramento NWRs. The plant is threatened by agriculture, urbanization, overgrazing, and habitat fragmentation and loss (CNPS 2014).

Designated vernal pool critical habitat for Greene’s tuctoria, Unit 3 is in Butte County, along the west side of State Highway 99, north of Durham Dayton Highway (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.14 Solano Grass (Tuctoria mucronata) and its critical habitat

Solano grass (Federal and State-listed endangered species), also known as Crampton’s tuctoria, is in the tribe Orcuttieae of the grass family. Solano grass is endemic to saline-alkali vernal pools of the Solano–Colusa Vernal Pool Region. It appears similar to Green’s tuctoria, but the inflorescence of Solano grass is partially hidden by its leaves even when mature. Solano grass is know from three populations: Olcott Lake and another site 2.5 miles to the southwest in the Jepson Prairie in Solano
County; and the largest population occurs to the west on Department of Defense telecommunications lands in Yolo County. Only four plants were found at Jepson Prairie in 1993, and none in 1994-1996, 1998, 2000 and later; site presumed extirpated in 2005. Population threats include land conversion, over collecting, discing and grading, herbicide runoff, salt applications, and industrial contaminants (CDFG 2005a; USFWS 2005a). The plant is also threatened by non-native plants (CNPS 2014).

Designated vernal pool critical habitat for Solano grass, Unit 1 is in Yolo County, south of Interstate 80, east of the intersection of Tremont Road and Road 104/ Mace Boulevard (Federal Register Vol. 71 No. 28 February 10, 2006).

**Invertebrates**

**6.13.15 Conservancy Fairy Shrimp** (*Branchinecta conservatio*) and its critical habitat

Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp occur exclusively in vernal pool habitats that are flooded with rainwater. They occur as eggs in summer and fall dry periods, hatching and growing into breeding adults during their wet cycle following rain during winter and spring. Vernal pool habitat occurs at the Llano Seco Unit and the Llano Seco Ranch easement.

The Conservancy fairy shrimp (Federal-listed endangered species) is a small crustacean that ranges in size from about $\frac{1}{2}$ to one inch long. They have delicate elongate bodies, large stalked compound eyes, no carapaces, and eleven pairs of swimming legs. Conservancy fairy shrimp inhabit rather large, cool-water vernal pools with moderately turbid water (Eriksen and Belk 1999). The pools generally last until June. Female fairy shrimp carry their eggs in a ventral brood sac. The eggs are either dropped to the pool bottom or remain in the brood sac until the mother dies and sinks. When the pool dries out, so do the eggs. They remain in the dry pool bed until rains and other environmental stimuli trigger them to hatch. Resting fairy shrimp eggs are known as cysts. They are capable of withstanding heat, cold and prolonged desiccation. When the pools refill, some, but not all, of the cysts may hatch. The cyst bank in the soil may contain cysts from several years of breeding. Hatching can begin within the same week that a pool starts to fill. Average time to maturity is forty-nine days. In warmer pools, it can be as little as nineteen days (Eriksen and Belk 1999).

The Conservancy fairy shrimp is currently known from several disjunct populations: the Vina Plains in Tehama County, south of Chico in Butte County; the Jepson Prairie Preserve and surrounding area in Solano County; Sacramento Refuge in Glenn County (Silveira 2005); Mapes Ranch west of Modesto, San Luis Refuge, and the Haystack Mountain/ Yosemite Lake area in Merced County; and two locations on the Los Padres National Forest in Ventura County (USFWS 2005a).

Designated vernal pool critical habitat for the conservancy fairy shrimp, Unit 1E is in Butte County, northeast of State Highway 99 (Federal Register Vol. 71 No. 28 February 10, 2006).

**6.13.16 Vernal Pool Fairy Shrimp** (*Branchinecta lynchii*) and its critical habitat

The vernal pool fairy shrimp (Federal-listed threatened species) is a small crustacean that occupies a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools. Although the species has been collected from large vernal pools, including one exceeding 25 acres, it tends to occur in smaller pools. It is most frequently found in pools measuring less than 0.05 acre. These are most commonly in grass or mud bottomed swales, or basalt flow depression pools in unplowed grasslands. Vernal pool fairy shrimp have been collected from early December to early May.

The vernal pool fairy shrimp is widespread but not abundant. Known populations extend from Stillwater Plain in Tehama County through most of the length of the Central Valley to Pixley National Wildlife Refuge in...
Tulare County. Along the central coast, they range from northern Solano County to Pinnacles National Monument in San Benito County. Four additional, disjunct populations exist: near Soda Lake in San Luis Obispo County; in the mountain grasslands of northern Santa Barbara County; in the Santa Rosa Plateau in Riverside County; and near Rancho California in Riverside County. Vernal pool fairy shrimp are found on Sacramento Refuge (Silveira 2005).

The vernal pool fairy shrimp was identified relatively recently, in 1990. There is little information on its historical range. However, since it is currently known to occur in a wide range of vernal pool habitats, the historic distribution may have coincided with the historic distribution of Central Valley and Southern California vernal pools (USFWS 2005a).

Designated critical habitat for the vernal pool fairy shrimp, Units 7D-F and Unit 9 are in the northwestern part of Butte County mostly between State Highways 99 and 32; Unit 11 in Yuba County, south of State Highway 20; Unit 12 in northwestern Placer County near State Highway 65; and Units 13 and 14 in Sacramento County, southeast of Sacramento (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.17 Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus) and its critical habitat

Valley Elderberry Longhorn beetle (Federal-threatened species) is in the longhorn beetle (Cerambycidae) family. They have long brightly colored black and red bodies, the sexes showing different color patterns, and they have antennae 2/3 (or more, for males) their body length. The males are smaller and more active than the females. Body length minus antennae length for males is ½ to ¾ inch and for females, ¾ to 1 inch. The Valley elderberry longhorn beetle is endemic to riparian floodplain habitats associated of the Sacramento and San Joaquin valleys. It is found only in association with its host plant, the blue elderberry (Sambucus mexicana). The species spends its entire life cycle on the host plant. Adults emerge in spring (late March through early May) and feed on foliage from March through June, during which time they mate and the females lay their eggs. Eggs are laid on leaves, branches, bark crevices, and trunks and hatch within a few days. Larvae bore through the stem pith, creating a pupation gallery. After one to two years, the larva chews a hole to the stem surface and returns to the chamber to pupate (Barr 1991, Halstead and Oldham 1990). When the host plant begins to flower, the pupa emerges as an adult and exits the chamber through a characteristic exit hole. Upon emergence, the adults occupy foliage, flowers, and stems of the host plant.

At the time of listing, the Valley elderberry longhorn beetle was known from less than 10 locations, occurring at American River, Putah Creek, and the Merced River. There are almost 200 records of the beetle, based primarily on exit holes. The species decline is due to a drastic decline of riparian and floodplain wetlands. Current threats includes continued habitat loss through levee construction, bank armor (riprap), channelization, bank and levee vegetation removal, agricultural,
urban, and recreational development, and non-native invasive Argentine ants, which prey on the beetle larvae (USFWS 2006a).

Sacramento River NWR was established, in part, to protect and restore habitat for the Valley elderberry longhorn beetle. Since 1989, over 118,000 elderberry bushes have been planted in over 4,500 acres of riparian and floodplain habitats at the Refuge. Restoration sites at Sacramento River NWR have been documented to support VELB populations through colonization (River Partners 2004) in a variety of restoration planting designs (Gilbart 2009). The Valley elderberry longhorn beetle is currently being considered for delisting.

In 1980, the Service designated two zones in Sacramento County as critical habitat for the Valley elderberry longhorn beetle. Both zones are in or adjacent to the American River parkway near densely urbanized areas (Federal Register Vol. 45 No. 155, August 8, 1980). Although the host plant (S. Mexicana) may be found within the WMAs’ 8-county action area, there is no designated critical habitat for the Valley elderberry longhorn beetle where WMA easements may be acquired.

**6.13.18 Delta Green Ground Beetle (Elaphrus viridis) and its critical habitat**

Delta green ground beetle (Federally-listed as threatened) is a bright metallic green and bronze ground beetle (Carabidae), which cryptically blends with green vernal pool grassland and alkali meadow vegetation. It superficially resembles a tiger beetle (Cicindelidae), with large mandibles and black eyes. It preys on springtail. Delta green ground beetle range overlaps with other ground beetles (*E. californicus, E. finitimus*), but the Delta green ground beetle is easily distinguished by its bright metallic colors. It is the only known California Elaphrus species which has adults that are active in winter.

The Delta green ground beetle is only known from the Jepson Prairie area in south-central Solano County. One known collection site from the mid-1970s has been diked and plowed. This species may have been more widespread in the Central Valley, but agricultural, industrial, and urban developments have eliminated most of the wetland and grassland habitat associated with this, and other vernal pool species. Current threats include natural gas exploration, lack of grazing which results in tall overgrowth of non-native annual grasses which does not provide good habitat for the ground beetle or its prey, and illegal collecting (USFWS 2005a). Since its listing in 1980, the following three threats to the species have been identified: non-native plants, wastewater sludge applications as fertilizer, and climate change (potential for increased winter flooding and drought in spring and summer) (USFWS 2009b). Of the 8 counties within the proposed easement acquisition area, the Delta green ground beetle is known to or believed to occur in Sacramento and Yolo counties (USFWS 2014) (http://ecos.fws.gov/ecos/home.action).

In 1980, the Service designated two zones in Solano County as critical habitat for the Delta green ground beetle. Although the beetle may occur in Sacramento County, there is no designated critical habitat for the beetle where WMA easements may be acquired (Federal Register Vol. 45 No. 155, August 8, 1980).

**6.13.19 Vernal Pool Tadpole Shrimp (Lepidurus packardi) and its critical habitat**

The vernal pool tadpole shrimp (Federal-listed endangered species) is a small crustacean with
compound eyes, a large shield-like carapace (shell) that covers most of the body, and a pair of long cercopods (appendages) at the end of the last abdominal segment. Vernal pool tadpole shrimp adults reach a length of 2 inches in length. They have about 35 pairs of legs and two long cercopods. This species superficially resembles the rice field tadpole shrimp.

Tadpole shrimp climb or scramble over objects, as well as plowing along or within bottom sediments. Their diet consists of organic debris and living organisms, such as fairy shrimp and other invertebrates. This animal inhabits vernal pools containing clear to highly turbid water, ranging in size from 54 square feet in the former Mather Air Force Base area of Sacramento County, to the 89-acre Olcott Lake at Jepson Prairie in Solano County (USFWS 2005a).

The life history of the vernal pool tadpole shrimp is linked to the seasonal cycle of the vernal pool. After winter rainwater fills the pool, the population is reestablished from cysts that lie dormant in the dry pool sediments. Sexually mature adults have been observed in vernal pools three to four weeks after the pools had filled. Some cysts hatch immediately and the others remain dormant in the soil to hatch during later rainy seasons.

The vernal pool tadpole shrimp is known from eighteen populations in the Central Valley, ranging from east of Redding in Shasta County south to Tulare County, and from a single vernal pool complex on the San Francisco Bay Refuge in the City of Fremont, Alameda County (USFWS 2005a). Vernal pool tadpole shrimp are found on Sacramento Refuge (Silveira 2005).

Sacramento Refuge is a Priority 1 recovery area for vernal pool tadpole shrimp, vernal pool fairy shrimp, Conservancy fairy shrimp, Hoover’s spurge, Green’s tuctoria, and hairy Orcutt grass, which are all included in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005a).

Designated critical habitat for the vernal pool tadpole shrimp, Unit 3, is in Butte County, east of State Highway 99 and north of Highway 32; Unit 4 is in Butte County mostly along Highways 99, 149, 191, and 70; Unit 6 is in central Colusa County, near the Sutter County line; Unit 7 is in Yuba County, north of Erle Road; Unit 8 is in eastern Sacramento County north of Highway 16; Unit 9 is in southeastern Sacramento County; and Unit 10 is in southern Yolo County, south of Interstate 80, east of the intersection of Tremont Road and Road 104/Mace Boulevard (Federal Register Vol. 71 No. 28 February 10, 2006).

6.13.20 California freshwater shrimp
(Syncaris pacifica)

The California freshwater shrimp (Federal-listed endangered species) is a decapod crustacean of the family Atyidae and is believed to be the only extant species of the genus. They are generally less than 50 millimeters (2.17 inches) (Eng 1981) in postorbital length (from eye orbit to tip of tail). Juveniles and males typically appear translucent to nearly transparent while mature females are often brown with a tan dorsal stripe. They are found in low elevation, low gradient, freshwater, perennial streams in Marin, Napa, and Sonoma counties, California. During the winter, habitat includes shallow margins of stream pools containing undercut banks and...
exposed living fine-root material that provide shelter and refuge from high water velocities associated with winter storm events. During the summer months, California freshwater shrimp are often associated with submerged leafy branches. It is believed both winter and summer habitat components need to be found in close proximity in order for this species to persist for prolonged periods.

The California freshwater shrimp is a true freshwater shrimp, inhabiting freshwater streams in Napa, Sonoma, and Marin counties California. The California freshwater shrimp is also known or believed to occur in Colusa and Yolo counties (USFWS 2014) (http://ecos.fws.gov/ecos/home.action).

Although there is habitat for the California freshwater shrimp on WMA lands, it is not known whether it occurs on WMA lands.

**Fish**

6.13.21 **North American Green Sturgeon** *(Acipenser medirostris)* **southern Distinct Population Segment (DPS)**

In North America, the green sturgeon ranges from the Bering Sea to Ensenada, Mexico, a range that includes the entire coast of California. Green sturgeon southern DSP (Federal-listed threatened species) occurs in the San Francisco Bay Estuary, Sacramento–San Joaquin Delta, Sacramento River and Feather River. The Green sturgeon is superficially similar in appearance to white sturgeon *(Acipenser transmontanus)*, with which they co-occur. Spawning for the southern DSP occurs in the Sacramento River, while it is much reduced on the Feather River with the construction of Oroville Dam and the thermal barriers at the Thermalito Afterbay (NOAA 2005, USFWS 1996).

Of the 8 counties within the proposed easement acquisition area, the Southern DPS is known to or believed to occur in Butte, Colusa, Glenn, Sacramento, Sutter, Yolo, and Yuba counties. Additional portions of its range within California still need to be refined (USFWS 2014) (http://ecos.fws.gov/ecos/home.action); therefore, the species may occur in other counties within the proposed easement acquisition area.

6.13.22 **Delta Smelt** *(Hypomesus transpacificus)* **and its critical habitat**

Delta smelt (Federal-listed threatened and State-listed endangered) is endemic to the upper Sacramento–San Joaquin estuary. The taxonomy and life history of the species is covered in Moyle (2002). They primarily occur in the Delta below Isleton on the Sacramento River and Mossdale on the San Joaquin River. The species is euryhaline (tolerates a wide range of salinities), but rarely occur in water
over 10 to 12 parts per thousand salinity, about one-third that of sea water. Spawning (January to July) and rearing can occur in the Sacramento River (to Sacramento), the Mokelumne River system, Cache Slough region, the Delta, and Montezuma Slough area of the estuary. During high flows they are washed into San Pablo Bay, but do not establish breeding populations. Since 1982, the Delta smelt population center has been in the northwestern Delta in the Sacramento River; however they recolonized the Suisun Bay in 1993 during high flows. Prior to the 1880s when levees were constructed to create the Delta Islands, a vast fluvial marsh system characterized the Delta estuary: the Delta smelt likely reared in the upstream areas of fresher water (USFWS 1996). Delta smelt were once the most abundant pelagic (living in open water away from the bottom) fish in the Sacramento–San Joaquin estuary. The causes of decline are multiple and have had synergistic effect in population declines. They include: reduction of outflows through water storage and diversions; entrainment losses to water diversions; high outflows which can flush smelt and plankton out of the system; changes in food organisms through non-native invasive copepods (Sinocalanus doerrii and two species of Pseudodiaptomus), while the dominant native euryhaline copepod Eurytemora affinis, has declined; toxic substances; disease, competition and predation; and, loss of genetic integrity. The single greatest factor in the decline of Delta smelt is habitat loss in the Delta and Suisun Marsh through reduced outflows from water diversions (USFWS 1996).

6.13.23 Chinook Salmon, Sacramento River
Winter-run ESU (*Oncorhynchus tshawytscha*) and its critical habitat

Chinook salmon, the Sacramento River winter-run ESU (Federal and State-listed endangered species), only occurs in the Sacramento River watershed in California and most spawning is limited to the main stem of the Sacramento River. Adult salmon leave the ocean and migrate through the Sacramento-San Joaquin Delta and upstream into the Sacramento River from December through July. Downstream migration of juvenile winter-run Chinook salmon occurs from November through May. Winter-run Chinook salmon can rear as fry in the following areas on the Sacramento River: above Red Bluff Diversion Dam (moving downstream as smolts), and probably in the lower river between river mile 70 and 164 (moving downstream as fry). Water temperatures determine juvenile rearing locations and river conditions strongly influence movement.

In 1993, critical habitat was designated for the Sacramento River winter-run Chinook salmon (58 CFR 33212, June 16, 1993). This species occurs in the Butte Sink WMA in the Butte Creek system, and the North Central Valley WMA including the east and west Sutter Bypass channels, the Yolo Bypass and the Sacramento River. Winter-run Chinook salmon are monitored by the CDFW (CDFG 2005b).

6.13.24 Chinook Salmon, Central Valley
Spring-run ESU (*Oncorhynchus tshawytscha*) and its critical habitat

Chinook salmon, the Central Valley spring-run ESU (Federal and State-listed threatened species), occurs in the main stem of the Sacramento River and the Mill Creek, Deer Creek, Big Chico Creek, and Butte Creek tributaries. Adult salmon leave the ocean and migrate through the Sacramento-San Joaquin Delta, upstream into the Sacramento River from March through September. Downstream migration of juvenile spring-run Chinook salmon occurs from March through June, while yearlings move downstream from November.
through April. Most spawning occurs in headwater tributary streams. Critical habitat designation for this ESU is under development. This species occurs in the Butte Sink WMA in the Butte Creek system, and the North Central Valley WMA including the east and west Sutter Bypass channels, the Yolo Bypass and the Sacramento River. Spring-run Chinook salmon are monitored by the CDFW (CDFG 2005b).

In 2005, the NMFS designated critical habitat for two Evolutionarily Significant Units (ESUs) of Chinook salmon, including the Central Valley spring run Chinook salmon and other fish. Critical habitat is designated for the ESU of the Central Valley spring-run Chinook in 7 of the 8 counties that are within WMA boundaries: Butte, Colusa, Glenn, Sacramento, Sutter, Yolo, and Yuba. Critical habitat includes the stream channels within the designated stream reaches, extending to the ordinary high water mark (Federal Register Vol. 70 No. 170, September 2, 2005).

6.13.25 Steelhead, Central Valley ESU (*Oncorhynchus mykiss*) and its critical habitat

Steelhead, the Central Valley ESU (Federal-listed threatened species), is an anadromous form of rainbow trout. This species has traditionally supported a major sport fishery in the Sacramento River system. Their historical range in the Central Valley has been reduced by dams and water diversions that now restrict the species to the lower portions of major rivers, where habitat is less favorable for steelhead spawning and rearing. Steelhead use the Sacramento River as a migration corridor to and from spawning grounds in the main stem of the river above the Red Bluff Diversion Dam, the tributary streams, and the Coleman National Fish Hatchery. They are present in the Sacramento River year-round, either as smolts migrating downstream or adults migrating upstream or downstream. Upstream migration begins in July, peaks in the fall, and continues through February or March. Most spawning occurs from January through March. Juvenile migration generally occurs during the spring and early summer after at least one year of rearing in upstream areas. Populations have greatly declined over much of the species’ range, including the Sacramento River basin, due to blockage of upstream migration by dams and flood control projects, agricultural and municipal diversions, harmful temperatures in the Sacramento River, reduced availability of spawning gravels, and toxic discharges. This species occurs in the Butte Sink WMA in the Butte Creek system, and the North Central Valley WMA including the east and west Sutter Bypass channels, the Yolo Bypass and the Sacramento River. Steelhead are monitored by the CDFW (CDFG 2005b).

In 2005, the NMFS designated critical habitat for five ESUs of *Oncorhynchus mykiss*, including the Central Valley *O. mykiss* and other fish. NMFS used the species' scientific name rather than “steelhead” because at the time they were being proposed for revision to include both anadromous (steelhead) and resident (rainbow/redband) forms of the species (Federal Register Vol. 70 No. 170, September 2, 2005). Critical habitat is designated for the Central Valley ESU of the steelhead in 7 of the 8 counties that are within WMA boundaries: Butte, Glenn, Placer, Sacramento, Sutter, Yolo, and Yuba.

Amphibians

6.13.26 California Tiger Salamander (*Ambystoma californiense*) and its critical habitat

California tiger salamander (Federal and State-listed threatened species) is an amphibian in the family Ambystomatidae. The species is restricted to grasslands and low foothill regions where lowland aquatic sites are available for breeding. They prefer natural ephemeral pools or ponds that mimic them (stock ponds that are allowed to go dry). Larvae require significantly more time to transform into juvenile adults than other amphibians such as the western spadefoot toad (*Scaphiopus hammondii*) and Pacific tree frog (*Pseudacris regilla*). Compared to the western toad (*Bufo boreas*) or western spadefoot toad, California tiger salamanders are poor burrowers. They
require refuges provided by ground squirrels and other burrowing mammals in which to enter a dormant state called estivation during the dry months (USFWS 2011).

This species is restricted to California and does not overlap with any other species of tiger salamander. California tiger salamanders are restricted to vernal pools and seasonal ponds, including constructed stock ponds, in grassland and oak savanna plant communities, predominantly from sea level to 2,000 feet (610 meters), in central California. California tiger salamanders require large contiguous areas of vernal pools (vernal pool complexes or comparable aquatic breeding habitat) containing multiple breeding ponds to ensure recolonization of individual ponds. In the Coastal region, populations are scattered from Sonoma County in the northern San Francisco Bay Area to Santa Barbara County (up to elevations of 3,500 feet/1067 meters), and in the Central Valley and Sierra Nevada foothills from Yolo to Kern counties. The Sonoma population appears to have been geographically isolated from the remainder of the California tiger salamander population by distance, mountains and major waterway barriers for more than 700,000 years (USFWS 2011). The California tiger salamander is known to occur or believed to occur in all 8 of the counties within the WMA acquisition area (Butte, Colusa, Glenn, Sacramento, Sutter, Placer, Yolo and Yuba). Additional portions of its range within California still need to be refined (USFWS 2014) (http://ecos.fws.gov/ecos/home.action).

The primary cause of the decline of California tiger salamander populations is habitat loss and fragmentation of habitat from land conversions to agriculture, industrial, and residential development. All of the estimated seven genetically distinct populations have significantly declined. Nonnative predators, especially bullfrogs are a threat. Although bullfrogs are unable to establish permanent breeding populations in vernal pools, dispersing immature frogs from permanent water bodies within two miles take up residence and prey on adult or larval salamanders in these areas during the rainy season. Louisiana swamp crayfish, mosquito fish, green sunfish and other introduced fishes also prey on adult or larval salamanders. Reduction of ground squirrel populations to low levels through widespread rodent control programs may reduce availability of burrows and adversely affect the California tiger salamander. Poison typically used on ground squirrels is likely to have a disproportionately adverse effect on California tiger salamanders, which are smaller than the target species and have permeable skins. Use of pesticides, such as methoprene, in mosquito abatement may have an indirect adverse effect on the California tiger salamander by reducing the availability of prey. Various nonnative subspecies of the tiger salamander within the Ambystoma tigrinum complex have been imported into California for use as fish bait. The introduced salamanders may out-compete the California tiger salamanders, or interbreed with them to create hybrids that may be less adapted to the California climate or are not reproductively viable past the first or second generations. Contaminated runoff from roads, highways and agriculture may adversely affect the species (USFWS 2011).

