APPENDIX M2

U.S. Fish and Wildlife Service Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
1-1-06-F-0027

MAR 16 2006

Memorandum

To: Area Manager, Bureau of Reclamation, South-Central California Area Office, Fresno, California

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office (SFWO), Sacramento, California

Subject: Formal Consultation on the Proposed San Luis Drainage Feature Re-evaluation (SLDFR); California Least Tern, Giant Garter Snake, and San Joaquin Kit Fox; Fresno, Kings, and Merced Counties, California

Introduction

This responds to your (U.S. Bureau of Reclamation; Reclamation; USBR; see Appendix A for a summary list of common abbreviations used in this document) memorandum dated May 17, 2005, to the U.S. Fish and Wildlife Service (Service) requesting consultation on the San Luis Drainage Feature Re-Evaluation; and your November 13, 2005, memorandum providing additional information in the form of a revised biological assessment and requesting that the consultation be completed by the end of February to accommodate the court mandated schedule. This consultation is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (ESA).

The findings and recommendations contained in this consultation are based on the following documents:

1. 1960 *The San Luis Act* (P.L. 86-488; Public Law)
2. 1990 San Joaquin *Valley Drainage Program (U.S. Department of the Interior [USDI] and California Resource Agencies)*
3. 2000 *U.S. Ninth District Court of Appeals findings (Case Number 95-15300)*
4. December 2002 *San Luis Drainage Feature Re-Evaluation Plan Formulation Report*

5. July 2003 *National Environmental Policy Act Comments on the San Luis Drainage Feature Re-Evaluation Plan and Draft Alternatives Report*
6. July 2003 Planning Aid Memorandum on the San Luis Drainage Feature Re-Evaluation Plan and Plan Formulation Report
7. Service's (U.S. Fish and Wildlife Service, USFWS) review of the 2004 *Plan Formulation Report Addendum*
8. May 2005 *Draft Environmental Impact Statement for the San Luis Drainage Feature Re-Evaluation Project* in western Fresno County, California
9. May 2005 *San Luis Drainage Feature Re-evaluation Biological Assessment*
10. Revised and Updated October 2005 *San Luis Drainage Feature Re-evaluation Biological Assessment*
11. 2006 documents provided by the Endangered Species Recovery Program (ESRP)
12. Telephone calls and electronic mail messages between Reclamation and the Service
13. Other information available to the Service.

Affected Species and Critical Habitat

This document represents our review of the proposed project on the following species:

- endangered California least tern (*Sterna antillarum* [= *albifrons*] *browni*)
- threatened giant garter snake (*Thamnophis gigas*)
- endangered San Joaquin kit fox (*Vulpes macrotis mutica*)

The proposed project does not affect any critical habitat because no critical habitat has been designated for these three species.

No Effect and Not Likely to Adversely Affect Determinations

Reclamation has determined that the proposed action will have no effect on the following species (Appendix B):

- No Effect:
  - Buena Vista Lake Shrew (*Sorex ornatus relictus*; Federal status: endangered)
  - Fresno Kangaroo Rat (*Dipodomys nitratoides exilis*; Federal status: endangered)
  - Giant Kangaroo Rat (*Dipodomys ingens*; Federal status: endangered)
  - Riparian Woodrat (*Neotoma fuscipes riparia*; Federal status: endangered)
  - Bald Eagle (*Haliaeetus leucocephalus*; Federal status: threatened)
  - California Condor (*Gymnogyps californianus*; Federal status: endangered)
  - California Red-legged Frog (*Rana aurora draytonii*; Federal status:

threatened)
- Blunt-nosed Leopard Lizard (*Gambelia silus*; Federal status: endangered)
- Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp (*Branchinecta lynchi* and *Lepidurus packardi*; Federal status: threatened and endangered [respectively])
- Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus;* Federal status: threatened)
- Palmate-bracted Bird's-beak (*Cordylanthus palmatus*; Federal status: endangered)
- California Jewelflower (*Caulanthus californicus*; Federal status: endangered)
- San Joaquin Wooly-threads (*Monolopia (=Lembertia) congdonii*; Federal status: endangered)
- Delta Smelt and Delta Smelt Critical Habitat (*Hypomesus transpacificus*; Federal status: threatened)

We concur with Reclamation's determination that the proposed action is not likely to adversely affect the following species (Appendix B):

- Not Likely to Adversely Affect:
  - Tipton Kangaroo Rat (*Dipodomys nitratoides nitratoides*; Federal status: endangered)
  - California Tiger Salamander (*Ambystoma californiense*; Federal status: threatened)

Consultation History

Coordination and consultation activities include the following:

2001 *September*: Project planning initiated--The Service and Reclamation negotiate a Scope of Work for the Fish and Wildlife Coordination Act Report.

October: Agencies participate in Alternatives Planning Team Meeting.

November: Public Scoping Meeting.

December: The Service provides an initial species list for preliminary In-Valley and Delta Disposal Alternatives; agencies participate in Team Coordination Meeting.

2002 *January*: The Service submits Planning Aid Memorandum to Reclamation.

February: Agencies participate in evaporation pond work group.

March: Agencies participate in meeting to discuss project purpose and preliminary alternatives.

April: Agencies participate in Team Coordination Meeting.

June: The Service provides a revised species list to reflect the addition of Ocean Disposal Alternatives.

August: Species list is shortened to reflect elimination of Santa Cruz Ocean Disposal Options.

September: Agencies participate in Interagency Workshop.

December: The Service accepts Cooperating Agency status.

2003 *April*: The Service submits Planning Aid Memorandum to Reclamation.

June: The Service provides an updated species lists for In-Valley, Ocean, and Delta Disposal Alternatives; the Service submits first Draft Fish and Wildlife Coordination Act Report (CAR).

July: The Service releases an additional Planning Aid Memorandum to discuss changes in the project dealing with the addition of land retirement as an alternative and a new Plan Formulation Report "addendum" prepared by the Bureau.

October: The Service begins participation in the monthly SLDFR Mitigation Work Group (MWG). The MWG continues to meet and now averages bi-weekly meetings.

November: The Service provides comment letter on National Environmental Policy Act (NEPA) documents.

2004 *Throughout year*: Agencies participate in numerous meetings.

November: The Service provides comment and recommendations on project. USFWS-USBR Interagency Meeting to Discuss Planning Process for project.