There is no designated critical habitat in counties where WMA easements lands may be acquired.

6.13.27 California Red-legged Frog (*Rana draytonii*) and its critical habitat

California red-legged frog (Federal-listed threatened species) is the largest native frog in the western United States, ranging from 1.5 to 5 inches long. Adults are brown, olive, gray to reddish with small black flecks and larger irregular dark blotches, and mostly red abdomen and hind legs. The California red-legged frog requires a combination of specific aquatic and riparian habitat components, including slow moving to still water with deep pools and shrubby, overhanging vegetation mixed with emergent plants, such as cattails, along the edges. Like the California tiger salamander; adults also experience a dormant period, using rodent burrows and dense leaf litter for shelter (USFWS 2002c).
The California red-legged frog is endemic to California and Baja California, Mexico, at elevations ranging from sea level to approximately 5,000 feet (1,524 meters). Records indicate a California distribution from Riverside County to Mendocino County along the Coast Range, from Calaveras County to Butte County in the Sierra Nevada. California red-legged frogs are still locally abundant in parts of the San Francisco Bay area, including Marin County, and the central coast. Only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (USFWS 2002c). The California red-legged frog is known to occur or believed to occur in all 8 of the counties within the WMA acquisition area (Butte, Colusa, Glenn, Sacramento, Sutter, Placer, Yolo and Yuba). Additional portions of its range within California still need to be refined (USFWS 2014) (http://ecos.fws.gov/ecos/home.action).

California red-legged frogs are currently threatened by habitat loss and degradation through industrial, residential and other urban developments, mining, improper management of grazing, recreation, water impoundments and diversions, degraded water quality, invasion of nonnative plants, and introduced predators. These threats have resulted in the isolation and fragmentation of habitats within many watersheds, which can prevent dispersal between sub-populations. Habitat fragmentation and nonnative species represent the most significant current threats to California red-legged frogs (USFWS 2002c).

Of the 8 counties within the easement acquisition area, designated critical habitat for the California red-legged frog is in Butte, Placer, and Yuba counties; however, the critical habitat is in the higher elevations of the counties, above the easement acquisition area on the floor of the Central Valley. Easement acquisition on the valley floor is generally below 200 feet elevation.

**Reptiles**

6.13.28 Giant Garter Snake (*Thamnophis gigas*)

The giant garter snake (GGS) (Federal-listed and State-listed threatened species) is an endemic species to the valley floors of the Sacramento and San Joaquin valleys (USFWS 1999a). Although the boundaries of its original distribution are uncertain, giant garter snakes probably historically occurred from Butte County in the north, southward to Buena Vista Lake in Kern County (USFWS 1999a). The present distribution is from Chico to central Fresno County. Loss, degradation, and fragmentation of habitat are the primary threats to the giant garter snake. Conversion of wetlands for agriculture and urban and industrial development has resulted in the loss of more than 90 percent of suitable habitat for this species in the Central Valley (CDFG 2005a).

The GGS requires freshwater wetlands, such as marshes and low gradient streams. Permanent wetlands are of particular importance, as they provide habitat over the summer and early fall, when seasonal wetlands are dry. The GGS also inhabits rice fields, irrigation and drainage canals, sloughs, ponds, small lakes, low gradient streams, and adjacent uplands in the Central Valley.

The Service prepared a draft Recovery Plan for this species in 1999. The plan identified four recovery units within the range of the giant garter snake (Sacramento Valley, Mid-Valley, San Joaquin Valley, and South Valley) and proposes recovery criteria. The recovery criteria include adaptive management and monitoring; successful reintroduction within the historic range of the species; documentation of successful breeding and survivorship in 90 percent of the subpopulations in the recovery units; and maintenance of connectivity between subpopulations.

GGSs occur on all of the Refuges in the Complex. Intensive monitoring efforts by U.S. Geological Survey (USGS) between 1996 and 2005 indicated thriving populations particularly at Colusa and Sacramento Refuges, and along the Colusa Basin Drain (Carpenter...
These investigations also documented a positive response from GGS to wetland restoration and management on Colusa Refuge, including increased Refuge populations, decreased exposure to mortality factors, and reduced home range size (Wylie et al., 2006; USFWS 1999a).

**Birds**

6.13.29 Western Yellow-billed Cuckoo *(Coccyzus americanus occidentalis)* and its proposed critical habitat

The western yellow-billed cuckoo, a Federal-listed and State-listed threatened species, requires dense, large tracts of riparian woodlands with well-developed understories for breeding. Cuckoos nest in larger trees, such as Fremont’s cottonwoods, located in close proximity to foraging habitat (mixed riparian forest and willow and herbaceous scrublands). Their breeding range in California includes the lower Colorado, Kern, and Sacramento rivers.

The western yellow-billed cuckoo is threatened by loss and degradation of its habitat due to land clearing, fire, flood control projects, surface water diversions and groundwater pumping, and overgrazing by livestock (CDFG 2005a). Such disturbances often foster the establishment of invasive non-native plants, such as tamarisk and giant reed. The resulting fragmentation reduces the size and quality of habitat for the cuckoo.

The current population in California is about 60 to 100 pairs (Halterman et al., 2001). A statewide survey of yellow-billed cuckoos in California conducted during 1986 and 1987 found a total of 30 to 33 pairs and 31 unmated males at nine localities (Laymon and Halterman 1989). The majority of the cuckoos were concentrated along the upper Sacramento River from Red Bluff to Colusa (18 pairs and 19 unmated males) and at the South Fork Kern River (7 pairs and 3 unmated males) (Laymon 1998). During a study conducted in 1999 and 2000, cuckoos were located within portions of the Sacramento River NWR (Hammond 2011; Dettling and Howell 2011), adjacent to the Llano Seco and Butte Sink Units, and on Sutter NWR and adjacent areas (Isola 2000). It also occurs on the Sacramento River and Sutter NWRs that are a part of the Refuge Complex.

**Mammals**

6.13.30 Riparian Brush Rabbit *(Sylvilagus bachmani riparius)*

Riparian brush rabbit (Federal and State-listed endangered species) is a medium to small cottontail in the Leporidae family. There are 13 subspecies of brush rabbit, distributed from the Columbia River to the tip of Baja California. The riparian subspecies can be distinguished by color and cheek structure. Brush rabbits can be distinguished from desert cottontails by their smaller, inconspicuous tail and uniformly colored ears, lacking the black tips) (USFWS 1998).

Riparian brush rabbit habitat is characterized by riparian vegetation dominated by willow thickets (*Salix* spp.), California wild rose (*Rosa californica*), Pacific blackberry (*Rubus vitifolius*), wild grape...
Brush rabbits have small home ranges that usually conform to the size of available brushy habitat. Avoiding large openings in shrub cover, they frequent small clearings, where they feed on a variety of herbaceous vegetation, including grasses, sedges, clover, forbs, shoots and leaves. Grasses and other herbs are their most important food, including green clover (Trifolium wormskioldii) (USFWS 1998). The riparian brush rabbit is known or believed to occur in Sacramento County. Additional portions of the range for the species within California still need to be refined (USFWS 2014) (http://ecos.fws.gov/ecos/home.action); therefore, the species may occur in other counties within the proposed easement acquisition area.

Historical population declines were a result of statewide reduction of riparian communities by nearly 90 percent due to wood cutting, agricultural land conversions, flood control and land reclamation activities including dam building, channelization, and water diversions, ground water pumping, and commercial and urban development (USFWS 1998). Current potential threats to this species include habitat conversion to agriculture, wildfire, disease, predation, flooding, drought, clearing of riparian vegetation, use of rodenticides and browsing and trampling by ungulates (USFWS 1998).

7. Fish and Wildlife Management

Fish and wildlife management on these WMAs is mostly accomplished through habitat management, restoration, and enhancement. Habitat restoration and management can improve the overall health and productivity of fish and wildlife populations by increasing and enhancing breeding, staging, and wintering areas that provide food, cover and shelter. Habitat and management needs can be designed to benefit certain target species or, more commonly, multiple species.

7.1 Migratory Bird Management

One of the WMAs’ primary purposes is to provide habitat for migratory birds, particularly wintering waterfowl. The habitat management described in the Habitat section (section 4) contributes to achieving that purpose on easement and Service-owned lands. The combination of managed habitat types supports millions of migratory birds and a variety of species, both breeding and non-breeding, abundant and rare.

7.1.1 Migratory Bird Management on Easements

One of the primary purposes for easement acquisition is to protect and provide habitat for waterfowl and other migratory birds. The motivating interest behind most easement landowners is waterfowl hunting, and this interest often drives habitat restoration, enhancement and management on easement lands. The Complex’s private lands staff will often provide technical assistance as well as cost-share funding (through Partners for Fish and Wildlife Program, NAWCA grants, etc.) to help easement owners restore and enhance their lands for waterfowl and other migratory birds. The Easement Manager also reviews all proposed habitat projects and other relevant activities on easement properties to ensure they don’t negatively affect migratory birds and migratory bird habitat.

In addition to implementing habitat projects, many easement properties support other migratory bird activities including: wood duck nest box programs, waterfowl egg salvage programs, local waterfowl banding projects, and various migratory bird research and monitoring projects.

7.1.2 Migratory Bird Management on Service-owned Lands

Migratory bird management on Service-owned lands consists of primarily surveys and monitoring projects, which are described under section 7.4.

7.2 Threatened and Endangered Species Management

The WMAs provide habitat for a number of threatened, endangered, and sensitive species that occur across a variety of habitat types (Appendix L).
7.2.1 Endangered Species Management on Easements

While not explicitly managed for threatened and endangered species, easement lands provide similar habitats as Service-owned lands and, as a result, support many of the same special status species (Appendix L). Many habitat restoration and enhancement activities targeting migratory birds on easement lands (restoration of semi-permanent/permanent wetlands and riparian forest) provide ancillary benefits to threatened and endangered species. With this in mind, the private lands staff works with interested landowners to incorporate the needs of threatened and endangered species into habitat restoration and enhancement projects on easement lands. When providing cost-share funding or technical assistance on habitat projects through the Partners for Fish and Wildlife Program, Endangered Species Act compliance is obtained through the “Programmatic Intra-Service Formal Section 7 Consultation on Partners of Fish and Wildlife Program Proposed Actions, Fiscal years 2010 through 2020.” This consultation allows the Service and landowner to conduct wetland, upland and riparian habitat restoration as long as specific avoidance measures are implemented to reduce the impact on threatened and endangered species.

7.2.2 Endangered Species Management on Service-owned Lands

On Service-owned lands, specific management activities for these species and their habitats include vegetation manipulation (e.g., burning, grazing), population monitoring, and research efforts that are implemented through the same annual habitat management planning process as other biological resources (see section 4). Any special requirements are considered and documented in the Annual Habitat Management Plan (AHMP). Management of these habitats typically includes periodic treatments of burning, grazing, and herbicide applications to reduce and control non-native invasive plants and improve habitat for native wildlife and plants. Best management practices (BMPs) are implemented to reduce frequency of disturbance, while conducting these activities. Natural hydrology and other natural processes (i.e., grazing and fire) are emphasized.

Certain management activities that are beneficial to some species or habitats may negatively impact others. Because of the many management activities that regularly occur here, the Complex has consulted with the Service’s Ecological Services on operations and maintenance activities of the Refuges to ensure that their implementation complies with the Endangered Species Act. The resulting biological opinion stated these activities would not jeopardize the continued existence of any Federally-listed endangered or threatened species on the Complex (USFWS 1999d). As required by Service policy, the Refuges also incorporate State-threatened and endangered species into planning activities.

As discussed above, BMPs have been developed to accommodate Refuge management activities’ special requirements for endangered and threatened species and their habitats. For example, BMPs are identified for ditch and canal maintenance activities in giant garter snake habitat in the Llano Seco Unit AHMP. Specific protocol is identified in the AHMP which allows Refuge maintenance to proceed while minimizing and eliminating potential impacts to snake habitat including winter hibernacula. BMPs are conducted in accordance with the Sacramento NWR Complex Programmatic Intra-Service Formal Section 7 Consultation.

Endangered and threatened species management includes inventory and monitoring surveys to gather baseline data and information to assess Refuge habitat restoration and management activities and programs. It also includes research investigations designed to address questions and hypotheses of Refuge habitat restoration and management effects on various aspects of endangered species management, including habitat characteristics and population status and health (Garcia 2009, Gilbart 2009, Hammond 2011, Wingo 2009, Wylie et al., 2006, Wight 2002). Examples of surveys include vernal pool plant and
The Refuge Environment

Invertebrate monitoring at the Llano Seco Unit and adjoining Llano Seco Ranch. Not only are these surveys useful for tracking Refuge natural resources through time and various habitat treatments (e.g., prescribed grazing), but, along with basic soil inventory data collected from the site (Burkett and Conlin 2005), this information was used to restore vernal pool topography and hydrology at Llano Seco Unit Tract 17 (Ducks Unlimited, Inc. 2008). To increase restoration value for endangered species, research is being conducted to introduce vernal pool plants (e.g., Green’s tuctoria) at the Tract 17 vernal pools (Gottschalk Fisher 2013). This research also addresses vernal pool recovery activities developed by the Service to protect, restore, and manage vernal pool ecosystems in California (USFWS 2005a).

A recently completed study of State-listed threatened greater Sandhill Cranes assessed topographic features of wetlands used by cranes at the Llano Seco and Butte Sink Units, and other sites within the Sacramento NWR Complex (Shaskey 2012). Results indicated that cranes selected open wetland areas with water averaging 6.10 inches (15.5 cm), tolerating maximum water depths up to 9.25 inches (23.5 cm) deep. Wetland restoration and management for crane roosts should be designed with water depths closer to the 6.10 inches (15.5 cm) average and minimize tall emergent vegetation.

7.3 Game Management

Game species commonly occurring on the WMAs include black-tailed deer, California quail, mourning dove, wild turkey, ring-necked pheasant, various waterfowl species, and Wilson’s snipe. Riparian forests, grasslands, seasonal wetlands, and semi-permanent/permanent wetlands all contribute to nesting cover for upland game birds and other wildlife. Well-distributed semi-permanent and permanent wetlands also provide essential water sources for game species during summer months, when the WMAs are relatively dry.

7.3.1 Game Management on Easements

In addition to wetland management for waterfowl (described in section 5, above), easement landowners provide upland cover and food plots managed for game species. Food plots can be planted on up to 5 percent of the easement acreage and must be contained in upland areas. These planting typically consist of safflower, milo, and corn crops primarily managed to benefit doves, pheasant and deer. Game management and hunting opportunities on private lands are authorized under State fish and wildlife regulations and seasons. Some easement properties are licensed with the state as private pheasant clubs.

7.3.2 Game Management on Service-owned Lands

Hunting is not allowed on the Service-owned Butte Sink and Llano Seco Units. Other than waterfowl, game species are not managed for explicitly, and food plots are not grown on any Service-owned lands. However, deer and upland

Sandhill Cranes, Llano Seco Ranch. Photo: USFWS
game species receive incidental benefits from the habitats that are managed for other priority Refuge resources. Game populations are monitored through regular wildlife surveys.

7.4 Monitoring and Research

Monitoring and research projects are conducted by Refuge biological staff or cooperatively with principle investigators from government agencies, universities, and private conservation organizations. Monitoring and research are the foundation for management decisions on Service-owned lands, as well as for providing management information/guidance to easement landowners. Many of these investigations and long-term monitoring projects help provide feedback to broader management actions involving the State or even the Pacific Flyway (Appendix G).

7.4.1 Monitoring and Research on Easements

Most of the monitoring and research activities involving easement properties occur as part of Valley or State-wide monitoring efforts (Appendix E). The majority of these surveys are conducted by aircraft (such as the Mid-winter Waterfowl Index), but may also be conducted by ground if access and other arrangements are made in consultation with the landowner.

7.4.2 Monitoring and Research on Service-owned Lands

On Service-owned lands, a number of biological surveys are conducted to determine and track the distribution and abundance of biological resources and their use of habitats. The regular wildlife surveys are the cornerstone of these surveys. They are conducted by ground vehicle on standardized routes for the Butte Sink Unit and Llano Seco Unit. Species and numbers of waterfowl and other waterbirds, raptors, and other birds and mammals that can be seen readily are estimated and recorded for each management unit. This level of data collection allows for the evaluation of wildlife use by habitat type, management treatment, and type of adjacent visitor use (e.g., auto tour, walking trail). Other monitoring programs include disease surveillance, operational waterfowl banding, and facilitation of management-oriented research projects.

This information is stored, tracked, and analyzed in a database and used to develop Annual Habitat Management Plans, where projects designed to rehabilitate, enhance, and restore wildlife habitat are identified, prioritized, and project implementation is tracked and management actions are evaluated.

In addition, special surveys are conducted for a variety of rare or special status species or species of management concern. Examples include surveys for endemic vernal pool plants and invertebrates and various migratory birds. Study proposals are evaluated by refuge staff to assure that the research is compatible with the goals of the Service-owned land(s) and that some aspect of the results will contribute to wildlife and habitat management. A Special Use Permit (SUP) is issued to each research investigator. The SUP identifies and describes individual projects, provides contact information, identifies where research activities will take place, and describes special conditions to assure the health and safety of the environment and those who visit the Service-owned land. Because of the number of researchers that may be working on the Service-owned lands at any one time, coordination among the projects and with normal USFWS operations is essential. Researchers have come from universities such as California State University Chico, the University of California (UC) Berkeley, UC Davis, UC Santa Cruz, Sonoma State University, San Francisco State University, Exeter University and the University of Saint Andrews. Federal and State agencies such as the U.S. Geological Survey (USGS), USFWS, California Department of Water Resources, and CDFW also conduct research on the Service-owned lands. Researchers investigate a wide range of biological and physical phenomenon. These include topics on wildlife biology (distribution/abundance, reproductive success, predation, and impacts from contaminants), vegetation analysis (growth rates, species...
composition, succession, and exotic species impacts), water quality, soils analysis, geology, fluvial geomorphology, and hydrology.

7.5 Wildlife Disease Monitoring and Treatment

Because the WMAs are a concentration area for migratory birds and other wildlife, there is elevated potential to have significant disease outbreaks and mortality events. Historic disease losses on the Refuges are described in the Waterfowl Disease Contingency Plan for the Sacramento, Delevan, Colusa, and Sutter NWRs (USFWS 2009).

Avian botulism (Type C) and avian cholera are the two most common wildlife diseases that affect migratory birds within the WMAs. Botulism is generally a warm weather disease that usually occurs between July and October. Botulism spores from the bacteria Clostridium botulinum occur naturally in wetlands and can reproduce under the right environmental conditions, including low oxygen levels and warm temperatures (Sandler et al., 1993; Rocke and Samuel 1999). These bacteria produce a powerful neurotoxin that affects the central nervous system of waterfowl and other waterbirds resulting in paralysis and eventually death. During warm months, the disease can be spread rapidly through a carcass-maggot cycle where maggots that have fed on carcasses concentrate botulism toxin in their bodies and then are consumed readily by other birds, leading to their demise (USGS 1999). Outbreaks during winter or spring months are possible, but much less common and less severe in terms of mortality.

Avian cholera is typically a cold weather disease that typically occurs between the months of November and March. With cholera, the bacteria Pasteurella multocida infects and directly attacks birds’ internal organs and respiratory system. Recent studies indicate that cholera does not persist long in the environment (Samuel et al., 2004). Outbreaks are more likely started via carrier birds and transmitted primarily bird-to-bird (Mensik and Samuel 1995; Samuel et al., 1999). While a wide variety of other wildlife diseases have been documented or could potentially occur on the WMAs, botulism and cholera account for the majority of disease management operations.

In the last decade, annual mortality from botulism and cholera in the Sacramento Valley has decreased and may be related to restoration efforts and increases in waterfowl habitat in the Central Valley (Eddings and Eadie 2003, M. Wolder, unpublished data). Other diseases of concern that have not yet been detected or have not been documented to affect many animals at the WMAs include West Nile Virus, Chronic Wasting Disease, and Duck Viral Enteritis. Since 2005, there have been increasing concerns about highly pathogenic Asian H5N1 avian influenza (HPAI H5N1) reaching North America from Asia or Europe, possibly via inter-Flyway movements of migratory birds. Because of the potential of this disease to affect people, surveillance of migratory birds and their habitats for this disease has increased significantly as of 2005 (Interagency Asian H5N1 Early Detection Working Group 2006; Pacific Flyway Council 2006c; CDFG et al., 2006). Because of the Complex’s concentration of waterfowl, a number of Federal and State surveillance efforts continue to be facilitated here. As of September 2013, HPAI H5N1 had not been detected in North America.

One new disease that has been recently identified in the Sacramento Valley is hair-loss syndrome in black-tailed deer. The condition is caused by a heavy infestation with a Eurasian louse of poorly defined taxonomic status in the genus Damalinia (Cervicola) sp. When black-tailed deer become infested, they tend to develop a hypersensitivity (severe allergic) reaction to the lice, which causes irritation of the skin and excessive grooming by the deer. Eventually, this excessive grooming leads to loss of the guard hairs, leaving yellow or white patches along the sides. Infestations are heaviest during late winter and early spring, and many affected deer, especially fawns, die during this time.
7.5.1 Wildlife Disease Monitoring and Treatment on Easements

On easement lands, there is typically no organized monitoring effort for disease outbreaks. However, occasionally outbreaks occur and are reported by easement owners. CDFW is the primary agency responsible for addressing and responding to disease events on easement lands. However, depending on the situation, Sacramento NWR Complex staff may assist CDFW in responding to disease outbreaks on private lands.

7.5.2 Wildlife Disease Monitoring and Treatment on Service-owned Lands

On Service-owned lands, wildlife disease monitoring is conducted regularly throughout the year. Wetland units and other areas are inspected regularly and opportunistically for dead or sick animals while conducting other field work. During months of greater outbreak probability, some wetland units with notable disease histories are periodically surveyed via airboat to detect any problems early. During outbreaks, dead birds are located and removed using airboats to systematically cover all areas within a unit. Standard safety precautions are followed when picking up carcasses or conducting other disease surveillance (USGS 1999; USFWS 2006b). Monitoring includes documentation of the number and condition of dead and sick animals by management unit, tracking of effort, and shipment of diagnostic specimens to the USGS National Wildlife Health Center in Madison, Wisconsin, where the carcasses are necropsied and tested to confirm the cause of death (USGS 1999). Other carcasses may be saved for scientific or educational activities or incinerated. When appropriate, results are shared with other Service divisions (Law Enforcement, National Forensics Laboratory at Ashland, Oregon) and CDFW (game wardens, Wildlife Investigations Laboratory at Rancho Cordova).

Avian cholera outbreaks involving hundreds and sometimes thousands of waterfowl mortalities have occurred periodically at the Butte Sink Unit and occasionally at the Llano Seco Unit. Avian botulism outbreaks resulting in losses of thousands of birds have occurred on Complex refuges, but the magnitude and frequency of these outbreaks has declined in recent years.