2005 *February*: Updated species list is obtained from the Service through its Sacramento Office Endangered Species website; the Service provides Reclamation with the Draft Fish and Wildlife Coordination Act Report.

March: Administrative Draft Environmental Impact Statement (ADEIS) reviewed by agencies.

May 17: Reclamation requests initiation of formal consultation and transmits the Biological Assessment on the San Luis Drainage Feature Re-evaluation Project's In-Valley Disposal/Land Retirement Alternatives for public review and comment.

June 20: The Service submits a memorandum (Service reference: 1-1-05-I-1317) to Reclamation requesting additional information to initiate formal consultation on San Luis Drainage Feature Re-evaluation Project's In-Valley Disposal/Land Retirement Alternative.

July to December: Discussions conducted to resolve the array of alternatives to be evaluated in the BO and agree on the schedule for completing the Biological Opinion. Informal discussions conducted on various technical issues and conducting risk assessment related to minimizing or avoiding affects to migratory birds at the evaporation ponds.

September: The Service provides comments on draft Environmental Impact Statement (EIS).

November: Reclamation requests initiation of formal consultation and transmits a revised Biological Assessment on the San Luis Drainage Feature Re-evaluation Project's In-Valley Disposal/Land Retirement Alternatives. The Service delivers draft White Paper on adult avian mortality protocols. Interagency meeting with Regional Solicitors involving staff from the Service and Reclamation's South-Central California Area Office and Regional Office to discuss various issues, including the relationship of the concurrent consultation on the long term renewal of Central Valley Project (CVP) water service contracts in the San Luis Unit (SLU) and the SLDFR.

December: Reclamation transmits a memo to the Service modifying the project description provided in the biological assessment to include priority consideration of listed species recovery when retirement of those lands has first been determined to meet the needs of the SLDFR.

2006 *January to Present*: Continuing meetings to discuss or resolve issues; weekly telephone conference calls between FWS and Bureau/South-Central California Area Office and Regional Office to resolve issues and to assure close coordination of the CAR and Biological Opinion. Informal discussions conducted on various technical issues and conducting risk assessment related to minimizing or avoiding affects to migratory birds at the evaporation ponds.

BIOLOGICAL OPINION

Preamble

At the time of completing this consultation (coincident with the Final EIS), Reclamation has not yet selected a preferred alternative of precise locations for specific project features, although a general mitigation proposal (with an "initial estimate" of acreage obligations) and broad planning level analysis have been completed. The Service is able to analyze the current proposal in a similarly broad perspective. Additionally, the Service intends to continue participation with the SLDFR Mitigation Work Group (MWG) during future phases of the planning process, including assistance with the feasibility analysis, facilities siting, and the preparation of the mitigation monitoring and adaptive management plans.

Reclamation has (due to timing constraints) deferred detailed discussions regarding mitigation monitoring, adaptive management, and specific elements (e.g., specific site locations and water supplies) of the initial mitigation obligations to the feasibility analysis phase (following release of the Final EIS) of the SLDFR. These will be continued in coordination with the MWG, involving members of the Service, CDFG, and the California Central Valley Regional Water Quality Control Board, Fresno.

Description of the Proposed Action

Project Area

The drainage study area is located in the western San Joaquin Valley and consists primarily of the lands within the boundary of the Central Valley Project's San Luis Unit (SLU; Map 1). The project area includes the agricultural districts within CVP's SLU located in the northwest portion of Kings County, in western Fresno County, and in the southwestern tip of Merced County, California. In addition, the project area includes drainage impaired lands for the San Joaquin Exchange Contractors and Delta-Mendota Canal Unit. Lands immediately adjacent to the Unit, in the Grassland Drainage Area (GDA), have also been included. These lands in the GDA include drainage impaired lands of the San Joaquin Exchange Contractors and Delta-Mendota Canal Unit.

For discussion purposes, the drainage study area has been divided into the Westlands Water District (WWD) and the Northerly Area (Map 1). The lands within the Westlands region have been broken down into three subdivisions (north, central, and south).

The SLDFR planning area contains about 730,000 acres, most of which are intensively managed agricultural land (Table 1). Of these 730,000 acres, about 379,000 acres are, or are projected to be, drainage impaired within the 50-year project planning horizon. The drainage study area is semiarid, characterized by hot, dry summers and mild winters. Summer temperatures may reach 110 degrees Fahrenheit (°F), while winter temperatures may fall below 25 °F. Average annual precipitation is 8.6 inches per year, but varies from 2.4 to 20.6 inches.

The SLU includes Westlands in the south and the San Luis, Panoche, and Pacheco water districts in the Northerly Area. The SLDFR planning area also includes districts within the Delta-Mendota Canal Unit (Broadview, Widren, Oro Loma, Mercy Springs, and Eagle Field water districts) and San Joaquin Exchange Contractors (Firebaugh Canal Water District and Central California Irrigation District). All CVP water contract supply sources and supply system's operational issues are outside the project scope.

Proposed Action

Reclamation proposes to provide drainage service for the San Luis Unit and the GDA. When selected, the proposed action would fulfill the requirements of the Court Order filed in *Firebaugh Canal Co. et al. v. United States of America, et al.* (also referred to as the "Sumner-Peck settlement"), and be completed under the authority of Public Law 86-488. Reclamation has requested formal ESA consultation on the four In-Valley Drainage Impaired Lands Alternatives. The SLDFR Draft Environmental Impact Statement (DEIS) states that all phases of the project assume that farmers will be adopting on-farm and in-district drainage reduction actions regardless of which ultimate drainage solution alternative the Federal government selects. Drainage reduction actions include recycling drainwater, managing shallow groundwater, and reducing canal seepage. Following on-farm and in-district actions, the alternatives include varying amounts of land retirement, reuse areas, conveyance collection systems, reverse osmosis treatment plants, selenium biotreatment facilities and evaporation basins, and is based on the four "In-Valley Disposal/Land Retirement Alternatives" from the SLDFR DEIS. These four alternatives are: the In-Valley Disposal Alternative, the In-Valley Groundwater Quality Alternative, the In-Valley Water Needs Alternative, and the In-Valley Drainage-Impaired Area Land Retirement Alternative.

Reclamation has requested consultation of the four In-Valley Drainage Impaired Land Alternatives. To cover the maximum acreages of facilities and the maximum acreage of land retirement that would be implemented under any selected alternative, this opinion will analyze the two bookend alternatives: In-Valley Disposal and In-Valley Drainage Impaired Area Land Retirement.