8. Recreation on Easements

The Service has not purchased public access or other rights pertaining to recreation in the acquisition of conservation easements. As a result, easement owners largely control the types of recreation that are pursued on their properties.

The Service conservation easement does specifically state that hunting or operation of a hunt club is considered consistent with the management of easement lands. The specific inclusion of hunting as a retained right underscores the importance of hunting on easement lands. Currently (as well as historically) the majority of easement lands are used as hunting properties, which support recreational waterfowl hunting, and to a lesser degree upland game (ring-necked pheasants, mourning dove, California quail, turkey) and big game (deer) hunting, during the fall and winter months. All hunting activities on easement lands must be done in accordance with State and Federal laws regulating hunting on privately owned lands. In addition to Federal and State laws, many easement properties have their own, self-imposed rules which: 1) limit the number of hunters using the property, 2) limit the number of days hunted per week, 3) establish bag limits lower than State regulations and 4) establish inviolate wildlife sanctuaries on their properties.

In addition to hunting, other recreational activities on easement lands include fishing, bird watching, wildlife photography, hiking and “quiet enjoyment”.

9. Visitor Services on the Llano Seco Unit

9.1 Visitor Services and Management Policy

There are a variety of sources for policy and guidance to manage visitor service programs
on Refuges and other Service-owned lands. The Service Manual (605 FW 1-7) provides the policy for wildlife-dependent recreation including hunting, recreational fishing, wildlife observation, wildlife photography, environmental education, and interpretation. The policy also provides guiding principles for each of the wildlife-dependent recreation programs.

In 2007, the Service declared that “connecting people with nature” is among the agency’s highest national priorities (USFWS 2008a). A connection with nature, whether it’s hiking, fishing, camping, hunting, or simply playing outside, helps children develop positive attitudes and behaviors towards the environment. Positive interactions with the environment can lead to a life-long interest in enjoying and preserving nature. People’s interest in nature is crucial to the Service mission of conserving, protecting, and enhancing fish, wildlife, plants, and their habitats.

Other initiatives implemented at the Refuge Complex include: Birder Friendly Refuge/National Birding Initiative and Youth Initiative (Youth Conservation Corps and Chico State Field School volunteer opportunities).

9.2 Visitor Data

The Complex utilizes a variety of methods for estimating the number of annual wildlife-dependent visits. The types of estimation methods used are direct observation, traffic counters, trail counters, surveys, and estimation based on professional judgment. From these estimates, the numbers of visitors and visits are used to manage and improve the Complex’s visitor services program.

The National Wildlife Refuge System Visitation Estimation Workbook (USFWS 2005b) provides basic principles and definitions that have been used to describe the Complex’s visitation estimation program.

Recreational or educational activities that are allowed and monitored on the Llano Seco Unit include wildlife-dependent recreation (e.g., wildlife observation, photography, environmental education, and interpretation). Wildlife observation includes hiking trail visits. A Llano Seco Unit visitor (visitor) is a person that participates in at least one of the wildlife-dependent recreation activities. Visitors do not include staff, volunteers, researchers, contractors, people with special use permits, or people who are traveling through the Llano Seco Unit to reach another non-Llano Seco Unit location.

A visitor is not the same as a Llano Seco Unit visit (visit). A single visitor may make several visits to the Llano Seco Unit on a single day by participating in several different activities. The total amount of visits on a given day is a count of only individuals. The amount of time for each individual visit is not accounted for; whether it is minutes or hours.

It should be noted that there is no accurate method of counting all visitors or visits. Therefore, the numbers of visitors or visits reported are estimates, although the Service strives for consistency and quality of estimation monitoring methods to improve the accuracy of the information collected.

The hiking trail visits, which include wildlife observation, and the photography visits are recorded separately and added to the vehicle counts that are recorded by a traffic counter at the Llano Seco Unit entrance. Interpretation and environmental education visits are observed, planned or lead by Refuge staff.

A survey conducted by California State University – Chico students at the Sacramento NWR provided the following information about 446 visitors sampled from November through early March in 1997-1998 and primarily on Sundays: 43 percent were new visitors and 38 percent had visited 3 or more times previously; 48 percent stayed overnight; 87 percent of the overnight visitors spent one or two days visiting the refuge; 45 percent were in groups of two, 19 percent as groups of three, 17 percent as groups of 4, 6 percent as individuals, and 9 percent as groups of five or more; and for highest level of education 11 percent of visitors were high school, 30 percent completed college, 18 percent part of college, and 40 percent had post graduate education. In 2010, the visitor
log book at Sacramento NWR’s visitor center included where the visitors were traveling from. Most visitors that enter the visitor center are first time visitors, visitors with friends and family to show off exhibits, or want to purchase items from the bookstore. However, the data collected showed that local visitors who live within 75 miles made up 22 percent, northern California (excluding locals) 57 percent, southern California 6 percent, other states 12 percent, and other countries 2 percent.

9.3 Hunting

Currently, there is no public hunting on the Service-owned Llano Seco Unit. As part of the coordinated efforts of the Llano Seco Ranch Joint Management Committee (see section 10.2), an agreement was developed stating that CDFW would provide public hunting opportunities on the CDFW-owned Llano Seco Unit of the Upper Butte Basin State Wildlife Management Area. Alternatively, the Service agreed to provide wildlife sanctuary and other types of “non-consumptive” recreational opportunities including wildlife observation, photography, interpretation, and educational programs. These programs have been in place for more than a decade and continue to provide high quality visitor opportunities.

9.5 Fishing

Currently, there is no public fishing on the Llano Seco Unit. There are no permanent water bodies to provide fishing opportunities on the Service-owned lands located within the Llano Seco Unit.

9.5 Wildlife Observation

Wildlife observation opportunities are available on the Llano Seco Unit (i.e., favorable circumstances for seeing wildlife). Two viewing platforms offer panoramic views of the wetlands and wildlife. The Llano Seco Unit provides a parking area and a fully accessible restroom. Platforms are designed to allow wheelchair access. A half-mile hiking trail meanders along seasonal marshes providing visitors with close-up access to undisturbed wildlife. These facilities provide unique wildlife viewing opportunities, especially at the Track 12 wildlife viewing platform and along the hiking trail at Track 12 and Track 14 (T12 and T14 in Figure 11). The Llano Seco Unit is one of the few quality and regular spots for visitors to see sandhill cranes from October through February.

Several local birding organizations including Altacal Audubon Society, Chico State Birding Club, Northern California Birding Friends, and the Snow Goose Festival, utilize the area for birding events throughout the fall and winter months.

9.6 Wildlife Photography

The wildlife viewing platforms and hiking trails on Llano Seco Unit provide excellent photographic opportunities. The best time of year for photography occurs from November through February, when a variety of waterfowl, sandhill cranes, bald eagles, and shorebirds are present. The ducks here have been able to habituate to visitors to a certain degree, and photographers are often able to take pictures of ducks at close range.

Refuge staff provides annual photography field trips to the Llano Seco Unit every fall, as well as a photography workshop and field trip associated with the Snow Goose Festival in late January.
9.7 Environmental Education

Environmental education teaches students or adults about natural history topics, their environment, and their interactions with humans. It is often lead by Service staff, volunteers or teacher/leaders of the group in the classroom or on-site at a refuge. Hands-on activities cover a wide range of subjects, meet State standard curriculum, and are designed to inspire discovery, promote fact-finding. Activities also develop problem-solving skills that lead to informed decisions, personal involvement and action. The Service provides staff-lead programs for kindergarten through twelfth grade and college students.

Although the Llano Seco Unit is open to the public from 1 hour before sunrise to 1 hour after sunset, we encourage groups to make reservations for staff-lead activities to ensure that they will have the best possible experience and that needed resource materials are available.

In addition to staff-guided tours local colleges and universities utilize the kiosk, wildlife viewing platforms, and hiking trail during educational field trips for a variety of course work. California State University-Chico regularly utilizes the site for Waterfowl Ecology & Management, General Ecology, Riparian & Wetland Ecology & Restoration, Plant & Soil Science, and photography and art courses. Butte Junior College utilizes the site for similar activities including a Natural Resources Management course.

9.8 Interpretation and Outreach

Interpretation involves participants of all ages who voluntarily learn to make an intellectual or emotional connection with the natural or cultural resources. Interpretation communicates science in a more thought provoking way than just providing facts and figures. A firsthand experience often deepens a visitor’s personal connection and leads them to discover more. This may occur through a variety of methods including programs led by staff or volunteers, multimedia, kiosks, brochures, signs, and exhibits. The Service’s Children and Nature Initiative, Connecting People with Nature (USFWS 2008a) strives to ensure that America’s children have enjoyable and meaningful experiences in the out-of-doors and develop strong life-long connections with the natural world. The Llano Seco Unit also strives to meet this initiative by providing quality, wildlife-dependent recreational facilities and interpretive opportunities.

From November through February, refuge staff and volunteers offer planned visitor programs and regularly provide roving interpretation for visitors. In the 2012-2013 winter season, volunteers roved over 73 hours on 30 different days, and spoke with 647 visitors at the Llano Seco Unit. Roving volunteers provide interpretation involving unscripted, personal communication with visitors in an informal setting that is dictated by the location, resources, and the visitor’s needs and interests.

Refuge-related information is provided at annual local festivals or during special events held in the general region surrounding Llano Seco Unit, such as the Snow Goose Festival, National Wildlife Refuge Week, Coleman National Fish Hatchery Return of the Salmon Festival, Duck Days, California Junior Duck Stamp Program, and Chico Endangered Species Fair. During 2013, approximately 5,000 individuals attended the presentations and saw exhibits at these events.

9.8.1 Website and Social Media

Refuge staff maintains websites for each Refuge and WMA in the Complex: http://www.fws.gov/refuge/North_Central_Valley. Events, wildlife survey data, planning documents, and information about the Llano Seco Unit, and other Service-owned lands are posted on the website. The Complex also has a Facebook page, which as of February 2014, has over 1,300 “likes”. Since its inception in July 2012, 799 people have been engaged and several items of interest are posted on the Facebook page per week. The average follower is 25-34 years old and lives in the Sacramento area.
10. **Cooperation with Adjacent Landowners**

The WMAs are part of a mosaic of public and private land in the Sacramento Valley. Public lands consist primarily of wetland, upland, and riparian forest habitat managed as National Wildlife Refuges and State Wildlife Areas, while private lands are mostly agricultural land (rice, orchards, row crops) and managed wetlands (duck-hunting clubs), with some farmsteads, businesses, trailer parks, and isolated homes. To maximize our conservation efforts the Complex encourages and supports the cooperative approach to problem solving by working with neighbors on common issues (e.g., trespass, fire and fuel break management, drainage). The refuge manager is the primary contact for the cooperation with adjacent landowners.

10.1 **Working with Adjacent Landowners on Easements**

While there is no formal process for working with landowners adjacent to easement lands, coordination and cooperation with neighboring landowners is encouraged and pursued. In most cases, the acquisition of a conservation easement on existing wetlands does not change land management practices and has almost no effect on neighboring lands. In these circumstances, there is rarely coordination with respect to easement acquisition. When purchasing conservation easements on agricultural lands that require restoration, subsequent changes in habitat and management on easement properties can potentially affect adjoining lands. As a result, when habitat restoration is required, coordination with neighboring landowners is encouraged prior to easement acquisition and throughout the restoration process.

There are occasions when the management of easement properties and neighboring lands conflict. In these cases, we encourage easement landowners to work cooperatively with their neighbors to address issues. When issues directly affect the Service’s easement interest, the Service may help facilitate coordination between easement landowners and neighbors. In these situations the Service uses a cooperative approach to help find solutions that protect the Service’s interest while meeting the needs of both easement landowners and neighboring properties.

10.2 **Llano Seco Joint Management Committee**

During the late 1980s and early 1990s a significant portion of the Llano Seco Rancho was protected through easement or fee-title acquisition by several conservation agencies and groups. The easement and fee-title interests acquired by the Service fell under the authority of the North Central Valley WMA. In 1991, a contractual agreement was signed by the each of the parties holding conservation interest in the land, establishing the Joint Management Committee (JMC). The original members included the Service, CDFW, The Nature Conservancy and Parrott Investment Company. In 2008, additional lands within the Ranch were protected under both conservation and agricultural easements by the State of California. These lands are administered by the Northern California Regional Land Trust (NCRLT). Since that time, the NCRLT has also been a participant in the JMC.

The purpose of the JMC was to allow the parties to coordinate activities in a manner to meet their conservation, resource management, outdoor recreation and habitat preservation goals and objectives. The JMC agreement also addresses issues related to water delivery, infrastructure maintenance, access, drainage, etc.

To facilitate coordination and communications between the parties on management activities, budgets, and restoration work, the JMC agreement requires, at a minimum, an annual meeting to be held with at least one representative designated by the signatory members. Issues typically discussed at these meetings includes, but are not limited to proposed improvements, planting programs, water needs, and any other major activity that could affect other members.
10.3 Butte Sink Landowner Annual Meetings, MOUs, etc.

The Service, Colusa Shooting Club, and the Stack Farms hunting club have entered into an agreement (identified as a “Land Usage Agreement) regarding 75 acres of land identified as Parcel 3) in the southeast portion of the Butte Sink Unit. This parcel was purchased by the Service from Colusa Shooting Club and Stack Farms. The parties agree that “Parcel 3 will be maintained as natural habitat and the Service will manage the density and height of plants and trees so as to encourage maximum use by waterfowl. The agreement states that a management committee comprised of one representative each from Service, Colusa Shooting Club, and Stack Farms will be formed to coordinate water and land management issues of common interest on Parcel 3, such as water flow between the respective properties, and fall flood-up schedule. The agreement states that the committee will meet at least once annually on or about January 15th to discuss land and water management issues for the forthcoming year.

The Service has an easement and agreement with Butte Creek Farms for use and maintenance of Laux Road extension to access the Butte Sink Unit. The Service is responsible for 25 percent of the cost of maintaining the Laux Road extension. The Service provides labor and equipment to contribute its share of the cost.

The Butte Sink Waterfowl Association holds an annual meeting (typically in December) to discuss and address issues of concern in the Butte Sink. The Service attends this meeting and provides information regarding the Butte Sink Unit and easement lands in the Butte Sink WMA.

11. Fire Management

The term Fire Management includes wildland fire suppression, prevention, investigation, suppression repair, rehabilitation, prescribed fire, and hazardous fuels management. Details of Fire Management activities can be found in the Sacramento National Wildlife Refuge Complex Fire Management Plan (USFWS 2009, Appendix J). With all fire management activities, the protection of firefighter and public safety is the first priority.

11.1 Historic Role of Fire

Little is known about past fire regimes in California’s Central Valley grasslands, riparian woodlands, and freshwater marshes; however, evidence suggests a history of frequent, low-intensity fires that burned large expanses of the landscape in a mosaic pattern. Native Americans are known to have used fire frequently in the summer and fall months to improve hunting areas, increase the abundance and quality of plants used for food, medicine, fiber, and basketry, and to improve defense against other tribes (Anderson 2005, 2006). During certain times of the year, riparian and wetland corridors were used as barriers to limit fire spread. Lightning occurs at a low density in the valley and likely did not contribute significantly to the overall fire regime (Wills 2006). Potential fire frequency in the Central Valley before Euro-American settlement is estimated to have been 1-3 years (Frost 1998).

In the past 200 years, the Central Valley’s natural habitats and their fire regimes have been altered dramatically. It is estimated that the dominant vegetation types now occupy only 10 percent of their former range due to land use conversion and fragmentation (Wills 2006). Widespread conversion of native perennial grasslands to non-native annual grasslands has resulted in fires that are typically higher intensity and severity and often occur much earlier in the growing season (Reiner 2007). Fire suppression, intensive grazing, and elimination of Native American ignitions have greatly decreased fire frequency in some areas (Reiner 2007). Near urban areas, fire frequency has generally increased in annual grasslands due to accidental ignitions. However, habitat fragmentation limits fire size and most fires are contained at less than 4 ha (10 ac) (Wills 2006).

Prescribed fire is now commonly used by land managers as a tool to maintain and or restore
wetlands, native grasslands and other habitat types in the Central Valley. Fire, usually in combination with mechanical, chemical, or other methods, is also used to reduce hazardous fuels and protect communities from wildfires.

11.2 Fire Management on Easements

Where the Service has purchased conservation easements on private lands, responsibility for fire management remains with local fire departments unless a specific fire management agreement transfers that responsibility to the Service. Fire management staff may collaborate with private partners to provide them information on best management practices for fire management activities.

11.3 Fire Management on Service-owned Lands

The Service assumes responsibility for wildland fire management on Service-owned WMA lands unless otherwise specified in a management agreement. The Complex maintains a permanent and seasonal wildland firefighting staff that manages three engines, a fire station and fire cache. Their responsibilities include the full range of fire management activities including, fire suppression, fire prevention, and hazard fuels reduction. The Service is a signatory to all California state-wide wildland fire management agreements as well as local and countywide agreements to facilitate mutual aid. All non-wildland fire emergencies including structure fires, vehicle fires, medical aides, and hazardous materials remain the responsibility of local government fire departments.

Complex fire prevention programs focus on preventing the threat of unwanted human caused fires to Service-owned lands. Popular activities have included Junior Firefighter Program, Smokey Bear Program, and prevention activities at community events.

Prescribed fire in annual grassland, Llano Seco Unit. Photo: USFWS

Hazard reduction programs are intended to protect lives, property, and resources from unwanted wildfire. Projects are given highest priority to Wildland Urban Interface (WUI) areas. The WUI program is part of the National Fire Plan and is designed to reduce the potential for wildfire damage in zones where wildlands and infrastructure (assets at-risk) mix. The WUI program emphasizes pre-fire management around communities that are listed as “at-risk” to wildfire in the Federal Register and by the state of California.

Prescribed burns are conducted in accordance with both Department of the Interior and Service Fire Management Policy (621 FW 1-3 of the Service Manual). Use of prescribed burns for habitat management and hazardous fuel reduction is consistent with both the approved habitat and Fire Management Plans for the Complex. Prescribed fire use from 2000 to 2009 on WMA lands include: 509 acres on the Llano Seco Unit, with an annual range of 0 to 413 acres; and 0 acres for the Butte Sink Unit.

The Complex has recorded a range of 2 to 18 wildland fires annually for the past ten years. Wildland fire sizes range from 1/10th acre to 900 acres with most fires controlled below 5 acres. The Llano Seco Unit has a 10-year history of 10 wildfires totaling 12 acres, and Butte Sink Unit has had 2 wildfires totaling
The Refuge Environment

only 1 acre. Nearly all wildfires have been human-caused, including: escaped fires from the burning of fields, ditches, or natural vegetation, trains, mowers and agricultural equipment, electrical lines, discarded cigarettes, fireworks and intentional/suspicious ignition. Only one lightning caused fire has been recorded in the past ten years. Complex fire crews have also responded to threat fires adjacent to Refuge property, off-Refuge assignments throughout the United States, and international assignments to other Countries.

12. Law Enforcement and Resource Protection

The Service Division of Refuge Law Enforcement is charged with providing for the preservation and protection of wildlife and migratory birds on Service lands and the protection and safety of visitors using the Refuge facilities, including Service-owned lands within WMAs. The Refuge law enforcement program will focus on obtaining compliance with laws and regulations necessary for proper administration, management and protection of the National Wildlife Refuge System. To effectively carry out these duties, close coordination and cooperation with the local law enforcement departments is essential. Federal Wildlife Officers (FWOs) may be vested with California peace officer powers by Section 830.8(b) of the California Penal Code when enforcing applicable state, or local laws on property owned or possessed by the Service. By agreement and or Memorandum of Understandings (county Sheriff, California State Parks and Department of Fish and Wildlife), selected law enforcement departments may be called upon to assist Refuge officers on the Refuge within their jurisdiction. FWOs are authorized to protect Service property by enforcing and investigating wildlife and public use laws and regulations in the local area, or as directed. However, some of the wildlife laws are extremely complex and require extensive investigation. For that reason, FWOs are generally limited to enforcement of the following statutes and regulations issued pursuant thereto within the confines of the Service lands involved and in the immediate vicinity thereof.

D. Bald Eagle Protection Act of 1940, as amended (16 U.S.C. 668-668d)
J. Bear River Migratory Bird Refugce Act of 1928, as amended (16 U.S.C. 690-690h)
K. Fish and Wildlife Recreation Act of 1962, as amended (16 U.S.C. 460k)
M. Tariff Classification Act of 1962, as amended (19 U.S.C 1202)
N. Archaeological Resources Protection Act of 1979, as amended ( 16 U.S.C 460aa-460ll)
O. State Department of Fish and Wildlife Laws (Enforcement of these laws off-refuge should only be performed when: (1) consistent with Regional/California Nevada Operations Office (CNO) policy and (2) under proper State authority).

FWOs of the Complex may be authorized to enforce California Fish and Game laws, State and local laws under the following codes:
A. California Penal Code – 830.8(b)
B. Fish and Game Code – 856(a)
C. California Penal Code – 830.2(g)

**12.1 Law Enforcement on Easements**

Law enforcement issues on easement properties are generally under the jurisdiction of State and local authorities. However, Refuge law enforcement staff have jurisdiction over issues related to migratory birds and the Service’s easement interest on easement lands.

With regard to easement compliance, the Service’s primary approach is to use outreach to remind and educate landowners of their easement obligations. Along these lines, the Service provides technical assistance, annual mailings, and landowner workshops to help encourage easement compliance. To ensure compliance, the Service also spends a significant amount of time reviewing and authorizing habitat projects and other pertinent activities on easement lands. The Service also conducts an annual aerial survey flight on which all easement properties are monitored for compliance.

When potential easement compliance issues are discovered the initial course of action is for the Easement Manager to contact the landowner and visit the easement property. If an easement violation has occurred, the Easement Manager will work with the landowner to remedy the situation (for example, restore habitat or remove structures). If the landowner is unwilling to cooperate with the Easement Manager, the Easement Manager will work cooperatively with Refuge Law Enforcement staff to address the easement violation.

**12.2 Law Enforcement on Service-owned Lands**

The staff of the Sacramento NWR Complex recognizes the obligation that has been entrusted to them—the care of valuable natural and cultural resources—and they take this responsibility very seriously.

The Complex has a law enforcement staff that consists of two full-time FWOs and one dual-function officer. These officers are responsible for all law enforcement issues on Sacramento River, Sacramento, Delevan, Colusa, and Sutter Refuges, and on Service-owned lands of the Butte Sink WMA, and North Central Valley WMA. The dual-function officer conducts law enforcement in addition to their primary responsibilities, such as an assistant refuge manager. The regional Northern California Zone Officer also assists with law enforcement issues on the Complex.

Law enforcement on the Refuges and Service-owned WMA lands is used both for protection and for prevention. Law enforcement safeguards the visiting public, staff, facilities, and natural and cultural resources from criminal action, accidents, vandalism, and negligence. As prevention, law enforcement inhibits incidents from occurring by providing a law enforcement presence. Regular patrols occur depending on the amount and types of activity occurring on the WMAs. The FWOs are responsible for coordinating their activities and cooperating with other local, state, and Federal law enforcement officials.

**13. Facilities Maintenance**

Annual maintenance funding is to provide for the upkeep of refuge facilities and equipment by completing on time repairs rather than adding additional items to the deferred maintenance backlog. Annual maintenance
funds may be spent for supplies, materials, and contracts needed to complete preventive maintenance, repair facilities in the year in which deficiencies occur, and perform cyclical maintenance. Funds may also be used to replace small equipment on schedule (generally less than $5,000, as small and heavy equipment replacements are funded in separate accounts). No permanent staff may be funded from annual maintenance dollars; however, temporary and contract personnel may be paid with maintenance funding to complete specific maintenance projects. Permanent staff should be coded to 1262 base funds. Items of equipment that are operational in nature such as computers, office equipment and furniture cannot be purchased or maintained with these funds. Operational services such as lawn care, snow removal, and office janitorial services may not be funded with annual maintenance funding.

The Asset Business Plan is a report developed to help the Service better understand and manage their assets as they relate to the mission of the Service. Understanding the relevance and importance of how facility management supports the Service mission is a key factor in continued success in meeting our mission statement. Proper planning, effective tracking, and accurate reporting of our service assets assist in the justification of funding used to repair, rehabilitate, replace, and construct assets needed to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

Operations and maintenance (O&M) includes work activities performed to meet daily station operational needs, as well as recurring and preventive maintenance activities and associated utility/custodial costs. There are two critical steps in the O&M development process: 1) establishing requirements at the constructed asset level using O&M models or historical station records and 2) comparing the requirements to existing O&M actual costs so that O&M priorities can be set and executed.

13.1 Facility Maintenance on Easements
Easement landowners are responsible for the maintenance and repair of facilities and infrastructure on easement properties.

13.2 Facility Maintenance on Service-owned Lands
The Llano Seco Unit is administered by the Sacramento River NWR staff, and headquarters’ facilities consist of an on-site shop, office, and equipment storage building and parking area (in Sanctuary I). A visitor parking area, wheelchair accessible restroom, kiosk, walking trail, and two viewing platforms are available to the public (Sanctuary II). In addition, a system of levees, water control structures, and roads serve to maintain wetlands and provide access for habitat maintenance and operational needs. These areas require frequent maintenance and repair. Currently, the Refuge has two wage grade positions that are responsible for maintenance and operations. General road maintenance, including grading and mowing, is required on a number of the Tracts on the Llano Seco unit to provide safe access for visitors and staff through the area. Some additional upland areas require moving to reduce fire hazards, provide weed suppression, and provide access for maintenance or monitoring projects during the spring and summer months.

The Butte Sink Unit is administered out of the Colusa NWR headquarters located on the north end of Colusa NWR. Service facilities on the Butte Sink unit include gates, roads, levees, water control structures and a lift pump. These facilities require frequent maintenance and repair. General road maintenance, including grading and mowing, is required on a number of the roads/levees.

14. Safety
Safety is important both for the Complex staff and for Refuge visitors. Staff safety meetings are held monthly at the Refuge Headquarters. The intent of the meetings is to update and train personnel, as well as to resolve any safety concerns that arise.
Sample topics include Lyme’s Disease, West Nile Virus, and Hantavirus Safety, Tractor Safety, Hazardous Dump Sites, Boating Safety, CPR/First Aid, Hypothermia, Low visibility Driving, Heat Stress, and Respiratory Safety.

The Complex has a Safety Plan, updated annually, that describes the safety program and the responsibilities of the refuge staff and volunteers. The Safety Plan provides an extensive amount of safety information in its appendices. A safety committee comprised of a collateral duty safety officer and five additional people meets regularly throughout the year to discuss safety issues and coordinate safety inspections.

15. Cultural Resources

15.1 Regional Prehistory and History

From the late Pleistocene, more than 10,000 years ago, to present time, humans have occupied northern California and utilized its generous natural resources. Many diverse and complex cultures developed during this time, culminating in the Native American Tribes recorded by early ethnographers.

Wintun (Nomlaki) occupied both banks of the Sacramento River and the valley and foothills west of the River. The northwest Maidu lived in the valley, east of the River, along Butte and Big Chico Creeks, and had territories extending into the eastern foothills and mountains. The southernmost Yana tribe (Yahi) occupied lands east of the River, north of the Big Chico Creek. The territories of these tribes overlapped seasonally. For example, during the summer months the Nomlaki moved from the alluvial plain of the Sacramento River onto the alluvial fan of adjacent eastern foothills, while Yahi and northwest Maidu moved east, into the southern Cascade and northern Sierra Nevada Mountains, respectively. These people fished for Chinook salmon and hunted for tule elk, pronghorn, black-tailed deer, rabbits, California quail, and waterfowl. They also harvested acorns and a variety of seeds, roots, tubers, and bulbs from native plants (Goldschmidt 1978; Johnson 1978; Riddell 1978).

Euro-American contact with native tribes in the region began with the Spanish Moraga expedition of 1808. In the 1820s, fur trappers such as Jedediah Smith were working in the area. By the 1830s, smallpox and malaria had decimated the native population. The following decades brought increasing colonization to the area and the beginnings of the modern agricultural pattern.

American colonization of the Sacramento Valley began during the Mexican Rancho era. John Bidwell, Peter Lassen, and Sebastian Keyser were among those awarded Mexican Land Grants, which included Rancho del Arroyo Chico, Rancho Bosquejo, and Rancho Llano Seco, respectively. Statehood came soon after gold was discovered by James Marshall at Sutter’s Mill on the American River. Thousands of fortune seekers immigrated to California and those supplying goods and services to the miners realized economic success. The early ranches and farms provided vital agricultural commodities which helped expand settlement. People and freight were transported by wagon and steamboat. Thirteen ferries were located along the Sacramento River between Red Bluff and Colusa. River travel by steamboat was a practical mode of transportation because river boats could efficiently transport agricultural freight and the valley oak forests and woodlands supplied an abundance of fuel to power these paddle-wheeled steam boats. Ferries, river boat landings, and bridges all played a key role in the locations of towns and the development of a system of roads. Improved roads and the railroad system eventually replaced river boat travel.

Agriculture was first and foremost the central economic force in the Sacramento Valley. Dry land grain farming was the earliest agricultural practice. Row crops, orchards, rice, and irrigated pasture flourished when abundant water from the Sacramento River and its tributaries irrigated the fertile alluvial soils of the floodplain and basins. Water was distributed to farms through a system of river and stream diversions and water delivery canals. The development of the centrifugal
pump in the early 20th century facilitated the expansion of irrigated lands through ground water pumping. Finally, State and Federal water projects for land reclamation, irrigation and urban water supply, and flood control allowed for further agricultural and urban expansion and the industries that followed.

15.2 Land Use History and Known Cultural Resources of the WMAs

Butte Sink WMA: The Butte Sink Unit is located two miles west of Sutter Buttes, a landform that figures prominently in the creation myths of several Native American groups and which is considered sacred to those groups (Windmiller 1995:8). A sample archaeological survey conducted on the unit in 1995 identified no prehistoric or historic resources. However, it was noted that the area should be considered sensitive for the presence of resources associated with Butte Creek and historic hunting activity. Cultural resources could exist at depths below the present surface not only on the Service-owned lands but also within the easements, as has been demonstrated at other low-lying areas of the valley along the Sacramento River and its tributaries (Windmiller 1995:9).

Surveys:


Willow Creek-Lurline WMA: Under natural conditions, the Colusa Basin, in which the Willow Creek-Lurline WMA is situated, was characterized by vernal pools which supported large numbers of waterfowl in the winter. Topographic features of the area generally were not favorable for extended occupation by indigenous tribes, although temporary camps may have resulted from hunting and gathering activities. The villages of the River Patwin (Southern Wintun) were generally concentrated along the banks of the Sacramento River, which lies up to 5 miles east of the WMA at some points. Many of the parcels within the WMA were leveled in the 1960s and converted to rice cultivation.

While there are no Service-owned parcels within the boundaries of the Willow Creek-Lurline WMA, Sacramento NWR and Delevan NWR are located immediately adjacent to the WMA boundaries. Both refuges have been subject to varying degrees of archaeological survey in the past. At Delevan NWR, all surveys have returned negative results (Raymond 1990, Valentine 1996a, Parks 1999a). At Sacramento NWR, the land use history is reflected in the Refuge infrastructure built by the Civilian Conservation Corps between 1937 and 1942, including housing structures, roads, canals, dams, and other projects designed to improve habitat for wildlife.

Surveys:


North Central Valley WMA: Though the boundary of the North Central Valley WMA includes an extensive area on either side of the Sacramento River bounded by the Sierra and Coast ranges, the existing easement parcels are located on the east side of the Sacramento River and in the Yolo Bypass flood plain. While a comprehensive record search has not been conducted for the entire area within the approved WMA boundaries, there have been numerous surveys conducted and archaeological sites documented, particularly along the banks of the Sacramento River. At least two of these are within one to 1 ½ miles of the boundaries of existing conservation easements. They provide an indication of the types of sites that might be expected in areas of similar topographic composition. A brief summary of these sites is included for illustration:

CA-But-233: According to the State Historic Preservation Office in documenting the results of a 1992 record search, this was “recorded as a major prehistoric occupation site which is known to contain
human burials” (Raymond 1992: record search results). Located on an “old bend” in the river in the vicinity of what is now referred to as The Lagoon, this site was excavated in the 1960s; however no excavation report was prepared. The 1966 site form does not reference burials, but it does describe artifacts present as including net weights, a basalt drill, a small mortar, and other ground and flaked stone.

Sanctuary Mound Site (SRCA-003, no permanent trinomial): This site occupies a large mound on a terrace bracketed by old river meander scars (White et al., 2003: 83) on what is referred to later in this section as the Llano Seco Riparian Sanctuary Unit on the Sacramento River NWR. An extensive assemblage of artifacts was recorded, including mortar and pestle fragments, Olivella, clamshell disk shell beads, and historic glass. Human bone was also observed. Many of the parcels that comprise the existing conservation easements of the North Central Valley WMA are private duck clubs where few cultural resource investigations have been conducted. However, there are two service-owned parcels in the northern portion of the WMA that have a well-documented history.

“Llano Seco Unit” – The northernmost grouping of service-owned lands and conservation easements in the North Central Valley WMA are located within the area known historically as the Llano Seco Rancho Mexican land grant. The two Service-owned parcels, formerly known as Llano Seco Sanctuary 1 and Sanctuary 2, are now collectively referred to as the Llano Seco Unit of the North Central Valley WMA. A third service-owned parcel, known as the Llano Seco Riparian Sanctuary Unit, is within the boundaries of Sacramento River NWR and is not considered as part of this CCP.

Llano Seco (or “Dry Plain”) Rancho was granted to Sebastian Keyser by the Mexican Government in 1845. Consisting of 17,767.17 acres on the east side of the Sacramento River, the Rancho was originally used for grazing cattle. For several years, portions of the Rancho passed through various owners’ hands until John Parrott gradually secured title to it in its entirety, a process he started in 1861 (de Tristan 1961: 14). The property remained in the Parrott family throughout the late 19th and early 20th century, celebrating its centennial as the Parrott Investment Company in 1961. A history of the Llano Seco Rancho compiled on the occasion of the centennial provides a snapshot of the land use history (de Tristan 1961). Timberlands on the west side of the Rancho were cleared starting in the 1930s for cultivation, and by mid-century, farming and livestock operations were being conducted on a large scale. In the 1950s, leases were signed with Humble Oil & Refining Co to develop gas fields on the south end of the Rancho (Llano Seco field) and near its center (Perkins Lake field). The Llano Seco field was abandoned by the early 1960s due to lack of pressure. In 1991, the Service, The Nature Conservancy, and California Department of Fish and Wildlife began purchasing portions of the historic Rancho for the purposes of habitat restoration and to retain permanent conservation values.

Martin Family Cemetery – An historic family cemetery containing nine grave markers is located on the North Central Valley WMA Llano Seco Unit (Sanctuary 1, Tract 1). While it is not clear exactly when the Martin family arrived at Llano Seco Rancho, or how they acquired their land, the 1860 census indicates that Mrs. Minerva Martin gave birth to a son in Butte County. Some sources suggest that the family arrived between 1858 and 1860 (Sacramento River Partners 2001:4). In addition to seven Martin burials ranging in date between 1866 and 1870 (with three unknown), there are two burials bearing other names (David Murphy, d. 1863, and J.R. Taylor, d. 1875). The relationship between these people is not known. The cemetery is protected by an exclosure fence which is maintained annually by Youth Conservation Corps members.

Surveys:


15.3 Compliance with Historic Preservation Laws on Easements

Compliance with the National Historic Preservation Act (NHPA) is required for all undertakings funded with Federal funds or requiring a Federal permit. On WMA easements which are privately owned, for example, restoration activities funded through Service programs such as Partners for Fish and Wildlife require compliance with Section 106 of the NHPA. This is accomplished through a process initiated with the submittal of the Regional Cultural Resource Team’s Request for Cultural Resource Compliance. Projects are reviewed by the Regional Archaeologist, who identifies the steps necessary to ensure compliance with Section 106. As appropriate, cultural resource survey, identification, and evaluation is implemented according to the procedures set forth in the terms of the Fish and Wildlife Service Programmatic Agreement with the state of California. If the Programmatic Agreement criteria do not apply, further evaluations are conducted by either service archaeologists or certified archaeological contractors under the supervision of the Regional Archaeologist. If significant cultural resources are identified within the Area of Potential Effects, the Service, in consultation with the SHPO and any interested parties, will develop a plan to avoid, preserve, and/or mitigate the significant cultural resources.

15.4 Compliance with Historic Preservation Laws on Service-owned Lands

The Service, like other Federal agencies, is legally mandated to inventory, evaluate, and protect cultural resources located on those lands that the agency owns, manages, or controls. The Service’s cultural resource policy is delineated in 614 FW 1-5 and 126 FW 1-3 of the Service Manual. Field stations initiate the cultural resource review and compliance process under Section 106 by contacting the Regional Historic Preservation Officer/Regional Archaeologist (RHPO/RA). The RHPO/RA reviews the activities that comprise the undertaking, confirms the definition of the Area of Potential Effects, determines whether the proposed undertaking has the potential to impact cultural resources, and identifies the appropriate level of scientific investigation necessary to ensure legal compliance, assisting the field station in initiating consultation with the pertinent State Historic Preservation Office (SHPO) and Federally recognized Tribes. The systematic archaeological inventory and evaluation of sites on Service-owned lands, irrespective of projects subject to Section 106 compliance, is mandated by Section 110 of the NHPA.

16. Social and Economic Environment

16.1 Regional Economic Setting

The local economic region for this study is comprised of the 12 counties within which the North Central Valley WMA is located: Butte, Colusa, Contra Costa, Glenn, Placer, Sacramento, San Joaquin, Solano, Sutter, Tehama, Yolo, and Yuba. Butte Sink WMA is located in Butte, Colusa, and Sutter counties; and Willow Creek-Lurline WMA is in Colusa and Glenn counties.

16.2 Population and Density

Table 6 summarizes the population estimates and trends for the 12-county region included in this analysis. A 12-county area used in this analysis includes counties of which a portion of the county is within the existing approved acquisition boundary of one or more of the three WMAs. The combined 12-county area has more than 4.6 million residents, accounting for approximately 12 percent of California’s total population (U.S. Census Bureau 2012). The largest city in the study region is Sacramento with nearly 471,000 residents (California Department of Finance 2012b). The city of Sacramento is also California’s capital and the state’s sixth most populated city. As Table 6 indicates, significant variation exists among the population characteristics.
Chapter 3

of the 12 counties in the region. Generally, the counties located in the southern portion of the Sacramento Valley, near the Sacramento-San Joaquin River Delta, tend to have relatively higher total populations and are more densely populated than the rural counties to the north. Sacramento and Contra Costa counties are the most heavily populated with more than 1.4 million and 1 million residents, respectively. These two southern counties also have the highest population densities among the 12 counties in the study area, each with nearly 1,500 persons per square mile. Colusa and Glenn counties, in the north-western portion of the Sacramento Valley, are the least populated with approximately 21,000 and 28,000 residents, respectively. These 2 counties, along with adjacent Tehama County, have the lowest population densities in the study area, each with roughly 20 persons per square mile.

All 12 counties in the study area experienced positive population growth from 2000 to 2010 (U.S. Census Bureau 2012). However, significant differences exist in the rate of growth among these counties. The population of Placer County grew the fastest at 40 percent during the same time. Generally, the populations in the urbanized counties in the study area are expected to continue to grow at relatively slower rates compared to the adjacent urban fringe and northern rural counties. Among the 12 counties in the study area, the populations of the urbanized Sacramento, Contra Costa, and Solano counties are projected to grow the slowest at 24 percent, 32 percent, and 34 percent from 2010 to 2030, respectively (California Department of Finance 2012a). Located near these southern urban counties are those that could be considered urban fringe counties; here, anticipated development leads to the highest projected population growth among all counties within the study area. Directly north of Sacramento County near the Sierra Nevada foothills, Sutter, Yuba, and Placer counties are projected to grow at 78 percent, 71 percent, and 47 percent from 2010 to 2030, respectively. San Joaquin is an additional urban fringe county adjacent to the south of Sacramento and Contra Costa counties, and is projected to experience population growth of 63 percent during the same time. The populations of the rural northern counties of Tehama, Colusa, and Glenn are projected to grow in the range of 43 percent to 46 percent over the next 20 years.

### 16.3 Ethnicity, Race, Employment, and Income

Significant differences exist among the 12 counties in the study area in terms of the frequency of residents who identify ethnically as Hispanic.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Butte</td>
<td>220,000</td>
<td>134</td>
<td>8%</td>
<td>46%</td>
</tr>
<tr>
<td>Colusa</td>
<td>21,419</td>
<td>19</td>
<td>14%</td>
<td>45%</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>1,049,025</td>
<td>1,465</td>
<td>11%</td>
<td>32%</td>
</tr>
<tr>
<td>Glenn</td>
<td>28,122</td>
<td>21</td>
<td>6%</td>
<td>46%</td>
</tr>
<tr>
<td>Placer</td>
<td>348,432</td>
<td>248</td>
<td>40%</td>
<td>47%</td>
</tr>
<tr>
<td>Sacramento</td>
<td>1,418,788</td>
<td>1,471</td>
<td>16%</td>
<td>24%</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>685,306</td>
<td>493</td>
<td>22%</td>
<td>63%</td>
</tr>
<tr>
<td>Solano</td>
<td>413,344</td>
<td>503</td>
<td>5%</td>
<td>34%</td>
</tr>
<tr>
<td>Sutter</td>
<td>94,737</td>
<td>157</td>
<td>20%</td>
<td>78%</td>
</tr>
<tr>
<td>Tehama</td>
<td>63,463</td>
<td>22</td>
<td>13%</td>
<td>43%</td>
</tr>
<tr>
<td>Yolo</td>
<td>200,849</td>
<td>198</td>
<td>19%</td>
<td>34%</td>
</tr>
<tr>
<td>Yuba</td>
<td>72,155</td>
<td>114</td>
<td>20%</td>
<td>71%</td>
</tr>
<tr>
<td>California</td>
<td>37,253,956</td>
<td>239</td>
<td>10%</td>
<td>26%</td>
</tr>
</tbody>
</table>

*California Department of Finance, 2012a (population projections)*
or Latino. Approximately 13 percent of the population in Placer County identify as Hispanic or Latino, compared to 55 percent in Colusa County (U.S. Census Bureau 2010). Significant differences also exist among the 12 counties in terms of the frequency of residents who identify racially as White. The northern counties in the study area tend to have a higher frequency of the population who identify as White relative to the southern urbanized counties (U.S. Census Bureau 2010). Placer County has the highest frequency of residents who identify as White, at 84 percent of the population, followed by Butte, Tehama, and Glenn counties with 82 percent, 81 percent, and 71 percent, respectively. Comparatively, San Joaquin and Solano counties have the lowest frequency, each with 51 percent of residents who identified as White.

Significant differences also exist among the 12 counties in the region for median household income, percent of persons below poverty, and average unemployment rate. The median household income ranges from a high of more than $78,000 dollars per year in Contra Costa County, to a low of $38,000 per year in Tehama County (U.S. Census Bureau 2010). Tehama also has the highest poverty rate among the counties in the study area, with 20.3 percent of the population living at or below the Federal poverty line. Comparatively, Placer and Contra Costa counties have the lowest poverty rates at 6.6 percent and 9 percent, respectively.

Each of the 12 counties in the study area had a 2011 average unemployment rate higher than the average national rate of 9 percent (U.S. Bureau of Labor Statistics 2012). However, there was significant variability in unemployment rates between the counties in the study area. Contra Costa and Placer counties had the lowest average unemployment rates at 10.4 percent and 10.8 percent, respectively. Other counties in the region had substantially higher rates, most notably, Yuba, Sutter, and Colusa counties with 18.2 percent, 18.8 percent and 20.4 percent average unemployment for 2011, respectively.

Total non-farm employment for the 12-county study area accounts for more than 2.1 million jobs (Bureau of Economic Analysis 2010). Sacramento and Contra Costa counties have the largest number of jobs, accounting for approximately 35 percent and 22 percent of total non-farm employment in the study area, respectively.

State and local government has the highest percentage of total non-farm employment for the study area, contributing over 20 percent of jobs. Retail trade and the health care industries both represent approximately 13 percent of total non-farm employment. Other notable industrial sectors for the region include professional services, accommodation and food services, administrative services, finance, insurance, real estate, and construction.

16.4 Agriculture

The Sacramento Valley is one of the most agriculturally productive regions in California in terms of total gross value of agricultural product (California Agricultural Statistics Review 2011). In total, the 12-county region generates approximately $6 billion in gross agricultural product annually. Furthermore, agriculture in the study area accounts for 33,900 jobs annually (Bureau of Economic Analysis 2010). San Joaquin County ranks first in the 12-county study area, and seventh among counties in the state of California, generating nearly $2 billion in annual gross value of agricultural product. The rural counties in the northern portion of the Sacramento Valley are also highly productive. Combined, the 6 northern counties of Colusa, Butte, Glenn, Sutter, Tehama, and Yuba generate approximately one-half of the gross agricultural product for the 12-county region, or $3 billion annually.

The 12-county region produces a diverse range of agricultural goods. This region produces grapes, vegetables, fruit, nuts, small grains, and an assortment of animal products, including milk (California Agricultural Statistics Review 2011). In San Joaquin, the top agricultural producing county in the study area, the 5 agricultural commodities which generate the most value are fluid milk, wine grapes, walnuts, cherries, and almonds. However, the
most significant agricultural product for the 12-county study area is rice. The Sacramento Valley is known as the principal rice growing region of the state (California Rice 2012). The top 5 rice producing counties in California are located in the 12-county study area discussed in this chapter. The economic contribution of local rice production and possible effects of Service land acquisition are discussed in the Environmental Assessment (Appendix A).

16.5 Cover Types, Land Use, and Changes

The easement and Service-owned lands within the WMAs are bordered primarily by private lands. Private lands are mostly agricultural land (rice, orchards, row crops), with some private duck-hunting clubs, farmsteads, businesses, trailer parks, and isolated homes.