Common elements to all four alternatives include the treatment of reuse facility drainwater with reverse osmosis (RO) and selenium biotreatment before disposal in evaporation basins. Final selenium concentrations in the treated effluent from full-scale biotreatment plants would not exceed 10 ppb on average and, as determined necessary to minimize risk to wildlife, would include a post treatment oxidation step to convert residual selenium in the effluent to selenate. The minimum land retirement alternative retires 44,106 acres of land. Depending on the selected alternative, a total of up to 308,000 acres of land may be retired.

An Adaptive Operation and Monitoring Plan (Plan) will be developed, in cooperation with the Service, for all reuse and treatment facilities that will include, but not limited to, monitoring to determine the level of use by San Joaquin kit fox and California least tern, long-term facility monitoring, contingency plans, and adaptive management plans. Water quality monitoring at evaporation ponds and reuse facilities will be incorporated into the Plan. Monitoring for San Joaquin kit fox and California least tern will utilize a tiered system in which monitoring increases and additional contingency measures are implemented as needed based on thresholds to be established in the Plan. The focus of monitoring will be at the evaporation basins for the California least tern and at the reuse areas for the San Joaquin kit fox.

The four alternatives differ among additional project features. The four alternatives include up to 71 miles of inter-facility pipelines, a maximum of 16 regional reuse facilities on as much as 19,000 acres, as many as four evaporation basins on up to 3,290 acres, and up to four RO treatment plants and selenium biotreatment plants on a maximum of 14 acres. Effluent flow rates may be up to 5179 af/y in the Northerly Area and up to 4050 af/y in the Westlands North, Central and South Areas. As the amount of land retired increases, the amount of land converted to reuse areas or evaporation basins decreases (Figure 1).

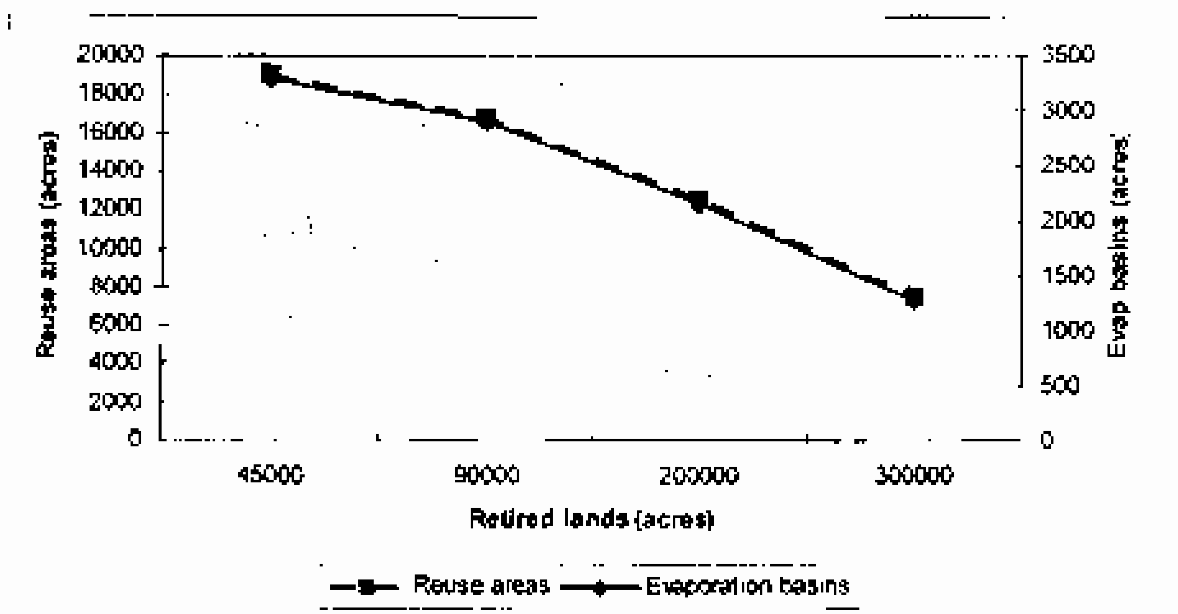

Figure 1. Relationships between acres in retired lands, reuse areas, and evaporation basins (source: USBR [October] 2005b).
A summary of the features of each SLDFR In-Valley Alternative is presented below:

1) In-Valley Disposal Alternative

- No new land retirement (Map 2)
- Reported as 44,106 acres retirement [Sumner Peck, Britz settlements, and Central Valley Project Improvement Act (CVPIA) demonstration program]
- Up to 3,290 acres evaporation basins
- 19,000 acres of regional reuse facilities

2) In-Valley Groundwater Quality Land Retirement Alternative (Map 3)

- 92,592 acres total retirement (existing 44,106 acres plus an additional 48,486 acres reflecting lands with shallow groundwater quality containing > 50 µg selenium/L water)
- Up to 2,890 acres evaporation basins
- 16,700 acres of regional reuse facilities

3) In-Valley/Water Needs Land Retirement (Map 4)

- 193,956 acres total projected retirement [existing 44,106 plus an additional 149,850 acres that include: lands with > 20 µg selenium/L water, the 65,000 acres acquired by Westlands that could later be brought back into production with drainage service (Sagouspe) and 10,000 acres from the Broadview Water District]
- Up to 2,150 acres evaporation basins
- Acreage represents the amount required to "retire enough lands to meet the internal water use needs of Westlands"
- 12,500 acres of reuse facilities

4) In-Valley/Drainage Impaired Area Land Retirement (Map 5)

- 308,000 acres total projected retirement (44,106 plus 263,894 acres representing the remainder of Westlands drainage-impaired lands, plus the 10,000 acres in Broadview)
- Excludes retirement of lands within the Northerly Area (71,000 acres) currently served by Grasslands Bypass Project
- Up to 1,270 acres evaporation basins in the Northerly Area
- 7,500 acres (1,700 acres existing) of reuse facilities

Table 1. San Luis Drainage Feature Re-Evaluation Project Features.