The 12-county study area spans more than 9.6 million acres in the Sacramento Valley (Conservation Biology Institute 2008). Of the study area’s total acreage, approximately 79 percent is privately owned, 16 percent is Federally owned, 4 percent is managed by the state of California, 1 percent is city or county owned, and less than 1 percent is Tribal land (Conservation Biology Institute 2008). WMAs are predominantly confined to the valley floor. Because it is not easily separable, the following land cover data by county reflects not only the WMAs, but also the foothill areas that lie within the counties outside the WMAs. Land cover type differs significantly between the individual counties within the study area. This variability in land cover type can be largely attributed to differences in population densities, land use, and geographic features. The highly populated Sacramento and Contra Costa counties have 21 percent and 23 percent of their total land cover considered urban, respectively. Comparatively, Butte, Colusa, Glenn, and Tehama counties located in the northern portion of the study area each have no more than 1 percent of total land cover considered urban. The northern rural counties also tend to have more forested land cover relative to the urban counties to the south. Approximately 52 percent and 39 percent of the land cover for Placer and Butte counties, respectively, are considered forest, compared to less than 1 percent in Sacramento County. This can be attributed to the northern counties having large tracts of land situated in the nearby mountains and foothills. Mixed cropland also differs greatly between the 12 counties; Sutter and San Joaquin counties have mixed cropland at 58 percent and 41 percent, whereas Placer County has far less with approximately 1 percent considered mixed cropland.

The loss of prime agricultural land in the study area occurred at a record pace from 2006 to 2008 (State of California Department of Conservation 2011). As a region, the study area netted 5,500 acres of urban growth during this time. San Joaquin, Sacramento, and Contra Costa primarily drove this urban expansion, being among the top 10 counties in California for number of acres converting to urban uses. Considering the variability of cover type and land uses (e.g., urban vs. mixed cropland), the projected population growth within the 12-county region may continue to apply pressure for future conversion of historic farmland and natural features to other uses. The effects of potential cover type and land use changes are discussed in Appendix A.

Each of the 12 counties in which the WMAs are located has its own General Plan that outlines land use policies. The portions of the counties’ General Plans that relate to management of the Refuges are summarized in Appendix N.

16.6 Transportation

Major transportation routes in the vicinity of the WMAs include Interstate 5, State highways 99, 45, 162, 20, and county route 99W. Many small paved county roads provide for local transportation, offering service access to local agricultural activities. These, and the large interstate and highways, provide access to the Refuge Complex’s visitor center south of the town of Willows and Llano Seco Unit’s visitor contact station and parking lot.
Figure 15. North Central Valley Wildlife Management Area: Proposed Wetland and Agricultural Easement Acquisition Areas
Walking trail through wetlands, Llano Seco Unit. Photo: USFWS
Chapter 4. Management Direction: Goals, Objectives, and Strategies

1. **Overview of Goals, Objectives, and Strategies**

One of the most important parts of the CCP process is the development and refinement of the WMAs’ vision and goals. This section contains the primary goals that will define the management direction of the WMAs for the next 15 years. In addition, as part of the CCP, the WMAs are expected to develop objectives and strategies that, together, will help achieve the goals. Goals are broad statements of the desired future conditions for refuge resources. WMA goals may or may not be feasible within the 15-year time frame of the CCP. Whenever possible, objectives are concise statements of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. They should be specific, measurable, achievable, results-oriented, and time-fixed, and should be feasible within the 15-year lifespan of the CCP. Strategies are specific actions, tools, or techniques that contribute toward accomplishing the objective. In some cases, strategies describe specific projects in enough detail to assess funding and staffing needs.

The five goals of the Willow Creek/Lurline, Butte Sink and North Central Valley Wildlife Management Areas are outlined below to provide a context for the proposed management direction.

**GOAL 1: Land Protection**
Protect wetlands, wetland-associated uplands and riparian habitats, and productive agricultural lands to support an abundance and natural diversity of wintering and migrating waterfowl, shorebirds, birds of prey, songbirds, and other wetland-dependent species in the Central Valley.

**GOAL 2: Wildlife and Habitat**
Conserve, manage, restore, and enhance habitats and associated wildlife and plant species, with an emphasis on supporting an abundance and natural diversity of wintering and migrating waterfowl, shorebirds, other waterbirds, birds of prey, and songbirds.

**GOAL 3: Visitor Services**
On the Llano Seco Unit and other appropriate Service-owned lands, provide visitors of all ages and abilities with quality wildlife-dependent recreation (wildlife observation, photography, environmental education, and interpretation) and volunteer opportunities to enhance public appreciation, understanding, and enjoyment of fish, wildlife, habitats, and cultural resources.

**GOAL 4: Threatened and Endangered Species**
Support self-sustaining populations of threatened and endangered species on fee-title Service-owned lands and on easement lands with willing landowners.

**GOAL 5: Climate Change**
Maintain and enhance current habitat values under anticipated climate change scenarios in the Central Valley.

2. **Organization**

Each objective and strategy is given a unique numeric code for easy reference. Objectives have a two-digit code (e.g., 1.1, 1.2, 2.1, 2.2). The first digit corresponds to the goal to which the objective applies. The second digit is sequential. Similarly, each strategy has a three-digit code (e.g., 1.1.1, 1.1.2, 2.1.1, 2.1.2). The first
and second digits refer to the appropriate goal and objective, respectively. The third digit is sequential and represents the strategy.

3. **WMA Management Goals, Objectives, and Strategies**

**GOAL 1: Land Protection**

*Protect wetlands, wetland-associated uplands and riparian habitats, and productive agricultural lands to support an abundance and natural diversity of wintering and migrating waterfowl, shorebirds, birds of prey, songbirds, and other wetland-dependent species in the Central Valley.*

**Objective 1.1: Easement – Willow Creek-Lurline WMA Wetland Easement Acquisition.**

Acquire 2,141 acres of wetland conservation easements from willing sellers in Willow Creek-Lurline WMA to protect existing wetlands and future restored wetlands to help meet the habitat restoration and protection objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**

The Willow Creek-Lurline WMA was established in 1985 with the primary purpose of preserving wetland habitat for wintering waterfowl and other wetland-dependent wildlife (USFWS 1979b). Freshwater wetlands have declined by 90 to 95 percent in the Central Valley and the wetlands of the Willow Creek-Lurline WMA represent some of the last remaining wetlands in the Sacramento Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). Managed wetlands and associated upland and riparian habitats within the WMA provide critical food, water and cover for waterfowl, shorebirds, waterbirds, and a diverse array of wildlife species. The Willow Creek-Lurline WMA also provides an important corridor of wetland habitat which helps link Sacramento, Delevan and Colusa NWRs to create a larger and more productive block of conservation lands.

Conservation easements are recognized as an effective tool for: protecting private wetlands in perpetuity, maintaining land in private ownership, and meeting Service habitat objectives in a timely and cost efficient manner. The existing easement acquisition objective for the Willow Creek-Lurline WMA is 8,000 acres (USFWS 1979b), and to date, approximately 5,859 acres of wetlands have been protected. This objective proposes acquiring the remaining 2,141 acres of conservation easements from willing sellers to protect existing wetlands and future restored wetlands within the WMA.

This objective helps support many of the habitat and wildlife population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 1998, 2012), the Central Valley Joint Venture (CVJV) Implementation Plan (CVJV 2006) and the Central Valley and Bay-Delta Region Conservation Actions in the California Wildlife Action Plan (CDFG 2005c).

Achievement of this objective is dependent upon the willingness of landowners to participate in the easement program and available funding to acquire easements.

**Strategies:**

1.1.1. Annually, contact landowners of remaining unprotected wetlands and restorable agricultural lands to assess their interest in the conservation easement program.

1.1.2. Acquire up to 994 acres of conservation easements in Colusa County and 1,147 acres of conservation easements in Glenn County (Land Acquisition Ascertainment Report for the Colusa Basin Wetlands, 1979b).

1.1.3. Coordinate the appraisal and acquisition of potential easement properties with the Service’s Region 8 Realty Office.

1.1.4. Pursue funding through the Migratory Bird Conservation Fund, Land and Water Conservation Fund and other sources for easement acquisition.
Objective 1.2: Easement – North Central Valley WMA Wetland Easement Acquisition.

Acquire 15,000 acres of conservation easements from willing sellers in North Central Valley WMA to protect existing wetlands and restored future wetlands to help meet the habitat restoration and protection objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

Rationale:

The North Central Valley WMA was established to preserve existing and restored wetlands for waterfowl and other wetland-dependent plants and wildlife in the Sacramento Valley and Delta regions. Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990), and the protection and restoration of wetlands is crucial to migratory bird populations (CVJV Implementation Plan 2006). Managed wetlands, and associated upland and riparian habitat, within the North Central Valley WMA provide critical food, water and cover for waterfowl, shorebirds, waterbirds, and a diverse array of wildlife species.

In 1991, the North Central Valley WMA was established to help meet the habitat protection and restoration goals of the 1990 Central Valley Habitat Joint Venture Implementation Plan and ultimately the waterfowl population goals of the North American Waterfowl Management Plan. In the establishment of the North Central Valley WMA, conservation easements were recognized as an effective tool for: protecting private wetlands in perpetuity, maintaining land in private ownership, and meeting Service habitat objectives in a timely and cost efficient manner. In 1991, the authorized easement acquisition objective for the North Central Valley WMA was 48,750 acres, of which approximately 14,707 acres have been acquired, leaving a remaining balance of 34,043 acres to be acquired. This Objective proposes acquiring 15,000 acres from willing sellers to protect existing wetlands and future restored wetlands throughout the North Central Valley WMA. The proposed acquisition Objective was reduced from 34,043 acres to 15,000 acres to: 1) accommodate estimated demand for wetland easements over the 15-year CCP planning period, 2) enable a portion of proposed easement acquisition to be focused on protecting agricultural land for migratory birds (see Objective 1.3), and 3) realistically correspond to expected funding for easement acquisition over the 15-year planning period. More information about the conservation objectives of the Central Valley can be found in the Joint Venture Implementation Plan (CVJV 2006).

New wetland easement acreage objectives for each county were developed based on CVJV basin wetland restoration and protection goals (CVJV 2006), the availability of appropriate lands (wetlands and lands with historic hydric (wetland) soils) in the county, and the proximity of appropriate lands to protected areas and urban lands within each county. Wetland easement objectives were limited to seven counties (Butte, Colusa, Glenn, Placer, Sutter, Yuba, and Yolo) which had appropriate lands, high waterfowl use and historic landowner demand.

In addition to supporting the habitat and migratory bird population goals of the 2006 CVJV Implementation Plan and the North American Waterfowl Management Plan, this Objective also supports many of the action items of the Central Valley Bay Delta Action Items of the California Wildlife Action Plan (CDFG 2005c).

Achievement of this objective is dependent upon the uncertainty regarding the willingness of landowners to participate in the easement program and available funding to acquire easements.

Strategies:

1.2.1. Redefine county wetland easement acreage objectives in the North Central Valley WMA to better correspond with landowner demand and the 2006 CVJV Implementation Plan’s wetland restoration and protection goals for hydrologic basins in the Sacramento Valley (Table 7). Acquire wetland easements
from willing seller in Butte, Colusa, Glenn, Placer, Sutter, Yuba, and Yolo counties.

1.2.2. Increase outreach efforts to inform wetland and agricultural landowners of easement opportunities via presentations, brochures, mailings, and website.

1.2.3. Annually, contact 10-30 landowners of remaining unprotected wetlands and restorable agricultural lands to assess their interest in the conservation easement program.

1.2.4. Coordinate the appraisal and acquisition of potential easement properties with the Service’s Region 8 Realty Office.

1.2.5. Pursue funding through the Migratory Bird Conservation Fund, Land and Water Conservation Fund and other sources for easement acquisition.

<table>
<thead>
<tr>
<th>County</th>
<th>Wetland Easement Objective (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butte</td>
<td>4,509</td>
</tr>
<tr>
<td>Colusa</td>
<td>863</td>
</tr>
<tr>
<td>Glenn</td>
<td>428</td>
</tr>
<tr>
<td>Placer</td>
<td>1,917</td>
</tr>
<tr>
<td>Sutter</td>
<td>3,687</td>
</tr>
<tr>
<td>Yuba</td>
<td>2,392</td>
</tr>
<tr>
<td>Yolo</td>
<td>1,204</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15,000</strong></td>
</tr>
</tbody>
</table>

1.2.6. Objective 1.3: Easement – North Central Valley WMA Agricultural Easement Acquisition.

Acquire 19,043 acres of agricultural easements from willing sellers in the North Central Valley WMA, to provide habitat and open space buffers adjacent to Refuges and other protected wetlands, and provide long-term protection of productive agricultural lands that support large numbers of migratory birds and other wetland-dependent species in the Pacific Flyway. Agricultural easements will help meet the conservation objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**
The agricultural easement acreage objective (19,043 acres) plus the wetland easement acreage objective (15,000 acres) equals the total remaining North Central Valley WMA easement acreage objective (34,043 acres). Rice, corn, wheat, irrigated pasture and alfalfa (wildlife friendly agriculture) provide important habitat for waterfowl, shorebirds and waterbirds throughout the North Central Valley WMA. Approximately 68 percent of all wintering waterfowl food resources are provided by agricultural habitats, with post-harvest flooded rice providing the bulk (CVJV 2006). Currently about 500,000 acres of rice and 200,000 acres of corn are grown annually within the WMA. These lands compliment Refuges and other protected wetland areas by providing foraging and roosting habitat for migratory birds and other wildlife (Elphick 1998). In fact, the 2006 CVJV Implementation Plan assumes that at least 50 percent of waterfowl food needs in the Sacramento Valley and the Delta will be met by rice and corn agriculture. Long-term security of these important agricultural habitats is not assured, and agricultural easements will help meet conservation objectives in each of the Valley’s basins (CVJV 2006). In addition to directly providing habitat, agricultural lands provide critical open space which buffers Refuges and other protected wetlands from urban encroachment.

While agriculture currently provides significant wildlife habitat and open space, increasing human populations, economic variability and water issues make the future less certain. This Objective proposes to acquire up to 19,043 acres of agricultural easements to: 1) ensure that wildlife friendly agricultural is maintained near Refuges and other protected wetlands, 2) maintain open space to buffer Refuges and other protected wetlands from commercial and residential development, and 3) provide long-term protection to productive
agricultural lands which traditionally support large numbers of migratory birds.

Agriculture easement objectives for each county were determined using geographic information systems (GIS) to identify agricultural lands that could provide complementary wildlife habitat and buffer existing conservation lands from current and future development pressures.

Achievement of this objective is dependent upon the uncertainty regarding the willingness of landowners to participate in the easement program and available funding to acquire easements.

**Strategies:**

1.3.1. Acquire agricultural easements in the North Central Valley WMA in strategic areas that buffer and provide connectivity between Refuges and other important protected wetlands in Butte, Glenn, Colusa, Sutter, Sacramento and Yolo Counties (see Table 8).

1.3.2. Work with partners (conservation and agricultural organizations) and consult with counties to identify and evaluate other important areas within the North Central Valley WMA for agricultural easement acquisition.

1.3.3 In coordination with partners, develop an agricultural easement agreement that meets Service’s and agricultural landowner’s objectives. Appendix C provides the draft Agricultural Easement agreement.

1.3.4. In coordination with partners, develop an outreach plan to inform agricultural landowners of easement opportunities via presentations, brochures, mailings and website.

1.3.5. Contact landowners of unprotected agricultural lands near important conservation area to assess their interest in the agricultural easement program.

1.3.6. Develop and pursue agricultural easements that focus on preserving open space buffers around Refuges and other important wetland areas.

1.3.7. Develop and pursue agricultural easements that focus on providing wildlife-friendly agricultural habitat near Refuges and other important wetland areas.

1.3.8. Coordinate the appraisal and acquisition of potential easement properties with the Service’s Region 8 Realty Office.

1.3.9. Pursue funding through the Migratory Bird Conservation Fund, Land and Water Conservation Fund and other sources for easement acquisition.

**Table 8. Proposed agricultural easement acreage objectives for counties within the North Central Valley WMA.**

<table>
<thead>
<tr>
<th>County</th>
<th>Agricultural Easement Objective (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butte</td>
<td>2,392</td>
</tr>
<tr>
<td>Colusa</td>
<td>1,844</td>
</tr>
<tr>
<td>Glenn</td>
<td>2,310</td>
</tr>
<tr>
<td>Sacramento</td>
<td>5,000</td>
</tr>
<tr>
<td>Sutter</td>
<td>4,591</td>
</tr>
<tr>
<td>Yolo</td>
<td>2,906</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19,043</strong></td>
</tr>
</tbody>
</table>

**Objective 1.4: Easement – Land Protection Partnership.**

Work cooperatively to help partners restore and protect wetlands and protect important agricultural lands within the North Central Valley WMA to help meet the habitat restoration and protection objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**

The North Central Valley WMA was established to help implement the land protection objectives of the CVJV. The Service represents only one of the 22 Federal Agencies, State Agencies, and Conservation organizations which form the CVJV partnership. Many of these CVJV partners manage important conservation programs which also protect wetlands and agricultural lands within the North Central Valley WMA. It is imperative
that the Service work with these partners to leverage resources to help meet North Central Valley WMA and CVJV Implementation Plan land protection objectives.

**Strategies:**

1.4.1. Continue to serve on NRCS’s Wetland Reserve Program (WRP) ranking team to help evaluate potential properties for the WRP easement program.

1.4.2. Assist NRCS in the implementation of WRP and other Farm Bill Programs in accordance with the established MOU (USFWS 2010) and serve on the NRCS State Technical Advisory Committee.

1.4.3. Assist CDFW in the implementation of their Permanent Wetland Easement Program.

1.4.4. Coordinate with CVJV partners and others to protect important wetlands and agricultural lands.

1.4.5. Continue to serve on, advise, or provide information to CVJV Working Groups and Technical Committees.

**Objective 1.5: Service-owned – North Central Valley WMA Fee-title Acquisition.**

Acquire in fee-title from willing sellers 3,321 acres of wetlands and restorable agricultural lands within the North Central Valley WMA to help meet the conservation objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**

Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990), and the protection and restoration of wetlands is crucial to migratory bird populations (CVJV Implementation Plan 2006). In 1991, the North Central Valley WMA was established to help meet the habitat protection and restoration goals of the 1990 Central Valley Habitat Joint Venture Implementation Plan and ultimately the waterfowl population goals of the North American Waterfowl Management Plan. While the first priority of the North Central Valley WMA was to implement a conservation easement program, it was acknowledged that in some circumstances fee-title acquisition might be necessary to provide minimum waterfowl sanctuary or to resolve management issues. Specific management issues where fee-title acquisition may be considered include: 1) the purchase of properties that improve the administration and management of refuge lands and 2) the protection of sensitive habitats that are vulnerable to degradation in private ownership.

In 1991, the fee-title acquisition of 6,250 acres was authorized for the North Central Valley WMA, with the only specified acquisition being a 1,195 acre addition to Colusa NWR. Since that time, the Llano Seco Unit and the majority of the Colusa NWR addition have been acquired. Of the original 6,250 acres authorized for fee-title acquisition, approximately 3,321 acres remain. While the focus of North Central Valley WMA still remains on implementing a conservation easement program, the 2006 CVJV Implementation Plan recognizes that there are still locations where wildlife sanctuaries and fee-title acquisition may be appropriate. The Service proposes to help meet the CVJV objectives by acquiring up to 3,321 acres in appropriate locations. The Service would consult with affected counties prior to acquiring any land in fee-title.

In addition to supporting the habitat and migratory bird population goals of the 2006 CVJV Implementation Plan and the North American Waterfowl Management Plan, this Objective also supports many of the action items of the Central Valley Bay Delta Action Items of the California Wildlife Action Plan (CDFG 2005d).

Achievement of this objective is dependent upon the uncertainty of the availability of appropriate properties, willing sellers, and funding.

**Strategies:**

1.5.1. Focus fee-title purchases from willing sellers on remaining in-holdings at Colusa NWR and strategic locations within the
American, Butte & Sutter Basins per the priorities in the 2006 CVJV Implementation Plan.

1.5.2 Work with conservation partners and consult with counties to identify and evaluate lands for potential fee-title acquisition.

1.5.3 Coordinate the appraisal and acquisition of potential fee-title properties with the Service’s Region 8 Realty Office.

1.5.4. Pursue funding through the Migratory Bird Conservation Fund and Land and Water Conservation Fund for fee-title acquisition.

**Objective 1.6: Easement – Easement Compliance.**

Annually, attain 95 percent easement compliance with the terms and conditions of the conservation agreements (Grant of Easement) in the Butte Sink WMA, Willow Creek-Lurline WMA, and North Central Valley WMA to protect wetland resources that support migratory bird populations in the Pacific Flyway.

**Rationale:**

The Service’s conservation easements are purchased to protect wetland and agricultural habitats and support the wildlife resources that depend on them. The conservation easements contain terms and conditions that were developed specifically to protect habitat for migratory birds. Generally, these terms and conditions state that the easement owner, or any third party, cannot alter existing topography, cultivate agricultural crops (on wetland easements), place any structures on easement lands, or sell/transfer any water resources without written authorization of the Service (see Appendix C). Landowner compliance with these terms and conditions is paramount in the long-term protection of habitat and wildlife resources on easement lands. Given the broad geographic area of the WMAs, and the large number and acreage of easements, it is important that the Refuge be proactive in informing landowners regarding their easement obligations and monitoring the easement properties for compliance.

**Management Direction: Goals, Objectives, and Strategies**

**Strategies:**

1.6.1. Increase aerial surveys to twice a year, to monitor easement compliance on 100 percent of easement properties.

1.6.2. Annually, review and issue written letters of authorization for all proposed projects on easement properties which require Service authorization (see Easement Guidelines, Appendix C).

1.6.3. Annually, conduct on-site visits on at least 25 percent of easement properties to verify easement compliance and maintain communication with landowners.

1.6.4. Increase Service Law Enforcement support and coordination with easement manager on easement compliance issues.

1.6.5 Send annual easement compliance letter to all easement owners reminding them of their easement obligations per the Easement Guidelines.

1.6.6. Annually, document in writing results of easement compliance surveys and site visit for all easement properties.

**Objective 1.7: Easement – Water Supply.**

Within 5 years of CCP approval, inventory water rights and supply for all existing easement properties and all new easement acquisitions to determine if adequate water resources are available to maintain wetlands on easement lands in accordance with the easement agreement (Grant of Easement). Maintain existing agreements and water delivery infrastructure to ensure water availability to WMA wetlands.

**Rationale:**

The Service’s conservation easements are purchased to protect wetland and agricultural habitats and support the wildlife resources that depend on them. Within the WMAs, water is the most important resource affecting habitats and wildlife. The Service’s Grant of Easement document protects “Easement Waters”, which are generally described as all of the Grantor’s (landowners) water resources, limited to the amount necessary to flood
and maintain “Easement Lands” to historic fall and winter seasonal levels. Through the Grant of Easement the Service also reserves the right, but not the obligation, to use the “Easement Waters” to flood “Easement Lands” to historical fall and winter levels at the Service’s expense. In addition, the Service also requires landowners to receive written authorization prior to selling or transferring any “Easement Waters” to third parties (see Appendix C for easement guidelines).

While the Grant of Easement contains strong language protecting water on easement lands, little is known or documented regarding what water resources are available for individual properties. Given the uncertainty of water supplies, the agriculture/urban demand for water and the growth of water markets, it is imperative that the Service explicitly understand the water resources it has acquired and protected through its easement program. Likewise, it is important to document the water resources on all prospective conservation easement properties to ensure that there is enough water to provide the habitat proposed for protection. This information will allow us to protect the water resources we have acquired and determine if additional waters are needed to maintain habitat on easement lands.

The Service is party to a number of Agreements to ensure the availability and delivery of water to specific Service-owned and easement lands. It is in the Service’s interest to maintain these agreements and associated water delivery infrastructure into the future.