	In-Valley Alternatives			
Feature	**Disposal**	**Groundwater Quality**	**Water Needs**	**Land Retirement**
Land retired (acres)	44,106	92,592	193,956	308,000
Reuse Areas	16, on 19,000 acres	15, on 16,700 acres	14, on 12,500 acres	1, on 7,500 acres in Northerly Area
Evaporation Basins	4, on 2,870 acres (average) (3,290 maximum)	4, on 2,530 acres (average) (2,890 maximum)	4, on 1,880 acres (average) (2,150 maximum)	1, on 1,110 (average) (1,270 maximum) acres in Northerly Area
Treatment Plants	4, on 14 acres	4, on 12 acres	4, on 9 acres	1, on 5 acres in Northerly Area
Conveyance	71 miles of pipe	71 miles of pipe	71 miles of pipe	1.1 miles of pipe

Implementation of the proposed action, for all four alternatives, will replace the current Mud Slough disposal of drainwater with disposal into the proposed Northerly Area evaporation basin. In addition, selenium loading in the Delta-Mendota Canal (and downstream at Mendota Pool on the San Joaquin River) will decrease as a result of the construction of a pipeline to convey the discharges of the Firebaugh Sumps (sumps along the Delta Mendota Canal that currently discharge into the DMC) into the Northerly Area reuse, treatment, and disposal system.

The major project facilities/features are briefly described below, but can also be found in greater detail in the SLDFR DEIS.

Retired Lands

Some lands with poor drainage characteristics would be retired to reduce the overall volume of drainwater requiring disposal. The total acreage of retired lands has not yet been determined but would range from 44,106 (existing condition) to 308,000 acres of active and fallowed agricultural land.

Retired lands that are not used for project purposes (e.g., reuse areas, evaporation basins, etc.) would be dryland-farmed, grazed, or fallowed, in roughly equal proportions. Retired land acquired and managed under the CVPIA Land Retirement Program (up to 7000 acres) would be managed and monitored for wildlife habitat. Initial goals for all retired lands would be to protect the soil and help prevent the spread of noxious weeds until long-term operating strategies can be implemented by owners/lessees/operators. These initial efforts would include discing fallowed lands twice annually, planting new vegetation (if appropriate), controlling weeds, and possibly removing or relocating the existing irrigation infrastructure.

Conveyance/Collection Systems
Reclamation would construct a closed collection system to collect and convey drainwater from on-farm subsurface tile drains to regional reuse facilities. The closed collection system would consist of sumps and pipelines. Drain sumps would be placed at the lowest corner of the quarter sections of land or at some other low point on the quarter section lines. Farmers would pump drainwater from their drains into the sumps, and pipelines would convey drainwater from the sumps to the reuse areas. The In-Valley Disposal/Land Retirement Alternative conveyance system may include up to sixteen pumping plants. These plants would pump reuse water from the reuse areas to either another pumping plant or a treatment/evaporation basin area. All of the pumping plants would be located in reuse areas.

Under the minimum land retirement scenario (44,106 acres), project facilities necessary to convey drainwater to treatment sites would require construction of about 71 miles of inter-facility conveyance pipelines and a linear network of approximately 770 miles of buried collection lines and associated sumps, pumps, and controls. Under maximum land retirement (308,000 acres), new conveyance facilities would be limited to the Northerly Area and would consist of 1.1 miles of conveyance pipelines and approximately 24 miles of new buried collection lines added to the area's existing system of open drains and buried pipelines. As envisioned, both the conveyance system and the entire collection network would be installed as buried pipelines (as opposed to open canals and drains). Construction would take place in narrow linear corridors entirely within the agricultural heart of the valley and generally would be limited to previously disturbed road, canal, and railroad rights-of-ways or the perimeters of agricultural fields. In this previously disturbed, topographically flat, and easily accessed landscape, pipeline construction (trench excavation, pipe placement, and backfilling) would be expected to move quickly, with only minor and temporary disturbances to terrestrial wildlife resources.

Reuse Areas
Under the minimum land retirement scenario, collected drainwater would be used to irrigate salt-tolerant crops at up to 16 regional reuse facilities totaling as much as 19,000 acres. Under the maximum land retirement scenario, a single reuse facility would be required, totaling 7,500 acres and located in the Northerly Area at the site of the existing Grasslands Bypass Project (GBP) Panoche Facility. The number and total area of reuse sites would increase as the area of retired land decreases. Subsurface tile drains would be installed to collect the reused drainwater. Each reuse facility would also function as an underground regulating reservoir to control the flow of reused drainwater to downstream features. The reused drainwater would be conveyed via pipeline or canal to treatment and then to disposal facilities.

Staged development of the reuse areas would require surface disturbance of up to 19,000 acres, most of which would take place on active cropland dominated by cotton and row crops where existing tillage practices likely have limited habitat value (Maps 7 & 8). Activities required to initially develop typical reuse sites would be similar to farming activities that historically took place at the sites. Initial development would include surface contouring and leveling; installation of irrigation systems, subsurface drains, sumps, and buried collectors; initial planting, clearing, or turning under of existing crops; and similar site preparation activities. These activities, like the previous farming practices, could result in minor or temporary effects to the common terrestrial species that have adapted to the San Joaquin Valley's intensively managed agricultural landscape. For reuse facilities that would be located in whole or in part on already retired, abandoned, or fallowed parcels, construction would remove ruderal vegetation, non-irrigated cover crops, or residual vegetation from earlier farm use.

Crops
Reuse area crops would likely include salt-tolerant perennial grasses such as Bermuda grass, Jose tall wheatgrass, Rio wildrye, and alkali sacaton. Legumes may be added to pasture mixes in less saline areas. Smaller acreages of barley, canola, and other salt-tolerant grains and/or forage mixes may be grown, and some tree varieties may be used in appropriate areas. Grasses and grains would likely be harvested for local livestock producers if there is a market for such produce. Sheep grazing may be used to harvest some pasture forages on-site.

Irrigation Management
Climate- and soil-based irrigation scheduling would be continual. Irrigation events would be monitored on site at all times. During the peak irrigation season, fields may be irrigated as often as every 2 weeks. One goal of the irrigation management program would be to eliminate standing tailwater. An underground tailwater collection, conveyance, and redistribution system would be installed as needed on each reuse area. Any tailwater collected from higher fields would be conveyed and used on lower fields. Tailwater from the lowest fields would be pumped back to higher fields.

Drainage System
One key component of the reuse area would be the subsurface drainage system. No drainwater would be applied to reuse area fields until the required drains have been installed. The drainage system would consist of buried drain pipes at prescribed depths and spacing. The depths and spacing would vary from one reuse area to the next based upon the hydraulic characteristics of the subsoil. The drains would be sized to handle the peak flow generated by the irrigation of the salt-tolerant crops. The drainage system would be spaced to keep the water table at 4 feet, or more, below the ground surface all year.

Drainwater in the spaced drains would flow into a buried collector drain that would carry the drainwater to a small pumping plant where the water would be pumped to the water treatment facility. The entire drainage system would be underground with access for monitoring, cleaning, and sampling through concrete manholes at pipeline junctions. Some use of Drain or Sub-Irrigation Riser (DOS-IR) valves would be incorporated as flow controls when groundwater storage is required to distribute the water table more evenly under the fields. The water table would be used as a storage reservoir to allow the drain discharge to be regulated to near the average annual flow from each reuse area. The near steady drain discharge is desired for the water treatment plant design and operation.

The drainage systems would be installed as a part of the development of each reuse area. As installation progresses, more extensive subsoil investigations would be needed to determine adequate drainage system layouts and designs. Shallow observation wells would be used to provide water table depth information for proper storage/discharge operations of the drains.

Each reuse facility would provide an opportunity to control the flow of reused drainwater to downstream features. The water quality of effluent reused drainwater would be the same as the water quality of the perched aquifer beneath the reuse facility. In general, it is expected that water quality of the perched aquifer would gradually decline during long-term use, as do all aquifers underlying irrigated farmlands.

Reverse Osmosis Treatment
Reused drainwater collected from the reuse area(s) would be conveyed to reverse osmosis (RO) treatment plant(s) to produce high-quality product water that could be blended with CVP water for irrigation. Depending on the amount and locations of retired lands, up to four RO treatment plants would be constructed. Each RO treatment system would be associated with an adjacent evaporation basin (see below) and would consist of a single-stage, single-pass array with appropriate pretreatment to achieve 50 percent recovery.

Selenium Biotreatment
The concentrate reject stream from each RO facility would be conveyed to an adjacent selenium biotreatment facility. The effluent from the selenium biotreatment plants would then be discharged to their adjacent evaporation basins. Under the minimum land retirement scenario, a separate treatment/evaporation facility would be located in each of four drainage zones: Northerly Area, Westlands North, Westlands Central, and Westlands South. Under the maximum land retirement scenario, the flow rate to the single biotreatment plant in the Northerly Area would be approximately 4,428 acre feet/year. Under the minimum land retirement scenario, influent to the Northerly Area biotreatment plant would be 4,050 acre feet/year and flow rates for the Westlands North, Central, and South areas would be approximately 1,668, 2,992, and 1,421 AF/year, respectively. The flow-weighted average final selenium and total dissolved solids (TDS) concentrations after reuse and RO treatment are estimated to be 475 micrograms per liter (µg/L) and 35,600 milligrams per liter (mg/L), respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that the initial and final Se concentrations in the treated effluent from full-scale biotreatment plants would average 10 µg/L.

Siting of the proposed RO and biological treatment facilities would occur entirely on active or former agricultural lands, or other previously disturbed agricultural parcels. Construction of the facilities would permanently remove existing vegetation from the sites, resulting in the permanent loss of 5 acres of agricultural habitat (under the maximum retirement scenario) to 14 acres (under the minimum retirement scenario).

Evaporation Basins

About 16 square miles of land are being investigated for potential sites for evaporation facilities. Four evaporation basins, occupying a total of up to 3,290 acres (2,870 acres average), would be constructed under the minimum land retirement scenario. This acreage represents the maximum area estimate based on evaporation basin capacity needed for wet years of flow and corresponds to a maximum disturbed land area. It is based on peak outflows from the reuse areas under the minimum land retirement scenario for average wet year conditions. The estimate of 2,870 acres represents an average "wetted" area under average flow years. Under the maximum land retirement scenario, a single evaporation basin totaling 1,270 acres maximum (1,110 acres average) would be constructed to serve the Northerly Area.

Mitigation and Adaptive Management

All four alternatives may include measures to minimize significant impacts to biological resources and, if necessary, to compensate for losses or damage to protected species, important habitats, or natural communities. All four alternatives may include measures from the following categories:

Preliminary Site Studies, Biological Surveys

- completed during feasibility and final design project planning to define site conditions and biological resources;

Project Design, Facility Operations Measures

- includes (a) design and siting measures for planning, sizing, or routing of project facilities to minimize project effects; (b) operation and maintenance measures incorporated into the standard operating procedures of each facility to minimize long and short term effects to biological resources; and (c) construction-related measures incorporated into construction activities to minimize effects to biological resources associated with construction;

Mitigation Habitat Site Measures

- includes (a) dedicated site measures developed to provide specific habitat function associated with attracting impacted species away from hazard areas, or diluting the concentration of harmful substances in food sources; (b) enhancing existing wildlife habitat to provide additional quality or quantity of specific habitat functions (Maps 7 & 8); and (c) other measures established at dedicated mitigation sites that may not meet multiple criteria for alternative habitat or compensation habitat, but which provide benefits that contribute toward overall mitigation habitat objectives;

Adaptive Management Measures

- includes (a) long term monitoring activities, contingency plans, and adaptive management plans to be incorporated into the operating plans of individual facilities, and a detailed *Monitoring and Adaptive Management Plan* to be developed for the preferred alternative; and (b) measures developed to replace or compensate for lost or irreparably damaged biological resources when significant impacts cannot be avoided. Certain measures, such as the creation of habitat to offset harm to migratory bird populations from project facilities, have the potential to adversely affect listed species. These effects are not ripe for consultation until Reclamation has selected a preferred alternative and determined how much such mitigation is required. The future creation and operation of such habitat, together with any other measures that may adversely affect listed species, will undergo separate review under ESA section 7 prior to implementation.

Action Area

The action area is located in the western San Joaquin Valley, and consists primarily of lands within the boundary of the CVP's SLU and adjacent lands of the GDA (Maps 1-5; Appendices C & D). Specifically, the action area encompasses the drainage impaired lands in the Westlands, Broadview, Panoche, Pacheco, and the southern portion of the San Luis water districts; approximately 36,000 acres of adjacent lands within the Grassland Drainage Area; and the San Joaquin River down to Vernalis for terrestrial species, and to the estuary for aquatic species. Vernalis was chosen as the downstream end point because the effects on terrestrial species are not expected to be detectable beyond that point. The estuary was selected for aquatic species as there is some evidence that contaminant loading may be detectable and significant to that point.