**Strategies:**

1.7.1. Contract water rights specialists/hydrologists to inventory water rights/supply on existing easement properties within five years.

1.7.2. Incorporate a water rights/supply inventory into the acquisition process for all new easement properties.

1.7.3. Determine if adequate water resources are available for easement properties.

1.7.4. Pursue additional water sources for easement properties if needed.

1.7.5. Maintain the Bifurcation Operations Agreement for the long-term operation and maintenance of the Bifurcation Dam facility to ensure water delivery to the Butte Sink WMA.

1.7.6 Work Cooperatively with Butte Sink Waterfowl Association and others to maintain the “1922 Agreement” which provides water for the Butte Sink Unit and many easement properties within the Butte Sink WMA.

1.7.7 Maintain the “Memorandum of Agreement By and Between the U.S. Bureau of Land Management and U.S. Fish and Wildlife Service Regarding Use of Water Acquired through Gover Acquisition and Orwick Exchange by the Sacramento NWRC” which provides approximately 1,470 acre feet of water (before line loss) to be used on easement properties within the Willow Creek Division of the Willow Creek-Lurline WMA.

1.7.8 Maintain the “Wheeling Agreement between Glenn-Colusa Irrigation District, U.S. Fish and Wildlife Service, and Willow Creek Mutual Water Company for Conveyance of Water to Conservation Easement Lands” to ensure the delivery of up to 1,470 acre feet of water to Willow Creek Mutual Water Company for use on easement lands.

1.7.9. Continue to work collaboratively with CDFW, M&T Chico Ranch and Llano Seco Rancho to implement long-term measures to protect and maintain a reliable long-term water supply to M&T Chico Ranch, Llano Seco Rancho, Service-owned and easement lands, and CDFW wildlife management areas and private wetlands.

1.7.10 Upgrade Butte Sink lift pump facilities. See also strategy 2.14.3.

**GOAL 2: Wildlife and Habitat**

Conserve, manage, restore, and enhance habitats and associated wildlife and plant species, with an emphasis on supporting an abundance and natural diversity of wintering and migrating waterfowl, shorebirds, other waterbirds, birds of prey, and songbirds.
Objective 2.1: Easement – Landowner Outreach.

Annually, contact 100 percent of easement landowners to provide habitat management information and other technical assistance.

Rationale:

The Service’s conservation easements are primarily purchased to protect wetland and agricultural habitats and support the wildlife resources that depend on them. While habitat protection is paramount to the easement program, habitat management is essential to maximize the value of easement lands to migratory birds and other wetland-dependent wildlife. While the Service does not purchase habitat management rights through easement acquisition, it is in the Service’s best interest to see that easement lands are managed to their potential. To this end, the Service will employ a number of techniques to inform, educate and encourage easement owners to effectively manage habitat on their lands.

Strategies:

2.1.1. Coordinate and conduct semi-annual Wetland Management Workshop locally to disseminate current wildlife and habitat management information to easement landowners and other conservation partners.

2.1.2. Annually, conduct site visits on at least one third of easement properties to evaluate and offer habitat management recommendations.

2.1.3. Provide technical assistance to easement landowners as solicited.

2.1.4. Promote habitat incentive programs such as CDFW’s California Waterfowl Habitat Program and NRCS’s Conservation Reserve Program on easement lands.

2.1.5. Participate in CDFW California Waterfowl Habitat Program and NRCS Conservation Reserve Program status reviews, visiting selected conservation properties and offering habitat management recommendations as appropriate.

Objective 2.2: Easement – Habitat Enhancement.

Annually, enhance 1,000 acres of managed wetlands and associated upland and riparian habitat on WMA easement lands, as described in Chapter 3, section 5.2, to support migratory birds and other wetland-dependent wildlife.

Rationale:

While Service conservation easements are primarily purchased to protect wetland and agricultural habitats, the Service recognizes that habitat needs to be managed and enhanced to maximize wildlife resource values. In particular, the infrastructure of managed wetland habitat requires periodic enhancement or repair to maintain water management capabilities. Specifically, the 2006 CVJV Implementation Plan recognizes that water control structures, levees and water conveyance networks on managed wetlands should undergo structural enhancement every 10-15 years. This enhancement helps ensure proper water management on wetlands that maximizes food values and foraging opportunities for migratory birds. The Service will strive to see that easement wetlands are enhanced on a regular basis to maintain habitat management capabilities and wildlife values.

Strategies:

2.2.1. Work with easement owners and partners to enhance habitat on all existing and newly acquired easement properties as needed.

2.2.2. Facilitate habitat enhancement project funding on easement properties through a variety of sources, including the Service’s Partners for Fish and Wildlife Program, the NAWCA Grant Program, NRCS’s Wetland Reserve Program, California Wildlife Conservation Board’s Inland Wetland Conservation Program, and others as available.

Objective 2.3: Easement – Wetland Restoration.

Restore up to 12,535 acres of managed wetlands and associated upland and riparian habitats on newly acquired easement lands in the North Central Valley WMA and the Willow Creek-Lurline WMA, as described in Chapter
3, section 5.1, to help meet conservation objectives of the CVJV Implementation Plan (CVJV 2006) and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**

One of the main purposes the North Central Valley WMA and Willow Creek-Lurline WMA were established was to protect restored wetlands for waterfowl and other wetland-dependent plants and wildlife in the Sacramento Valley. Accordingly, when wetland easements are purchased on agricultural property, the lands must be restored to wetlands and associated upland and riparian habitats. The 1991 North Central Valley WMA Environmental Assessment delineates historic wetland areas with the best potential for wetland restoration within the WMA boundary. Areas identified as having the best potential for wetland restoration in the WMA primarily included rice lands (USFWS 1991). When appropriate, the Service will work with willing sellers, conservation partners and other interested parties to restore wetlands on these lands. The 15,000 in North Central Valley WMA and 2,141 acres in Willow Creek-Lurline WMA of restored wetlands represent the remaining easement acres to be purchased for the North Central Valley WMA and Willow Creek-Lurline WMA, respectively. It is unlikely that the entire 15,000 acres or 2,141 acres will entail restoration as many of the easements will be purchased on existing wetlands. It is estimated that approximately 25 percent or 535 acres of the Willow Creek-Lurline WMA will require restoration and approximately 80 percent or 12,000 acres of the North Central Valley WMA will be restored.

**Strategies:**

2.3.1. Work with easement owners and partners to restore wetlands, and associated upland and riparian habitat on all newly acquired easement properties as needed.

2.3.2. Work cooperatively with landowners and partners to survey, design and implement site specific wetland restoration plans on easement lands.

2.3.3. Work cooperatively with landowners and partners to secure all necessary permits for wetland restoration activities on easement lands.

2.3.4. Facilitate habitat restoration funding on easement properties through a variety of sources, including the Service’s Partners for Fish and Wildlife Program, the NAWCA Grant Program, NRCS’s Wetland Reserve Program, California Wildlife Conservation Board’s Inland Wetland Conservation Program, and others as available.

**Objective 2.4: Service Owned-Wetland Restoration.**

In the North Central Valley WMA, restore 3,321 acres of wetlands and associated upland and riparian habitat on newly acquired fee-title (Service-owned) lands, and on the Llano Seco Unit, restore 15 acres of grassland to managed seasonal wetlands, as described in Chapter 3, section 5.1, to help meet Sandhill Crane conservation objectives (Pacific Flyway Council 1997), the CVJV Implementation Plan (CVJV 2006), and support the waterfowl population goals of the North American Waterfowl Management Plan (USFWS et al., 1986, 2012).

**Rationale:**

Newly acquired Service-owned land would need to be restored to appropriate wetland and associated upland and riparian habitat to provide for migratory birds and other wetland-dependent wildlife. Historic wetlands and associated habitats in the Sacramento Valley have been lost to agricultural, industrial and urban land uses (refer to sections 4.1.1, 4.1.2, 4.1.3 and 4.1.4). Habitat restoration can achieve maximum benefits to wildlife and the public through the Refuge’s habitat management program, which accounts for adaptive management through an annual monitoring and evaluation cycle and dedicated specialized staff (refer to sections 5, 7 and 9).

**Strategies:**

2.4.1 Where appropriate, restore wetlands, and associated upland and riparian habitat, on all newly acquired Service-owned lands.
2.4.2 Pursue funding for wetland restoration through various internal and external sources, such as NAWCA, CVPIA Restoration Program, and California State Duck Stamp.

2.4.3. Secure all necessary compliance documentation and permits for restoration activities on Service–owned lands.

2.4.4. When appropriate, work with conservation partners to survey, design, and implement site-specific wetland restoration plans on Service-owned lands.

2.4.5. Restore 15 acres of shallow seasonal wetlands for Sandhill Cranes in Tract 4 of the Llano Seco Unit.

Objective 2.5: Service-owned – Managed Wetland Habitat.

Annually, manage high quality wetland habitat on Service-owned lands to provide a majority of seasonal wetlands with up to 15 percent semi-permanent/permanent wetlands on the Llano Seco Unit and up to 5 percent semi-permanent/permanent wetlands on the Butte Sink Unit to support migratory birds and other wetland dependent species. Greater than 75 percent of seasonal wetlands will be managed to: 1) contain 5 to 50 percent tall emergent cover; 2) contain greater than 50 percent desirable forage plant species cover, and 3) have an average depth of 12 inches (range 1 to 36 inches). Greater than 75 percent of permanent and semi-permanent wetland units will: 1) contain 20 to 70 percent cover of desirable submergent or floating-leaved emergent species, 2) contain 30-80 percent tall emergent cover, and 3) have average water depths of 24 inches (range of 12-36 inches) during May thru October and less than 18 inches during November thru April.

Rationale:
Managed wetlands are an essential component upon which significant numbers of waterfowl, waterbirds, shorebirds, other birds, threatened and endangered species rely (refer to Chapter 3, sections 4.1.1.1 and 4.1.1.2). Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). Managed seasonal wetlands support the greatest abundance and diversity of wildlife on Service-owned lands and support habitat and population objectives identified in the Central Valley Joint Venture (CVJV) Implementation Plan (CVJV 2006) and North American Waterfowl Management Plan (USFWS et al., 1986, 1998, 2012), respectively. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Actions C and L in the California Wildlife Action Plan (CDFG 2005c).

Strategies:
2.5.1. Within 5 years of CCP approval, develop a Habitat Management Plan (HMP) specific to WMA Service-owned lands that is a subset of the HMP for the Sacramento NWR Complex.

Semi-permanent wetland. Photo: CDFW
2.5.2. Consistent with the HMP, incorporate wetland management into Annual Habitat Planning process (see Chapter 3, section 5 – Habitat Management).

2.5.3. Actively manipulate water levels on managed wetlands consistent with Annual Habitat Management Plans.

2.5.4. Annually, conduct wetland maintenance or enhancement practices, as described in Chapter 3, section 4.2, on at least 10 percent of the wetland habitat, as needed.

2.5.5. Use irrigation, mowing, disk- ing, de-leveling, prescribed fire, herbicides, and grazing to manage vegetation and enhance wetland habitat.

2.5.6. Maintain water control infrastructure.

2.5.7. Annually, conduct wetland vegetation evaluations.

2.5.8. Conduct regular wildlife surveys to assess wildlife use of the individual management units.

2.5.9. Support and facilitate management-oriented research on wetland habitat, including monitoring the impacts of climate change.

2.5.10. Incorporate data from wildlife and vegetation surveys, and research results into habitat management planning process (adaptive management).

Objective 2.6: Service-owned – Vernal Pool/Annual Grassland Habitat.

On the Llano Seco Unit, enhance and manage 404 acres of vernal pool/annual grassland habitat to: 1) maintain annual grasslands with > 5 percent native wildflower cover to provide spring and summer nectar sources for native pollinators, 2) maintain annual grasses at an average height of < 4 inches over 90 percent of annual grass cover from November through April to provide optimum foraging habitat for wintering arctic geese and Sandhill Cranes, 3) maintain vernal pools with >20 percent cover of native and endemic grasses to help support populations of endangered and threatened plants, and 4) maintain <10 percent non-native annual grass cover to provide vernal pool habitat to help support threatened and endangered vernal pool Branchiopod crustaceans, in accordance with the Recovery Plan for Vernal Pool Ecosystems (USFWS 2005a).

Rationale:

In combination, vernal pools and annual grassland habitats support the greatest percentage of rare, endemic, and Federal and State listed species on the Service-owned lands. Additionally, these areas support important wintering arctic goose and sandhill crane foraging areas (refer to sections 4.1.1.4 and 4.1.2). The Llano Seco Unit is a particularly important area for cranes and spring goose populations have increased dramatically over the last 5 years. Approximately 75 percent of all vernal pools in the Central Valley were lost by 1997 (Holland 1978, 1998). Early losses were primarily related to conversion to agriculture. Losses that are more recent have been a result of conversion of historic cattle grazing lands to other uses and widespread urbanization (USFWS 1998, 2005a). Vernal pool conservation, management, and restoration are among the mandated purposes of the Service-owned lands. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Action C in the California Wildlife Action Plan (CDFG 2005c).

Strategies:

2.6.1. Within 5 years of CCP approval, develop a Habitat Management Plan (HMP) (specific to WMA fee-title lands) that is a subset of the HMP for the Sacramento NWR Complex.

2.6.2. Consistent with the HMP, incorporate vernal pool/annual grassland management into annual habitat management planning process.

2.6.3. Use prescribed fire (approximately 100 acres/year), herbicides, and grazing as primary methods to reduce and control non-native and invasive plant species, enhance native and endemic plant species, and support pollinators in vernal pool/annual grassland habitat.

2.6.4. Protect hydrology of vernal pool/annual grassland habitat by controlling runoff from surrounding flooded lands.
2.6.5. Manage timing of grazing, as described in annual grazing plan, to promote short grass (<4 inches) winter browse for wintering arctic geese and Sandhill Cranes.

2.6.6. Restore additional acres of vernal pool/annual grassland habitat as opportunities arise. Use plant materials derived from local ecotypes to construct natural plant communities, which may support locally rare native plants, pollinators, endemic species, and threatened and endangered species.

2.6.7. When restoring vernal pool/annual grassland habitats, implement restoration for species identified in the Vernal Pool Recovery Plan when and where possible (refer to Threatened and Endangered Species Strategies).

2.6.8. Conduct and evaluate regular wildlife surveys to assess wildlife use of vernal pool/annual grassland habitats.

2.6.9. Conduct and evaluate periodic vernal pool/annual grassland vegetation surveys.

2.6.10. Support restoration and management-oriented research on vernal pool/annual grassland habitats.

2.6.11. Incorporate data from wildlife and vegetation surveys, and research results into habitat management planning and decision-making process (adaptive management).

Objective 2.7: Service-owned – Perennial Grassland/Oak Savannah Habitat.

On the Llano Seco Unit, restore 200 acres of irrigated pasture to perennial grassland/oak savannah habitat on Tract 2 to support grassland bird populations. Annually, manage and enhance 300 acres of existing grassland/oak savannah to maintain >80 percent native plant species cover and support grassland bird populations.

Rationale:
Perennial grasslands/oak savanna provide numerous important habitat components, including foraging areas, nesting, and thermal and escape cover, for a variety of wildlife species on the Service-owned lands (refer to sections 4.1.2 and 4.1.3). Less than 1 percent of California’s original grasslands remain (Huenneke 1989) due to conversion to crop land, development, wildfire suppression, and introduction of non-native plant species. The Grassland Bird Conservation Plan (CPIF 2000) has addressed population and habitat objectives for healthy grassland bird populations. Refuge management strategies will support these objectives. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Action C and Statewide Conservation Action H in the California Wildlife Action Plan (CDFG 2005c).

Strategies:

2.7.1. Within 5 years of CCP approval, develop a Habitat Management Plan (HMP) (specific to WMA fee-title lands) that is a subset of the HMP for the Sacramento NWR Complex.

2.7.2. Consistent with the HMP, incorporate grassland management into annual habitat management planning process.

2.7.3. Conserve, protect, enhance, and restore perennial grasslands and oak savanna, where appropriate, based on soils, hydrology, or other features.

2.7.4. Use mowing, prescribed fire, herbicides, and grazing, or other appropriate treatments to reduce and control non-native and invasive plant species, enhance and maintain native species composition, and provide a mix of tall or short grassland structure on 300 acres of existing grassland/oak savannah.

2.7.5. Restore approximately 200 acres of native grasslands/oak savanna using plant materials derived from local ecotypes on the Llano Seco Unit.

2.7.6. Enhance topographic features for selected wildlife species (e.g., burrowing owl).

2.7.7. Conduct and evaluate regular wildlife surveys to assess wildlife use of grassland/savanna habitats.

2.7.8. Conduct and evaluate periodic grassland vegetation surveys.

2.7.9. Support management-oriented research on grassland habitats.
2.7.10. Pursue funding for 200 aces perennial grassland and oak savanna habitat restoration from various sources, such as CVPIA Restoration Program and National Wild Turkey Federation.

2.7.11. Incorporate data from wildlife and vegetation surveys, and research results into habitat management planning and decision-making process (adaptive management).

Objective 2.8: Service-owned: Riparian Habitat.

On the Butte Sink Unit, restore and enhance 30 acres of riparian habitat to maintain >80 percent native woody vegetation to support migratory landbirds. Manage and enhance existing riparian habitat on all Service-owned lands to maintain ≥80 percent native woody vegetation to support migratory landbirds and other riparian dependent wildlife.

Rationale:

Wetlands and riparian forests once covered about five million acres of the Central Valley before intensive settlement began in the late 1800s. Flood-control and subsequent conversion of natural wetlands to agricultural production have reduced these habitats to less than one-tenth their former extent (Dahl 1990). Less than 2 percent of the pre-1850 acreage of riparian forest remains, with virtually all of the Valley oak forest type gone (Bay Institute 1998).

Riparian forests and other riparian plant communities of California’s Central Valley provide habitat for a diversity of resident and migratory terrestrial and aquatic wildlife, including rare and endangered species (refer to section 4.1.3; Gaines 1974, 1977; Moyle 2002; Riparian Habitat Joint Venture 2004; Roberts et al., 1977; Small et al., 2000). The Partners in Flight North American Landbird Conservation Plan (Rich et al., 2004), the California Partners in Flight/Riparian Habitat Joint Venture Riparian Bird Conservation Plan (2004), and CVJV Implementation Plan (2006) identify focal species and habitat conservation and restoration needs for Central Valley birds. Refuge management strategies will support these objectives. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Actions C and L in the California Wildlife Action Plan (CDFG 2005c).

Strategies:

2.8.1. Within 5 years of CCP approval, develop a Habitat Management Plan (HMP) (specific to WMA fee-title lands) that is a subset of the HMP for the Sacramento NWR Complex.

2.8.2. Consistent with the HMP, incorporate riparian management into annual habitat management planning process.

2.8.3. Enhance 30 acres of riparian habitat on Tract 1 along Butte Creek by planting indigenous native trees and shrubs, using local ecotypes when practicable and feasible, on the Butte Sink Unit along Butte Creek.

2.8.4. Enhance riparian habitat by eliminating or reducing non-native and invasive...
trees and shrubs through manual removal and herbicide application to maintain >80 percent native woody vegetation.

2.8.5. Annually, conduct and evaluate wildlife surveys to assess wildlife use of riparian habitats.

2.8.6. Annually, conduct up to 5 surveys to evaluate riparian vegetation (based on 1 survey during annual habitat management planning, 1 aerial survey, and 3 surveys during invasive weed management in March, April, and May).

2.8.7. Support management-oriented research on riparian habitats, including monitoring the impacts of climate change.

2.8.8. Incorporate data from wildlife and vegetation surveys, and research results into habitat management planning and decision-making process (adaptive management).

**Objective 2.9: Service-owned and Easement – Wintering Waterfowl**

Annually, assess trends in the abundance, distribution, recruitment, and health of wintering waterfowl in the Central Valley and Pacific Flyway by conducting annual and periodic surveys; these surveys typically occur throughout the Valley floor, and occur on Service-owned and easement lands, as well as other lands.

**Rationale:**

Migratory birds are Federal trust species under the jurisdiction of the Service. Many species of migratory and resident birds depend on wetlands for winter habitat. Their conservation, management, and restoration are among the mandated purposes of the Service-owned lands. Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). The North American Waterfowl Management Plan (USFWS et al., 1986, 1998, 2012), CVJW Implementation Plan (CVJW 2006), and Pacific Flyway Management Plans (Pacific Flyway Council 2007) address population and habitat objectives for healthy waterfowl populations. Refuge management strategies will support these objectives. The Service-owned and easement lands provide wintering habitat for waterfowl. Monitoring is necessary to determine population status and trends, document habitat use, assess restoration and management needs, and to help determine some hunting regulations.

**Strategies:**

2.9.1. One to two times a month, conduct regular wildlife surveys on Service-owned lands for waterfowl.

2.9.2. Coordinate with Pacific Flyway entities including Division of Migratory Bird Management, Pacific Flyway Study Committee, California Department of Fish and Wildlife (CDFW), U.S. Geological Survey (USGS) National Wildlife Health Lab, and other organizations to conduct survey and monitoring efforts.

2.9.3. Conduct and report results from annual fall and winter waterfowl surveys, including special tule goose, white-fronted goose, white goose, and mid-winter waterfowl surveys.

2.9.4. Conduct periodic white-goose species composition (lesser snow and Ross’ geese) surveys, according to Flyway Management Plan, currently once every three years.

2.9.5. Annually, monitor Aleutian cackling geese at the Butte Sink Unit.

2.9.6. Collect data on age ratios of Arctic nesting geese for annual Flyway Productivity of Geese and Swans Report.

2.9.7. Monitor and control avian disease outbreaks on Service-owned lands according to Waterfowl Disease Contingency Plan for Sacramento National Wildlife Refuge Complex (USFWS 2009).

2.9.8. Conduct or facilitate Flyway-sponsored banding and marking of wintering waterfowl on Service-owned lands for population assessment.

2.9.9. Support management-oriented research on wintering waterfowl.

2.9.10. Provide technical assistance to easement owners regarding habitat
management and enhancement techniques that benefit wintering waterfowl.

**Objective 2.10: Service-owned and Easement – Breeding Waterfowl.**

Annually, assess trends in the abundance, distribution, recruitment, and health of breeding waterfowl and their habitat on Service-owned lands and cooperating easement lands.

**Rationale:**

Migratory birds are Federal trust species under the jurisdiction of the Service. Many species of migratory and resident birds depend on wetlands for breeding habitat. Their conservation, management, and restoration are among the mandated purposes of the Service-owned lands. Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982, Frayer et al., 1989, Kempka and Kollasch 1990). The North American Waterfowl Management Plan (USFWS et al., 1986, 1998, 2012) and the CVJV Implementation Plan (CVJV 2006) address population and habitat objectives for healthy waterfowl populations. WMA management strategies will support these objectives by providing breeding habitat for waterfowl on easement and Service-owned lands. Monitoring is necessary to determine population status, assess trends, and to identify habitat use as well as restoration and management needs.

**Strategies:**

2.10.1. Conduct regular wildlife surveys on Service-owned lands one to two times a month for waterfowl during the breeding season.

2.10.2. Provide and manage semi-permanent and permanent wetlands on Service-owned lands to accommodate nesting, brood-rearing, and molting waterfowl.

2.10.3. As habitat is available on Butte Sink and Llano Seco Units, conduct pre-season waterfowl banding in accordance with the Pacific Flyway Project, to meet or exceed established quotas for the Complex.