Conservation Measures

All Species

1. Reclamation will continue to address the needs of listed species on a broad basis through continuing programs such as the Central Valley Project Conservation Program and CVPIA b(1) other program as funding and authorizations allow.
2. Reclamation will ensure that evaporation basins will include escape points to allow egress in the event any species temporarily enters the basin.

Giant Garter Snake

1. Reclamation will follow the Service's *Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake (*Thamnophis gigas*) Habitat.*

San Joaquin Kit Fox

1. Reclamation will follow the Service's *Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior To or During Ground Disturbance*, including completion of pre-construction surveys to identify potential kit fox activity, and implementation of approved conservation and avoidance measures.

2. Reclamation will ensure that most construction activity will occur during daylight hours. No nighttime construction will be scheduled in the Northerly Areas. However, if nighttime construction becomes necessary in the Northerly Areas, Reclamation will contact the Service for guidance on appropriate protective measures to ensure the safety of kit fox engaged in nocturnal activities.

3. Reclamation will coordinate with Service, CDFG, ESRP, and other knowledgeable parties to identify plants and management strategies that both maximize the function of the reuse areas for the drainage program (e.g., to evapotranspire large volumes of applied drainwater) while minimizing the risk of selenium bioaccumulation to the kit fox. Reuse sites will be designed to limit crop types that support abundant small mammal prey populations. Vegetation types that kit fox prefer to avoid (e.g., tall, robust species that form dense ground cover), produce minimal seed, and/or are not known to bioaccumulate selenium, will be planted.

4. Reclamation will develop an Adaptive Operation and Monitoring Plan, in cooperation with the Service, for the reuse and treatment facilities that will include monitoring to determine the level of use by San Joaquin kit fox. The San Joaquin kit fox monitoring will utilize a tiered system in which monitoring increases and additional contingency measures are implemented as needed based on thresholds to be established in the Plan. The focus of monitoring for San Joaquin kit fox will be the reuse areas.

5. Reclamation will give priority to land retirement in areas needed for listed species recovery, particularly by San Joaquin kit fox, when retirement of those lands has first been determined to meet the needs of the SLDFR.

6. Reclamation will seek to implement any land retirement in accordance with the Endangered Species Recovery qualifying criteria listed on page 307 of Appendix F of the Recovery Plan for San Joaquin Valley Upland Species.

7. Reclamation will assist the Service's SFWO to develop and implement economic or other incentives for conservation and recovery on non-Federally owned lands retired as part of the SLDFR.

California Least Tern

1. Reclamation and the water districts will work with the local mosquito abatement districts to minimize the use of *Gambusia* in the evaporation basins.

2. Reclamation will ensure that terminal cells of the evaporation basins will be capped quickly, when the cells are dry, to discourage nesting. Capping will be done in compliance with Regional Water Quality Control Board standards.

3. Reclamation will develop an Adaptive Operation and Monitoring Plan, in cooperation with the Service, for the evaporation ponds that will include monitoring to determine the level of use by California least tern. The California least tern monitoring will utilize a tiered system in which monitoring increases and additional contingency measures are implemented as needed based on thresholds to be established in the Plan. The focus of monitoring for California least tern will be the evaporation basins.

Contemporaneous Consultations

The following consultations are not considered part of the Environmental Baseline because final biological opinions have not yet been issued for them.

CVP Long-term Water Contracts
The SFWO is working with Reclamation's South Central California Area Office to accumulate the information necessary to evaluate the effects of renewing the long-term water contracts for the (a) San Felipe Division, which includes the San Benito County Water District and the Santa Clara Valley Water District; and (b) the San Luis Unit, which includes California Department of Fish and Game property, City of Avenal, City of Coalinga, City of Huron, Pacheco Water District, Panoche Water District, San Luis Water District, Westlands Water District, including the effects of contract assignments to the Westlands Water District from Broadview Water District in the Delta Mendota Canal Unit.

Status of the Species

San Joaquin Kit Fox

Listing.
The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (USFWS 1967) and was listed by the State of California as a threatened species on June 27, 1971. This canine is the umbrella species for the Recovery Plan for Upland Species of the San Joaquin Valley, California (USFWS 1998).

Description.
The kit fox is the smallest canid species in North America and the San Joaquin kit fox is the largest subspecies in skeletal measurements, body size, and weight. Adult males average 80.5 centimeters (31.7 inches) in total length, and adult females average 76.9 centimeters (30.3 inches in total length (Grinnell *et al.* 1937). Kit foxes have long slender legs and are approximately 30

centimeters (12 inches) high at the shoulder. The average weight of adult males is 2.3 kilograms (5 pounds), and the average of adult females is 2.1 kilograms (4.6 pounds) (Morrell 1972).

General physical characteristics of kit foxes include a small, slim body, relatively large ears set close together, narrow nose, and a long, bushy tail tapering slightly toward the tip. The tail is typically carried low and straight.

Color and texture of the fur coat of kit foxes varies geographically and seasonally. The most commonly described colorations are buff, tan, grizzled, or yellowish-gray dorsal coats (McGrew 1979). Two distinctive coats develop each year: a tan summer coat and a silver-gray winter coat (Morrell 1972). The ear pinna (external ear flap) is dark on the back side, with a thick border of white hairs on the forward-inner edge and inner base. The tail is distinctly black-tipped.

Historical and Current Range.
In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy, San Joaquin County, on the west side, and near La Grange, Stanislaus County, on the east side (Grinnell *et al.* 1937; USFWS 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland.

Kit foxes currently inhabit some areas of suitable habitat on the San Joaquin Valley floor and in the surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi Mountains, from southern Kern County north to Contra Costa, Alameda, and San Joaquin Counties on the west, and near La Grange, Stanislaus County on the east side of the Valley, and some of the larger scattered islands of natural land on the Valley floor in Kern, Tulare, Kings, Fresno, Madera, and Merced Counties (Map 6).

The largest extant populations of kit foxes are in western Kern County on and around the Elk Hills and Buena Vista Valley, Kern County, and in the Carrizo Plain Natural Area, San Luis Obispo County (Map 6). Though monitoring has not been continuous in the central and northern portions of the range, populations were recorded in the late 1980s at San Luis Reservoir, Merced County (Briden *et al.* 1987); North Grasslands and Kesterson National Wildlife Refuge (NWR) area on the Valley floor, Merced County (Paveglio and Clifton 1988); and in the Los Vaqueros watershed, Contra Costa County in the early 1990s (USFWS 1998). Smaller populations are also known from other parts of the San Joaquin Valley floor, including Madera County and eastern Stanislaus County (Williams 1990).

Essential Habitat Components.
Kit foxes prefer loose-textured soils (Grinnell *et al.* 1937, Hall 1946, Egoscue 1962, Morrell 1972), but are found on virtually every soil type. Dens appear to be scarce in areas with shallow soils because of the proximity to bedrock (O'Farrell and Gilbertson 1979, O'Farrell *et al.* 1980), high water tables (McCue *et al.* 1981), or impenetrable hardpan layers (Morrell 1972). However,

kit foxes will occupy soils with a high clay content, such as in the Altamont Pass area in Alameda County, where they modify burrows dug by other animals (Orloff *et al.* 1986). Sites that may not provide suitable denning habitat may be suitable for feeding or providing cover (Maps 7 & 8).

[Note: The following sections discussing land values for kit fox were prepared for Reclamation by Brian Cypher in the report *Kit Fox Conservation in the San Luis Drainage Unit Study: Ecological Considerations Relevant to the Development of a Conservation Strategy for Kit Foxes* (Cypher 2006).]

Natural Land Values.

Kit foxes are an aridland-adapted species. They occur in arid regions, typically deserts, throughout North America (Cypher 2003). Accordingly, in the San Joaquin Valley, optimal habitats for San Joaquin kit foxes generally are those in which conditions are more desert-like. These include arid shrublands and grasslands (USFWS 1998). These areas are characterized by sparse or no shrub cover, sparse ground cover with patches of bare ground, short vegetative structure (herbaceous vegetation < 18 inches tall), and sandy to sandy-loam soils.

Tall and/or dense vegetation generally is less optimal for foxes (Smith *et al.* 2005). Such conditions make it difficult for foxes to detect approaching predators or capture prey. Kit foxes also tend to avoid rugged, steep terrain. Predation risk apparently is higher for foxes under such topographic conditions (Warrick and Cypher 1998). In general, flat terrain or slopes under 5% are optimal, slopes of 5-15% are suitable, and slopes greater than 15% are unsuitable. For this reason, the foothills of the Coast Ranges generally are considered to demark the western boundary for suitable kit fox habitat. Finally, kit foxes appear to be strongly linked ecologically to kangaroo rats. Kit foxes are especially well adapted for preying on kangaroo rats, and consequently, kit fox abundance and population stability are highest in areas where kangaroo rats are abundant (USFWS 1998, Cypher 2003). Kangaroo rats also are aridland-adapted species, and thus, reach their greatest densities in the San Joaquin Valley in arid habitats.

Following are assessments of relative value for various natural habitats present in the San Joaquin Valley:

Saltbush scrub. This is an aridland habitat generally dominated by saltbush shrubs (*Atriplex* spp.), and with ground cover dominated by non-native Brome grasses (*Bromus* spp.). Kangaroo rats are abundant. This habitat is optimal for kit foxes, and kit foxes generally achieve their highest densities in areas with this habitat type (e.g., Lokern Natural Area, Buena Vista Valley, Carrizo Plain, Elkhorn Plain). Although this habitat is favorable for foxes, it should be noted that dense patches of shrubs provide cover for kit fox predators and may be avoided by foxes.

Arid grasslands. This is an aridland habitat with few or no shrubs, and which is dominated by non-native grasses, particularly red brome (*Bromus madritensis rubens*). Vegetation structure is low and patches of bare ground are common. Kangaroo rats are abundant. This habitat is optimal for kit foxes. Grazing can further reduce the vegetative structure rendering this habitat even more suitable.

Alkali sink. This habitat occurs in lower regions closer to the Valley center, and thus is subject to soil saturation and seasonal flooding in the winter and spring. It usually is dominated by iodine bush (*Allenrolfea* spp.) or sinkweed (*Suaeda* spp.) shrubs with a patchy, low-structure ground cover. Kangaroo rats can be abundant. This habitat **can be suitable** for kit foxes, particularly if slightly higher topography is available for dens.

Mesic grasslands. This habitat type is more common in the eastern and northern portions of the Valley where precipitation is more abundant. This type tends to have few or no shrubs and is dominated by non-native wild oat grasses (*Avena* spp.). Vegetation structure may be higher than 18 inches and dense, particularly in years with above-average precipitation, and this could result in increased predation risk for kit foxes. Bare ground may be sparse. The rodent community tends to be dominated by California ground squirrels instead of kangaroo rats. This habitat **can be suitable** for kit foxes, particularly if it is moderately-to-heavily grazed.

Oak woodland savannah. This habitat occurs primarily off the Valley floor up in the Coast Ranges. Oak trees (*Quercus* spp.) tend to form a sparse to moderate canopy, and the herbaceous cover is dominated by non-native wild oats and other grasses. Vegetation structure and density tends to be high with little bare ground. Kangaroo rats are not abundant and California ground squirrels are common. This type probably is **marginally suitable** for kit foxes at best, although grazing can improve permeability for kit foxes.

Chaparral. This habitat occurs in higher, more-mesic areas in the Coast Ranges. It is characterized by a diverse and dense shrub community. Predation risk is high and kangaroo rats are uncommon. This habitat is **unsuitable** for kit foxes.

Wetlands and riparian forests. These habitats are characterized by wetland and riparian vegetation that can be quite dense. Constant or periodic flooding preclude den establishment and kangaroo rats are less common. These habitats are **unsuitable** for kit foxes.

Agricultural Land Values.

Agricultural lands inherently present challenges for kit foxes. Ground disturbance is frequent (e.g., tilling, maintenance, harvesting), which can destroy dens. Also, most agricultural lands in the Valley are irrigated, which can flood and collapse dens. Agricultural lands also are subject to intensive chemical applications, including fertilizers, pesticides, and defoliants. Use of rodenticides is common in some agricultural environments and is particularly problematic for kit foxes due to the potential for secondary poisoning. Finally, all of the factors above in addition to the relative sterility of most agricultural fields (e.g., weed suppression) result in a lack of prey availability for kit foxes.