2.10.4. Evaluate waterfowl nesting, brood rearing, and molting habitat on Service-owned lands.

2.10.5. Monitor and control avian disease outbreaks on Service-owned lands according to Waterfowl Disease Contingency Plan for Sacramento National Wildlife Refuge Complex (USFWS 2009).

2.10.6. Support management-oriented research on breeding waterfowl.

2.10.7. Coordinate with NRCS Conservation Reserve Program and CDFW California Waterfowl Habitat Program to evaluate nesting and brood rearing habitat on participating easement lands.

2.10.8. Provide technical assistance to easement owners regarding habitat management and enhancement techniques that benefit breeding waterfowl.

**Objective 2.11: Service-owned and Easement – Shorebirds.**

Annually, assess trends in the abundance, distribution, and health of shorebirds in the Central Valley by conducting annual and periodic surveys. Manage wetlands, uplands, and irrigated pasture to enhance shorebird habitat on cooperating easement lands and on at least 10 percent of Service-owned lands. Work cooperatively with private landowners to enhance shorebird habitat on easement lands.

**Rationale:**

Migratory birds are Federal trust species under the jurisdiction of the Service. Many species of migratory and resident birds depend on wetlands for winter habitat. Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). The U.S. Shorebird Conservation Plan, Southern Pacific Shorebird Conservation Plan (Hickey et al., 2006), and CVJV Implementation Plan (CVJV 2006) addresses population and habitat objectives for healthy shorebird populations. Refuge management strategies will support...
these objectives. Service-owned and easement lands provide wintering, migration, and breeding habitat for shorebirds. Monitoring is necessary to determine population status, assess trends, and identify habitat use, as well as restoration and management needs.

**Strategies:**

2.11.1. Manage water levels and vegetation in managed wetlands on Service-owned lands to promote wintering shorebird use, and optimize shorebird habitat management during peak use periods, such as spring and fall migration. Examples include employing staggered seasonal wetland drawdowns from mid-March to early May and timing summer wetland drawdowns (i.e., semi-permanent wetlands) to coincide with early fall migration between mid-July and mid-August.

2.11.2. Conduct regular wildlife surveys on Service-owned lands one to two times a month for shorebirds.

2.11.3. Conduct periodic coordinated shorebird surveys on Service-owned and cooperating easement lands with Central Valley Joint Venture partners.

2.11.4. Monitor and control avian disease outbreaks on Service-owned lands.

2.11.5. Support management-oriented research on shorebirds.

2.11.6. Provide technical assistance to easement owners regarding habitat management and enhancement techniques that benefit shorebirds.

**Objective 2.12: Service-owned and Easement – Other Waterbirds**

Annually, assess trends in the abundance, distribution, and health of other waterbirds in the Central Valley by conducting annual surveys. Manage wetlands, uplands, and irrigated pasture to enhance waterbird habitat on cooperating easement lands and on at least 10 percent of Service-owned lands. Work cooperatively with private landowners to enhance waterbird habitat on easement lands.

**Rationale:**

Migratory birds are Federal trust species under the jurisdiction of the Service. Many species of migratory and resident birds depend on wetlands for winter habitat. Freshwater wetlands have declined by 90 to 95 percent in the Central Valley (Holland 1978, 1998; Gilmer et al., 1982; Frayer et al., 1989; Kempka and Kollasch 1990). The North American Waterbird Conservation Plan (Kushlan et al., 2002) and the CVJV Implementation Plan (CVJV 2006) address population and habitat objectives for focal species of waterbirds. Refuge management strategies will support these objectives. The Service-owned and easement lands provide breeding and wintering habitat for egrets, herons, rails, ibises, grebes, and other waterbirds. Monitoring is necessary to determine population status, assess trends, and identify habitat use, as well as restoration and management needs.

**Strategies:**

2.12.1. Conduct regular wildlife surveys on Service-owned lands one to two times a month for herons, egrets, bitterns, pelicans, grebes, ibis, and other waterbirds (see Appendix G).

2.12.2. Monitor colonial waterbird rookery locations, size, and reproductive success on Service-owned lands.

2.12.3. Conduct periodic surveys with cooperating agencies and NGOs on easement and Service-owned lands for selected species, including sandhill crane, white-faced ibis, and black terns.

2.12.4. Participate in coordinated colonial waterbird monitoring project (Migratory Birds Program) on Service-owned and cooperating easement lands.

2.12.5. Monitor and control avian disease outbreaks on Service-owned lands.


2.12.7. Manage spring and summer wetlands on Service-owned lands to
optimize nesting and foraging habitat and successful breeding of waterbirds.

2.12.8. Provide technical assistance to easement owners regarding habitat management and enhancement techniques that benefit other waterbirds.

2.12.9. On Llano Seco Unit, manage and restore wetlands for crane habitat (including roost sites) that includes average water depths of 6 inches on at least 25 percent of the wetland acreage and minimizes tall emergent vegetation in those areas.

**Objective 2.13: Service-owned and Easement lands – Landbirds**

Annually, assess trends in the abundance and distribution of landbird species on Service-owned and cooperating easement lands.

Manage uplands to enhance landbird habitat on cooperating easement lands and on at least 10 percent of Service-owned lands.

Work cooperatively with private landowners to enhance landbird habitat on easement lands.

**Rationale:**

Migratory birds are Federal trust species under the jurisdiction of the Service. Easement and Service-owned lands provide habitat for migratory and resident land birds. Monitoring is necessary to determine population status, assess population trends, determine causes for poor productivity, determine habitat restoration needs, and assess restoration success.

**Strategies:**

2.13.1. Conduct regular wildlife surveys on Service-owned lands one to two times a month for raptors, upland game birds, and other selected landbirds (see Appendix G).

2.13.2. Conduct periodic surveys with cooperating agencies for selected species, including tricolored blackbird, yellow-billed cuckoo, Swainson’s hawk, and burrowing owl on Service-owned and cooperating easement lands.

2.13.3. Monitor and control avian disease outbreaks on Service-owned lands.

2.13.4. Support management-oriented research on landbirds.

2.13.5. Provide technical assistance to easement owners regarding habitat management and enhancement techniques that benefit landbirds.

**Objective 2.14: Service-owned and Easement – Anadromous and Native Fisheries.**

Annually, on the Butte Sink Unit, maintain all water control structures and fish exclusion structures to facilitate anadromous fish passage and minimize entrapment consistent with the Butte Sink Cooperative Management Plan. On easement lands within the flood plain, provide 100 percent of landowners with Best Management Practices to avoid fish entrapment.

**Rationale:**

The Service and the Refuge System both identify anadromous fish conservation in their mission statements. The Sacramento River system supports four distinct salmon runs making Chinook salmon and Central Valley steelhead important ecological, recreational, and commercial fisheries. Adult and juvenile salmon and steelhead migrate through the Sacramento River system, including the Yolo and Sutter Bypass channels and the Butte Sink, at various times of the year depending upon the run. Floodplain wetlands within this system are important for growth and survival of immature salmonids and other native fishes. The relatively warmer waters of floodplain wetlands are very productive and produce an abundance of prey for juvenile fishes. Juvenile salmonids migrate downstream through the Butte Sink, Sutter Bypass and Yolo Bypass, and depending upon flood conditions may use inundated wetlands in the Butte Sink WMA and North Central Valley WMA.

**Strategies:**

2.14.1. Maintain the Bifurcation Dam Operations Agreement to ensure that long-term water and fisheries management in the Butte Sink WMA is consistent with the Butte Sink Cooperative Management Plan (Jones & Stokes 2001); see also strategy 1.7.3.
2.14.2. Consistent with the Butte Sink Cooperative Management Plan, continue to provide and monitor the flow-through water management system at the Butte Sink Unit to prevent entrapment of native fish.

2.14.3. Maintain all water conveyance systems on Service-owned lands including anadromous fish exclusion structures on the lift pump and outfall pipe at Butte Creek on the Butte Sink Unit. See also strategy 1.7.10.

2.14.4. Implement BMPs for mosquito control and herbicide applications (Integrated Pest Management (IPM) Plan is an appendix to the Sacramento, Delevan, Colusa, and Sutter NWR CCP (USFWS 2009) on Service-owned lands to minimize pesticide use and potential negative effects on native fisheries.

2.14.5. Continue to promote flow-through water management and fish-friendly water control structures in appropriate locations within the Butte Sink WMA and the North Central Valley WMA.

2.14.6. Promote riparian plantings in appropriate locations to provide shaded riverine aquatic habitat.

2.14.7. Develop Best Management Practices to avoid anadromous fish entrapment and distribute to all easement owners within the floodplain; provide technical assistance to easement owners regarding habitat management and enhancement techniques that benefit anadromous and native fisheries.

**Objective 2.15: Service-owned and Easement – Invasive Species Control.**

Annually, treat invasive plant species to prevent spread and reduce abundance on up to 30 percent of Service owned lands as described in IPM Plan (USFWS 2009). On easement lands, notify 100 percent of easement landowners regarding new invasive plant species and provide technical information and assistance on how to control invasive plants.

**Rationale:**

Invasive species have become the single greatest threat to the Refuge System and the Service’s wildlife conservation mission. More than eight million acres within the Refuge System are infested with invasive weeds (Audubon 2002). Invasive species cause widespread habitat degradation, compete with native species, and contribute significantly to the decline of trust species (USFWS 2002b). The National Strategy for Management of Invasive Species (USFWS 2002b) has been developed within the context of the National Invasive Species Management Plan, as called for by Presidential Executive Order 13112, and functions as the internal guidance document for invasive species management throughout the Refuge System. This Plan has four goals: 1) Increase the awareness of invasive species issues, both internally and externally; 2) Reduce the impacts of invasive species to allow the Refuge System to more effectively meet its fish and wildlife conservation mission and purpose; 3) Reduce invasive species impacts on the Refuge System’s neighbors and communities; and 4) Promote and support the development and use of safe and effective integrated management techniques to deal with invasive species. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Actions C and P in the California Wildlife Action Plan (CDFG 2005c).

The Central Valley is occupied by a diversity and abundance of invasive-species that are harmful because they crowd out or replace native species that are important to wildlife habitat diversity and ecosystem function. These species often dominate fallow agricultural fields and early successional stages of restoration sites. In addition, some late successional stages of native vegetation are also dominated by these undesirable species. As a result, habitat must be managed to control invasive species to favor a diversity and abundance of native, indigenous plants.

**Strategies:**

2.15.1. Through mailings notify 100 percent of easement landowners regarding new invasive plant species; provide outreach and technical assistance to landowners on how to control these plants.
2.15.2. Provide information to easement landowners on funding opportunities available to control invasive species, including the Service’s Partners for Fish and Wildlife Program, NRCS Environmental Quality Incentive Program (EQUIP) and others.

2.15.3. Annually, evaluate and prioritize invasive species to be controlled (Appendix F) on Service-owned lands; locate, map, and monitor species that may trigger a management response.

2.15.4. Annually, control invasive species on up to 30 percent of Service-owned lands using prescribed fire, irrigation, grazing, herbicide treatment, mowing, disk ing or other proven techniques as identified in the IPM plan (USFWS 2009).

2.15.5. Conduct, facilitate, and/or support research to identify invasive plant biology and ecology and to evaluate techniques for controlling invasive plant species on Service-owned and easement lands.

2.15.6. Maintain current knowledge of potential new invasive species that threaten habitat on easement and Service-owned lands by coordinating with local weed management areas, the California Early Detection Network (http://californiaedn.org/), and contacting California Invasive Plant Council (CAL IPC) for weed alerts and lists of highly invasive plants in California (http://www.cal-ipc.org/ip/management/alerts/index.php).

Objective 2.16: Service-owned and Easement – Mosquito Management.

Annually, coordinate with local Mosquito and Vector Control districts (MVCDs) that monitor and, if necessary, control refuge-based mosquito populations to address public health concerns in accordance with the 2009 IPM Plan. On easement lands, provide Best management Practices to 100 percent of landowners and provide technical assistance to reduce mosquito production on easement wetlands.

Rationale:

Local mosquito and vector control districts have identified a need to conduct mosquito monitoring and, if necessary, control activities on easement and Service-owned lands in order to protect the public from mosquito borne diseases. While mosquitoes are sometimes considered a nuisance because of their biting, some species are known vectors of serious diseases in California. There are primarily five mosquito species of concern potentially produced or harbored on easement and Service-owned lands: *Culex tarsalis*, *Aedes melaninom*, *Aedes nigromaculis*, *Aedes vexans*, and *Anopheles freeborni*.

The main diseases of concern for mosquito control programs in northern California are Western Equine Encephalitis (WEE), St. Louis Encephalitis (SLE), California Encephalitis, West Nile Virus (WNV), and malaria (see the IPM Plan appendix in USFWS 2009). *Culex tarsalis* is the main vector identified in wetlands in the transmission of these diseases, with the exception of malaria, which is vectored by *Anopheles freeborni*. The other mosquito species listed above can also potentially transmit WEE, SLE, and WNV, but are less competent vectors compared to *C. tarsalis*. WEE and SLE have caused significant outbreaks of human disease (CA Dept. of Health Services 2003). Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of WNV across the United States, and its detection in California in 2003.

In 2009, the Complex developed an IPM Plan for Service-owned lands in the Refuge Complex. The IPM Plan is an appendix to the Sacramento Delevan, Colusa, and Sutter NWRs CCP (USFWS 2009) that outlines a risk-based, hierarchical approach to mosquito management. This approach uses an understanding of mosquito biology and ecology whereby intervention measures depend on continuous monitoring of mosquitoes.

The IPM approach ensures legitimate human, fish, and wildlife health concerns are addressed.
It incorporates a combination of using a combination of best management practices (BMPs) in managed wetlands (Kwasny et al., 2004), biological controls, and a select group of pesticides, if warranted. Treatment thresholds (i.e., adult and larval mosquito population levels, and disease activity) and appropriate corresponding responses are identified in the compatibility determination for mosquito management (Appendix B). Under this program, if mosquito monitoring and disease surveillance indicate that human health thresholds are exceeded, the use of larvicides, pupacide, and/or adulticides may become necessary.

**Strategies:**

2.16.1. Work cooperatively with the local mosquito and vector control districts to monitor and manage pest mosquitoes consistent with National Policy, the Complex’s IPM plan, and Compatibility Determinations.

2.16.2. Implement BMPs (Kwasny et al., 2004) for mosquito management on Service-owned lands where and when appropriate on all habitat and water management activities.

2.16.3. Provide technical assistance to easement landowners on mosquito control issues, including providing BMPs to 100 percent of easement landowners.

2.16.4. Apprise MVCDs of new easement acquisitions and garner input when restoring wetland habitat on easement lands.

2.16.5 Meet annually with local MVCDs to discuss mosquito control and habitat management activities on Service-owned and easement lands.

**GOAL 3: Visitor Services**

*On the Llano Seco Unit (LSU) and other appropriate fee-title lands, provide visitors of all ages and abilities with quality wildlife-dependent recreation (wildlife observation, photography, environmental education and interpretation) and volunteer opportunities to enhance public appreciation, understanding, and enjoyment of fish, wildlife, habitats, and cultural resources.*
Objective 3.2: Wildlife Photography.

Provide high quality wildlife photography opportunities on the Llano Seco Unit to approximately 7,000 visitors per year.

Rationale:
Wildlife photography is identified in the Improvement Act as a priority public use that can be allowed when compatible with other Refuge purposes. The Service encourages first-hand opportunities to observe and photograph wildlife in their habitats. This activity will be managed to ensure that people have opportunities to photograph wildlife in ways that minimize wildlife disturbance and damage to vegetation and habitats. Wildlife photography will be managed to foster a connection between visitors and natural resources. The wildlife photography program will be managed in accordance with Service Manual 605 FW 5, Wildlife Photography.

Strategies:

3.2.1. Maintain loafing habitat adjacent to viewing platform to provide improved photographic opportunities (i.e., loafing logs, islands) north of viewing platforms.

3.2.2. Update photography guidelines and maps annually.

3.2.3. Maintain the Complex’s website to provide information about current photography guidelines and facilities.

3.2.4. Offer annual photography workshops and guided field trips on the Llano Seco Unit.

3.2.5. Annually, trim trees around parking area viewing platform to maintain wildlife visibility.

Objective 3.3: Environmental Education.

Within 5 years of CCP approval, in coordination with the Sacramento NWR Complex, develop an environmental education program to annually serve at least 500 students at the Llano Seco Unit who, by the end of their staff led program, 80 percent of visitors will recognize: (1) the types of wildlife on the Refuge, (2) and the importance of refuges, and (3) refuge management activities.

Rationale:
Environmental education is identified in the Improvement Act as a priority public use that can be allowed when compatible with other purposes of the Llano Seco Unit. The Service encourages environmental education as a process of building knowledge in students. The Refuge staff will work with local schools and universities to integrate environmental concepts and concerns into structured educational activities. These Service-lead or educator-conducted activities are intended to actively involve students or others in first-hand activities that promote discovery and fact-finding, develop problem-solving skills, and lead to personal involvement and action. Refuge staff will promote environmental education that: is aligned to the current Federal, State and local standards; is curriculum-based and meets the goals of school districts adopted instructional standards; and provides interdisciplinary opportunities that link the natural world with all subject areas. The environmental education program will be managed in accordance with Service Manual 605 FW 6 Environmental Education. This objective also helps to achieve Statewide Conservation Action J in the California Wildlife Action Plan (CDFG 2005c).
Strategies:

3.3.1. Develop an environmental education program that promotes in-depth studies of the ecological principles that are associated with wetland and riparian ecosystems and the Llano Seco Unit’s natural, cultural, and historical resources.

3.3.2. Encourage and promote school group field trips to Llano Seco Unit.

3.3.3. Annually, disseminate current environmental education program guidelines and activities offered to teachers.

3.3.4. Maintain the Complex’s website to promote current educational opportunities.

3.3.5. Utilize interpretive specialists, interns, and volunteers to facilitate the environmental education program.

Objective 3.4: Interpretation.

Within 5 years of CCP approval, in coordination with the Sacramento NWR Complex, develop an interpretive program to provide at least 1,000 annual interpretive visits at the Llano Seco Unit. At least 80 percent of the visitors will understand the importance of managing wetlands for waterfowl, sandhill cranes and other migratory birds.

Rationale:

Interpretation is identified in the Improvement Act as a priority public use that can be allowed when compatible with other purposes of the Llano Seco Unit. As a result, the Service encourages interpretation as both an educational and recreational opportunity that is aimed at revealing natural relationships, examining ecosystems, and exploring how the natural world and human activities are interconnected. Participants of all ages can voluntarily engage in stimulating and enjoyable activities as they learn about the issues confronting fish and wildlife resource management on the Llano Seco Unit. First-hand experiences with the environment will be emphasized, although presentations, audio-visual media, and exhibits will be necessary components of the interpretive program at Llano Seco Unit. The interpretive program will be managed in accordance with Service Manual 605 FW 7, Interpretation.

In 2007, the Service declared that “connecting people with nature” is among the agencies highest national priorities (USFWS 2008a). Positive interactions with the environment can lead to a life-long interest in enjoying and preserving nature. People’s interest in nature is crucial to the Service mission of conserving, protecting, and enhancing fish, wildlife, plants, and their habitats. In 2012, there were an estimated 700 annual interpretive visits.

Strategies:

3.4.1. Use the Complex’s visitor center to provide presentations and exhibits that promote the Llano Seco Unit.

3.4.2. Improve and maintain interpretive panels, and visitor facilities.

3.4.3. Annually, lead 7-15 tour groups on Llano Seco Unit.

3.4.4. Continue to participate in or provide information to local annual events (e.g., International Migratory Bird Day, National Wildlife Refuge Week, Snow Goose Festival, and Return of the Salmon Festival).

3.4.5. Maintain the Llano Seco Unit’s interpretation opportunities on the Complex’s website.

Objective 3.5: Public Outreach.

Within 5 years of CCP approval, develop an outreach program to attract at least 25,000 total annual visits. The program will promote public awareness and support of the Llano Seco Unit’s resources and management activities.

Rationale:

Effective outreach is an important component of the Visitors Service Program. The WMA will develop an effective outreach program that will provide two-way communication between the WMA and the public to establish a mutual understanding and promote involvement with the goal of improving joint stewardship of our natural resources. The outreach program will be designed to identify...
and understand the issues and target audiences, craft messages, select the most effective delivery techniques, and evaluate effectiveness. It will include education, interpretation, news media, information products and relations with nearby communities and local, State, Federal agencies. The WMA outreach program will follow the guidance of the National Outreach Strategy: A Master Plan for Communicating in the U.S. Fish and Wildlife Service, and America’s National Wildlife Refuge System: 100 on 100 Outreach Campaign.

Strategies:

3.5.1. Maintain the Sacramento Refuge Complex web site to promote current recreational and educational opportunities on the Llano Seco Unit.

3.5.2. Continue to participate or provide information to local events, such as International Migratory Bird Day, Snow Goose Festival, and Endangered Species Fair.

3.5.3. Continue to collect and report public use data for the RAPP, Provide Quality Recreation and Education section.

3.5.4. Participate in fire prevention education efforts to reduce fire incidence and damage. Provide outreach about the role and management uses of fire.

3.5.5. Write news releases for local and state newspapers and articles for magazines, when appropriate. Conduct television and radio interviews upon request.

Objective 3.6: Volunteers.

Within 5 years of CCP approval, provide at least 3 different types of volunteer opportunities to support a variety of Refuge programs on the Llano Seco Unit and Butte Sink Unit.

Rationale:

The National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 (P.L. 105-242) strengthens the Refuge System’s role in developing relationships with volunteers. Volunteers possess knowledge, skills, and abilities that can enhance the scope of refuge operations. Volunteers enrich refuge staff with their gift of time, skills, and energy. Refuge staff will initiate, support, and nurture relationships with volunteers so that they may continue to be an integral part of WMA programs and management. A Visitor Services Plan will be developed as a step down plan to provide guidance for the WMAs’ Visitor Services Program. The volunteer program will be managed in accordance with the Fish and Wildlife Service Manual, Part 150, Chapters 1-3, “Volunteer Services Program”, and Part 240 Chapter 9 “Occupational Safety and Health, Volunteer and Youth Program”.

In fiscal year 2013, the Complex volunteer program consists of 119 individuals that contributed over 6,000 hours by assisting with wildlife-dependent recreation, maintenance, wildlife and habitat management, environmental education, and cultural resource programs. Examples of past volunteer activities include roving interpretation, invasive weed removal, and “work days”.

Strategies:

3.6.1. Utilize interpretative specialists and interns to coordinate the volunteer program.

3.6.2. Recruit interns through the California Waterfowl, California State University Chico (CSU/Chico) internship program, and other universities.

3.6.3. Recruit a variety of community groups and individuals to volunteer (e.g., CSU/Chico, Butte College, local high schools, Boy Scouts, Girl Scouts, and Altacal Audubon Society).

3.6.4. Host an annual volunteer recognition dinner.

3.6.5. Facilitate volunteer training workshops.

3.6.6. Utilize the Girl Scout and Boy Scout Councils to recruit volunteers.

3.6.7. Provide Service volunteer uniforms for all volunteers to wear when greeting the public or at special events.

Objective 3.7: Public Safety.

Within 5 years of CCP approval, address and mitigate public safety hazards and issues on the Llano Seco Unit.
Rationale:

Historically, the Llano Seco Unit public use facilities have been vandalized and used during unauthorized times resulting in potential safety hazards. The remote nature of these lands presents the potential to attract vandals and illegal activities. Providing a safe public environment is a priority for the Service.

Strategies:

3.7.1. Use new LE supervisor and FWOs, as per Sacramento, Delevan, Colusa and Sutter NWR CCP (USFWS 2009), to increase regular patrols on the Llano Seco Unit and other WMA fee-title lands to protect natural resources and provide for public safety.

GOAL 4: Threatened and Endangered Species

Support self-sustaining populations of threatened and endangered species on fee-title Service-owned lands and on easement lands with willing landowners.

Objective 4.1: Service-owned – Threatened and Endangered Species.

Protect, restore and enhance threatened and endangered species (Appendix L) populations and their habitats where appropriate on Service-owned lands, including: 1) protecting and managing 404 acres of vernal pool grassland habitat on the Llano Seco Unit to support rare, threatened, and endangered plants and branchiopod crustaceans as described in Objective 2.6, and in accordance with the Recovery Plan for Vernal Pool Ecosystems (USFWS 2005a); 2) protecting the remaining elderberry plants on the Llano Seco and Butte Sink Units to help support the recovery of the threatened Valley elderberry longhorn beetle (VELB) in accordance with the VELB Recovery Plan (USFWS 1984); 3) maintaining up to 15 percent and 5 percent of managed wetlands as semi-permanent or permanent wetlands on the Llano Seco and Butte Sink Units, respectively, to support annual life cycle needs and recovery of the giant garter snake in accordance with the Draft Recovery Plan for the Giant Garter Snake (USFWS 1999a); and 4) annually maintaining and managing all water control structures and fish exclusion structures on the Butte Sink Unit to facilitate fish passage and minimize entrapment of threatened Chinook salmon, Central Valley Spring Run ESU, and steelhead, Central Valley ESU.

Rationale:

Federally-listed threatened, endangered, and candidate species are trust responsibilities under the jurisdiction of the Service. Threatened and endangered species, as well as those proposed for Federal listing, are those whose continued existence may be jeopardized by reducing the reproduction, numbers or distribution of that species. Where appropriate on Service-owned lands, the Refuge will help to achieve goals described in the recovery plans for vernal pool species including hairy Orcutt grass, Greene’s tuctoria, Hoover’s spurge, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp (USFWS 2005a), valley elderberry longhorn beetle (USFWS 1984), and giant garter snake (USFWS 1999a). The Refuge will also help achieve the recovery goals of threatened and endangered salmonids including Chinook salmon Sacramento River winter-run Evolutionarily Significant Unit (ESU), Chinook salmon Central Valley spring-run ESU, and steelhead Central Valley spring-run ESU.

Threatened and endangered species populations are in decline due, in part, to habitat degradation and destruction. Their conservation, management, and restoration are mandated purposes of the Refuges. Monitoring is necessary to determine population distribution, abundance, survival, habitat use, and to identify restoration and management needs. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Action C in the California Wildlife Action Plan (CDFG 2005c).

Strategies:

4.1.1. Document habitat of Federal- and State-listed threatened and endangered species (Appendix L) on Service-owned lands through regular, periodic, or specifically coordinated surveys.
4.1.2. Support recovery activities for threatened and endangered species identified in Service recovery plans for giant garter snake, Valley elderberry longhorn beetle, and vernal pool plant and animal species (USFWS 1984, 1999a, 2005a).

4.1.3. Implement giant garter snake avoidance measures, including conducting surveys prior to any planned work activities where hibernation areas may be disturbed, as described in its Draft Recovery Plan (USFWS 1999d).

4.1.4. Assist with the development and implementation of reintroduction and introduction programs to restore extirpated populations (USFWS 2005a) for the following: hairy Orcutt grass, Green’s tuctoria, Hoover’s spurge, vernal pool saltbush, Ferris milk-vetch, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, and other recovery plan species, where appropriate.

4.1.5. Support management-oriented research, such as the effects of various vegetation management techniques for the control of invasive plant species or describe soil and water characteristics (e.g., profile, texture, duripan, salinity, alkalinity) of species-specific reference pools for vernal pool habitat restoration projects.

4.1.6. Support research for actions identified in recovery plans that promote the recovery of threatened and endangered species such as: cooperative range-wide and directed population status and habitat condition surveys; seed/cyst collections/banking; genetics and demography for conservation and reintroduction/introduction; and effects of habitat management (USFWS 2005a, 2007a).

4.1.7. On Service-owned lands, document all observations of and habitat use by species Federally-listed as threatened and endangered.

4.1.8. Provide annual and periodic Refuge monitoring survey information on listed species to appropriate State (CDFW State Office, Habitat Conservation Planning Branch, Region 2 Office) and Federal agencies (USFWS–Sacramento Fish and Wildlife Office, Permit Coordinator, Endangered Species and Recovery branches).

4.1.9. Coordinate with NOAA Fisheries and CDFW to support actions related to conservation of Federally-listed anadromous fish.

4.1.10. Develop partnerships with other agencies, universities, or NGOs to conduct research and monitoring that supports threatened and endangered species conservation on the WMAs.

4.1.11. Support the actions identified in the various recovery plans for threatened and endangered salmonids (NOAA 2014).

Objective 4.2: Easement – Threatened and Endangered Species.

Work with willing landowners to protect, restore and enhance threatened and endangered species (Appendix L) populations and their habitats on easement lands.

Rationale:

Federally-listed threatened, endangered, and candidate species are trust responsibilities under the jurisdiction of the Service. Threatened and endangered species, as well as those proposed for Federal listing, may become extinct due to habitat destruction, habitat degradation and other environmental factors. Easement lands provide habitats that help support threatened and endangered species populations and may enhance species survival. Where appropriate, the Service will work cooperatively with willing easement landowners to help achieve goals and objectives described in the various recovery and management plans for the threatened and endangered species (Appendix L) occurring within the WMAs.

WMA easement management strategies support many of the goals and objectives of Federal and State threatened and endangered species recovery and management plans. This objective also helps to achieve Central Valley and Bay-Delta Region Conservation Action C in the California Wildlife Action Plan (CDFG 2005c).

Strategies:

4.2.1. Develop suggested habitat management recommendations for easement lands with regard to endangered species and their habitats.
4.2.2. Help disseminate suggested endangered species habitat management recommendations and avoidance measures to easement landowners.

4.2.3. Work with willing landowners to implement activities described in the various recovery plans for Federal and State listed threatened and endangered species on appropriate easement lands.

4.2.4. Promote incentive programs to restore and enhance endangered species habitat on easement lands with willing landowners.

GOAL 5: Climate Change

Maintain and enhance current habitat values under anticipated climate change scenarios in the Central Valley.

Objective 5.1: Climate Change Adaptation.

Within 5 years, identify and document changes in migratory bird use patterns and modify, as needed, management objectives for Service-owned lands and easement objectives to address the changes.

Rationale:

Climate change is already affecting wildlife throughout the state (Parmesan and Galbraith 2004), and its effects will continue to increase. It has particular significance for this region’s major river systems. For the Central Valley, this means more intense winter flooding, greater erosion of riparian habitats, and increased sedimentation in wetland habitats (Field et al., 1999, Hayhoe et al., 2004). For the Central Valley, the effects of climate change are likely to include reduced snow pack, longer, more frequent droughts, hotter, drier summers, and lower spring/summer river flows, may reduce water supplies and increase the water needs of both people and wildlife. This is likely to translate into less water for wildlife, especially fish and wetland-dependent species.

Strategies:

5.1.1. Work with partners to assess the potential effects of climate change and adapt management to address these effects. Coordinate with CVJV and California Landscape Conservation Cooperative (LCC) to implement portions of the CVJV Monitoring and Evaluation Plans, and other relevant monitoring activities that address the effects of climate change to Service trust resources.

5.1.2. Develop partnerships with local, state, and Federal land protection agencies and organizations and learn about their long-term, ecosystem goals for the Central Valley eco-region.

5.1.3. Collaborate with partners to implement appropriate land protection and management recommendations that address climate change.

5.1.4. Facilitate research that evaluates the effects of climate change on water supply/availability, migratory bird use patterns, special status species, invasive species, and habitat changes.

5.1.5. Use research results to inform easement acquisition and management decisions.

Objective 5.2: Climate Change Mitigation.

Assess and minimize the carbon footprint of Service operations and management on Service-owned lands. Reduce the Refuge’s energy consumption 2 percent annually to reach a 30 percent reduction in fuel and electricity consumption in 15 years.

Rationale:

Climate change is already affecting wildlife throughout the State (Parmesan and Galbraith 2004), and its effects will continue to increase. It has particular significance for this region’s major river systems. Depending on the model and assumptions, scientists project that the average annual temperature in California to rise between 4 and 10.5°F above the current average temperature by the end of the century (Hayhoe et al., 2004). Within 50 years, average winter time temperatures are expected to rise between 2 and 2.5 degrees. A rise in this range would substantially reduce annual snowpack and increase fire frequency and intensity. By mid-century, the Sierra snowpack could be reduced by 25 to 40 percent and by as much as 70 percent at the end of the
century (duVair 2003). The snow season would be shortened, starting later and melting sooner, while the fire season would be longer and hotter. The reduction of snowpack and more extreme fire conditions would have cascading effects on water resources, plant communities, and wildlife. Hotter temperatures, combined with lower river flows, will dramatically increase the water needs of both people and wildlife. This is likely to translate into less water for wildlife, especially fish and wetland species (CDFG 2005d). This objective also helps to achieve Statewide Conservation Action I in the California Wildlife Action Plan (CDFG 2005d). This objective meets with the Service’s climate change policy (for more information on applicable policies, see Appendix N), which recommends reducing Refuge staff carbon footprint to offset climate change impacts. The “carbon footprint” is defined by the Federal EPA as a measure of greenhouse gases that are produced by activities of a person, a family or a business that involve burning fossil fuels. The Refuge could also serve as a leader in the community to encourage neighbors to reduce their own carbon footprints.

**Strategies:**

5.2.1. Replace Service vehicles with more fuel-efficient vehicles (e.g., hybrid, electric) as replacement need arises and funding permits.

5.2.2. Retrofit existing Complex facilities to increase energy efficiency (e.g., use compact fluorescent bulbs, increase insulation, and replace single-paned windows incrementally, as replacement need arises).

5.2.3. Service staff will use telephone or computer video conference capabilities whenever possible to reduce carbon emissions.

5.2.4. Continue to meet or exceed the Service’s requirements for recycling and using recycled goods at the Complex.
Chapter 5. Plan Implementation

Once the CCP has been approved and the Service has notified the public of its decision, the implementation phase of the CCP process will begin. During the next 15 years, the objectives and strategies presented in this CCP will be implemented; the CCP will serve as the primary reference document for all Refuge planning, operations, and management until it is formally revised at the end of the 15-year period. The Service will implement the final CCP with assistance from existing and new partner agencies, organizations, and the public.

CCPs provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service’s best estimate of future needs. These plans detail program planning levels that may exceed current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. Plans do not guarantee a commitment of resources.

Activities required to accomplish the management strategies discussed in this CCP are referred to as projects. Every effort will be made to implement these projects by the deadlines established here. However, the timing of implementation of the management activities proposed in this document is contingent upon the following factors:

- **Funding**
- **Staffing**
- Completion of step-down management plans (detailed plans)
- Compliance with other Federal regulations
- **Partnerships**
- Results of monitoring and evaluation

1. **Funding and Staffing**

To implement the proposed action and to achieve the objectives and goals of this CCP, the Service will need additional funding. Needs are recorded in the Service Asset Maintenance Management System and Refuge Operating Needs System (RONS) for the Refuge System. Maintenance projects include repair and replacement of existing buildings and facilities and removal of unneeded infrastructure. RONS projects are proposed new projects that do not represent replacement of existing equipment or facilities. RONS projects in this CCP include habitat restoration, wildlife monitoring, and visitor services programs. It is important to note that additional projects proposed in this CCP will be added to the RONS list during the life of this CCP. The estimated initial capital outlay (one-time costs) to implement the actions described in the CCP is approximately $1,037,000 (Table 9). Not all of these capital expenditures would occur in the same year. The estimated annual recurring cost to fully implement the CCP is approximately $1.1 million (Table 10). However, costs must be incrementally increased for inflation and additional activities such as new research studies.

The WMAs are managed from the Sacramento NWR Complex. While the Service’s easement manager is permanently assigned to WMA-related duties, the WMAs also receive management, biological, law enforcement, maintenance, visitor services, and administrative assistance from staff that support the entire Sacramento NWR Complex. Salaries constitute a significant cost of implementing the CCP. Funding for 3 additional permanent staff is needed to implement the objectives and strategies of the CCP (Table 10).
The needs and costs shown in the tables below are best estimates and may not entirely reflect the costs of managing the WMAs. The expenditures are followed by a reference to the number of the strategy (from Chapter 4) that the expenditure implements or supports.

Table 9.  Estimated initial capital outlay to fully implement the CCP.

<table>
<thead>
<tr>
<th>Expenditure (related strategies)</th>
<th>Unit Cost</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop easement outreach materials for wetland and agricultural landowners (presentations,</td>
<td>$5,000</td>
<td>1</td>
</tr>
<tr>
<td>brochures, mailings, website (1.2.2.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract with Hydrologist to inventory water rights/supply on existing easement properties</td>
<td>$150,000</td>
<td>1</td>
</tr>
<tr>
<td>(1.7.1.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restore 15 acres of seasonal wetlands on the Llano Seco Unit (2.4.1.)</td>
<td>$15,000</td>
<td>1</td>
</tr>
<tr>
<td>Restore 200 acres of native grassland/oak savanna on the Llano Seco Unit (2.7.5.)</td>
<td>$500,000</td>
<td>2</td>
</tr>
<tr>
<td>At Butte Sink WMA, restore and enhance riparian habitat along Butte Creek (Up to 30 acres;</td>
<td>$60,000</td>
<td>2</td>
</tr>
<tr>
<td>10 acres riparian forest at $3,000/acre, 20 acres mixed forest/grassland at $1,500/acre)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2.8.3.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Llano Seco Unit, replace (2) viewing platforms to comply with ADA and engineering safety</td>
<td>$300,000</td>
<td>1</td>
</tr>
<tr>
<td>requirements (3.1.3.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Llano Seco Unit, install spotting scope on interior viewing platform (3.1.4.)</td>
<td>$5,000</td>
<td>3</td>
</tr>
<tr>
<td>At Llano Seco Unit, maintain loafing island in Tract 12 and enhance loafing habitat near</td>
<td>$2,000</td>
<td>2</td>
</tr>
<tr>
<td>viewing platform (3.1.5., 3.2.1.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Butte Sink, Willow Creek-Lurline and North Central Valley WMAs CCP (estimated capital</td>
<td>$1,037,000</td>
<td></td>
</tr>
<tr>
<td>outlay)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Butte Sink, Willow Creek-Lurline, and North Central Valley Wildlife Management Areas
Table 10. Estimated annual cost to fully implement the CCP

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Status</th>
<th>Unit</th>
<th>Quantity (FTE)</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Benefits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Leader – GS-14</td>
<td>Existing</td>
<td>FTE</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Deputy Project Leader-GS-13</td>
<td></td>
<td></td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Easement Manager – GS-12</td>
<td>Existing</td>
<td>FTE</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Assistant Manager Sacramento River NWR-GS-12</td>
<td>Existing</td>
<td>FTE</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>Assistant Manager Colusa NWR-GS-12</td>
<td></td>
<td></td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Private Lands Wildlife Biologist – GS-11</td>
<td>Existing</td>
<td>FTE</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Supervisory Wildlife Biologist-GS-12</td>
<td>Existing</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Wildlife Biologist-GS-11</td>
<td>Existing</td>
<td>FTE</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Wildlife Biologist-GS-9</td>
<td>Existing</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Engineering Equipment Operator Colusa NWR-WG-9</td>
<td>Existing</td>
<td>FTE</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Maintenance Worker Sacramento River NWR-WG-7</td>
<td>Existing</td>
<td>FTE</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Tractor Operator Colusa NWR-WG-6</td>
<td>Existing</td>
<td>FTE</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Maintenance Worker-WG-7/8</td>
<td>Existing</td>
<td>FTE</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Park Ranger-GS-7/9</td>
<td>Existing</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Park Ranger-GS-9</td>
<td>Existing</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Law Enforcement Officer-GL-9</td>
<td>Existing</td>
<td>FTE</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Administrative Officer-GS-9</td>
<td>Existing - Vacant</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Budget Technician-GS-6</td>
<td>Existing</td>
<td>FTE</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Forestry Technician-GS-5</td>
<td>Existing</td>
<td>FTE</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Tractor Operator – WG-6</td>
<td>Proposed and unfunded</td>
<td>FTE</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>To fulfill Goals 1, 2 and 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife Biologist– GS-11</td>
<td>Proposed and unfunded</td>
<td>FTE</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>To fulfill Goals 1, 2, and 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife Refuge Specialist – GS-11</td>
<td>Proposed and unfunded</td>
<td>FTE</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>To fulfill Goals 1, 2, and 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal - Salaries and Benefits</strong></td>
<td><strong>FTE</strong></td>
<td></td>
<td><strong>7.8</strong></td>
<td><strong>$684,895</strong></td>
</tr>
</tbody>
</table>

Expenditures

<table>
<thead>
<tr>
<th>Programs</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance (repairs, replacement, rentals, etc.)</td>
<td>$82,000</td>
</tr>
<tr>
<td>Water Costs</td>
<td>$252,000</td>
</tr>
<tr>
<td>Water Quality Monitoring</td>
<td>$1,800</td>
</tr>
<tr>
<td>Travel/Training</td>
<td>$10,000</td>
</tr>
<tr>
<td>Supplies</td>
<td>$24,000</td>
</tr>
</tbody>
</table>
2. Step-Down Management Plans

Some objectives in the CCP require more detailed planning than the CCP process is designed to provide. For these projects, the Service will refer to step-down management plans and other plans to provide additional details necessary to implement objectives and strategies in the CCP. A number of step-down plans for Service-owned lands will be developed or updated after completion of the CCP, including:

- Visitor Services Plan
- Resource Inventory and Monitoring Plan

The following step-down plans were completed for the Complex as part of the Sacramento, Delevan, Colusa, and Sutter NWRs’ CCP, apply to the Service-owned lands in the WMAs, and are incorporated by reference.

- Habitat Management Plan
- Integrated Pest Management Plan
- Disease Contingency Plan
- Fire Management Plan

3. Compatibility Determination

Federal law and policy provide the direction and planning framework to protect the Refuge System from incompatible or harmful human activities and to ensure that Americans can enjoy Refuge System land and waters. The 1997 Improvement Act is the key legislation on managing public uses and compatibility.

Before activities or uses are allowed on a refuge or in this case, Service-owned WMA lands, uses must be found to be compatible through a written compatibility determination. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge or WMA. Sound professional judgment is defined as a decision that is consistent with the principles of the Service’s management and administration, available science and resources, and adherence to the requirements of the 1997 Improvement Act and other applicable laws. Wildlife-dependent recreational uses may be authorized on a refuge and Service-owned lands when they are compatible and not inconsistent with public safety.

Compatibility determinations for environmental education and interpretation, grazing, mosquito monitoring and management, plant material gathering, research, hunting, and wildlife observation and photography are included in Appendix B.
4. **Compliance Requirements**

This CCP was developed to comply with all Federal laws, Executive orders, and legislative acts. For information on applicable laws and regulations, see the Legal and Policy Guidance section in Chapter 1 and Appendix N.

5. **Partnership Opportunities**

Volunteer and Friends Organizations efforts are critical to the achievement of Refuge or WMA objectives and strategies. The Sacramento NWR Complex has partnered with governmental agencies, nongovernmental organizations, and individuals to conduct wildlife monitoring, habitat restoration, and facility maintenance activities. These partners play an important role in helping the Service achieve its mission and the Refuge’s or WMA’s goals. The Service will continue to rely on these and other partners in the future to help implement this CCP and to provide input for future CCP updates. In addition, the Service will continue to explore other potential avenues for partnerships and assistance in the monitoring and restoration of the WMA Service-owned lands and easement lands with willing owners.

6. **Monitoring and Evaluation**

This CCP is designed to be in effect for a 15-year period. The Plan will be reviewed and revised as necessary to ensure that established goals and objectives are still applicable. The monitoring program will focus on issues involving visitor services activities, habitat restoration, wildlife monitoring, and other management activities. Monitoring and evaluation will use the adaptive management process. This process includes goal and objective setting, and applying management tools and strategies, followed by monitoring and analysis to measure achievement of objectives and to refine management techniques.

Collection of baseline data on native wildlife populations will continue. This data will be used to update existing species lists, determine habitat requirements, and guide management actions. Where information gaps exist, a concerted effort will be made to obtain information. With new information, goals and objectives may need modification. Public involvement will be encouraged during the evaluation process.

Monitoring of visitor services programs will involve the collection of visitor use statistics. Monitoring will be done to evaluate the effects of visitor services on WMA habitat, wildlife populations, and visitor experience.

7. **Adaptive Management**

An adaptive approach involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions (Williams and Brown 2012). Adaptive management promotes flexible, effective decision making that can be adjusted in the face of uncertainties as outcomes of management actions and other events become better understood. Careful monitoring of these outcomes advances understanding of the system and helps adjust policies. Adaptive management incorporates natural variability in evaluating ecological resilience and productivity (Trulio et al. 2007).

Adaptive management provides the framework within which biological measures and public use can be evaluated by comparing the results of management to the expected results of objectives. Under the CCP, habitat, wildlife, and public use management techniques and specific objectives would be regularly evaluated as the results of monitoring programs, new technology, and other information become available. These periodic evaluations would be used over time to adapt both the management objectives and the strategies to better achieve management goals. Such a system embraces uncertainty, reduces option foreclosure, and provides new information for future decision making, while allowing resource use. The management scenario proposed in this CCP provides for ongoing adaptive management.
of the Service-owned WMA lands. The CCP may be amended as necessary at any time in keeping with the adaptive management strategy. However, major changes to the CCP may require public involvement processes and additional NEPA compliance documentation. The Project Leader will determine the appropriate public involvement and NEPA compliance requirements. Plan revisions are discussed in the next section.

8. Plan Amendment and Revision

The CCP is intended to evolve as the WMAs change; to this end, the 1997 Improvement Act specifically requires that CCPs be formally revised and updated at least every 15 years. The formal revision process would follow the same steps as the CCP creation process. In the meantime, the Service will review and update this CCP periodically if needed, based on the results of the adaptive management program. While preparing annual work plans and updating the Refuge database, Service staff will also review the CCP. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the Plan. The goals described in this CCP would not change until they are reevaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of the resources on the WMAs. It is the intent of the Service that this CCP apply to any new lands that may be acquired as part of the WMAs. If revisions to the objectives and strategies are needed, the Project Leader will determine the appropriate public involvement and associated NEPA compliance requirements.

The intent of the CCP is for progress toward and/or achievement of CCP objectives during the lifetime of the Plan. Management activities would be phased in over time, and implementation is contingent upon and subject to the results of monitoring and evaluation, funding through Congressional appropriations and other sources, and staffing.
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FAX: 530-934-7814
http://www.fws.gov/refuge/Sacramento/Aboutthecomplex.html

California Relay Service
TTY: 1 800/735-2929
Voice: 1 800/735-2922

U.S. Fish and Wildlife Service
1 800/344-WILD
http://www.fws.gov

June 2015

Waterfowl at Butte Sink WMA
Photo: USFWS