Another detrimental attribute of agricultural lands is the presence of coyotes and non-native red foxes. Coyotes are the primary cause of mortality for kit foxes in most areas (Cypher *et al.* 2003). The threat to kit foxes from red foxes is still being evaluated, but the potential for both interference and exploitative competition is high (Cypher *et al.* 2001). These highly adaptable species are able to persist in agricultural lands. They are not dependent on dens for cover, they are highly mobile which facilitates avoiding dangers and locating food, and they are highly omnivorous. Also, kit foxes are more vulnerable to predation in agricultural areas due to the relative scarcity of den sites, as described previously. Thus, agricultural lands are generally not suitable for long-term occupation by kit foxes, although lands adjacent to natural habitats may be used for occasional foraging (Warrick *et al.* submitted).

Most available information on the value of agricultural lands to kit foxes is qualitative in nature, but one quantitative investigation has been conducted (Warrick *et al.* submitted). Following are assessments of relative value for several types of agricultural lands:

Annual crops (e.g., cotton, tomatoes, alfalfa, carrots): Lands with these crops usually have low to no prey (except possibly alfalfa), and are subject to frequent disturbance, irrigation, and chemical application. Kit foxes do not appear able to permanently occupy these lands, and use primarily appears limited to occasional foraging when these lands are adjacent to natural habitats.

Orchards (e.g., fruit trees, nut trees). Lands with these crops are not always "sanitized" of all herbaceous vegetation, and therefore sometimes may support some prey (primarily ground squirrels, deer mice, and house mice). Also, the open understory of orchards facilitates predator detection by kit foxes. Kit foxes have been observed to forage in orchards as well as to occasionally spend a day or so resting, usually in man-made structures (e.g., pipes, rubble piles). Orchards are probably relatively permeable for kit foxes, although the risk of an unsuccessful crossing most likely increases with distance.

Vineyards. Lands with these crops are not always "sanitized" of all herbaceous vegetation, and therefore sometimes may support some prey (primarily ground squirrels, mice). Vineyards probably are permeable to kit foxes, but as with orchards, the risk of an unsuccessful crossing most likely increases with distance. Also, the rodent-proof fences erected around some vineyards would severely inhibit entry by kit foxes.

Fallow land values. Some agricultural lands may be fallowed for a season, a year, or multiple years. The value of these lands for kit foxes is highly dependent upon the duration of fallowing and the location of the lands. Lands that are fallowed for only a season likely have little value to foxes. Generally, a season is not sufficient time for a prey base to reestablish. Also, renewed ground disturbance and irrigation at the end of the season likely would result in the destruction of any fox dens created during the fallow period. Lands that are fallowed for 1 or more years could have greater value to kit foxes. This time period might be sufficient for the reestablishment of some prey and the creation of dens. Lands fallowed for multiple years could even potentially be used by kit foxes to produce and raise young. Kit foxes likely would be forced from these lands when they were returned to agricultural production. Kit foxes would be at risk of injury or death during the reinitiation of agricultural activities if they failed to vacate the property in a timely manner. Foxes that did vacate also would be at greater risk if they were forced into unfamiliar areas.

Fallow lands immediately adjacent to natural lands might be used relatively quickly by kit foxes. In Kern County near Bakersfield, foxes have been observed to utilize agricultural lands within weeks of being fallowed with use increasing as these lands remained fallowed (B. Cypher, personal observation). As the distance between fallow lands and occupied habitat increases, the potential for use by kit foxes decreases. As described above, kit foxes face risks when crossing agricultural lands, and this risk may preclude colonization or use of fallow lands that are not adjacent to occupied habitat.

Foraging Ecology

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. In the southern portion of their range, kangaroo rats, pocket mice, white-footed mice (*Peromyscus* spp.), and other nocturnal rodents comprise about one-third or more of their diets. Kit foxes are also known to prey on California ground squirrel, black-tailed hares, San Joaquin antelope squirrels, desert cottontails, ground nesting birds, and insects (Scrivner *et al*. 1987a). Known prey species of the kit fox include white-footed mice (*Peromyscus* spp.), insects, California ground squirrels, kangaroo rats (*Dipodomys* spp.), San Joaquin antelope squirrels, black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972, Archon 1992), listed in approximate proportion of occurrence in fecal samples. Kit foxes also prey on desert cottontails (*Sylvilagus audubonii*), ground-nesting birds, and pocket mice (*Perognathus* spp.).

The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50 to 87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley *et al*. 1992).

Reproductive Ecology and Demography

Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972). Typically, pups are born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972). Mean litter sizes reported for San Joaquin kit foxes range from 2.0 (White and Ralls 1993) to 3.8 at the Naval Petroleum Reserve (Spenser *et al*. 1992; Spiegel and Tom 1996; Cypher *et al*. 2000). Pups appear above ground at about age 3 to 4 weeks, and are weaned at age 6 to 8 weeks.

Reproductive rates. The proportion of females bearing young, of adult San Joaquin kit foxes vary annually with environmental conditions, particularly food availability. Annual rates range from 0 to 100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher *et al.* 2000), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer *et al.* 1992). Although some yearling female kit foxes will produce young, most do not reproduce until age 2 years (Spencer *et al.* 1992; Spiegel and Tom 1996; Cypher *et al.* 2000). Some young of both sexes, but particularly females may delay dispersal, and may assist their parents in the rearing of the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about four to five months of age (Koopman *et al.* 2000; Morell 1972).

Mean annual survival rates reported for adult San Joaquin kit foxes range from 0.44 to 0.60 (Cypher *et al.* 2000; Standley *et al.* 1992; Spiegel and Disney 1996; Ralls and White 1995). However, survival rates vary widely among years (Spiegel and Disney 1996; Cypher *et al.* 2000). Mean survival rates for juvenile San Joaquin kit foxes (< 1 year old) are lower than rates for adults. Survival to age 1 year ranged from 0.14 to 0.21 (Cypher *et al.* 2000; Standley *et al.* 1992; Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes may live to ten years in captivity (McGrew 1979) and 8 years in the wild (Berry *et al.* 1987).

Estimates of fox density vary greatly throughout its range, and have been reported as high as 1.2 animals per square kilometer in optimal habitats in good years (USFWS 1998). At the Elk Hills in Kern County, density estimates varied from 0.7 animals per square kilometer in the early 1980s to 0.01 animals per square kilometer in 1991 (USFWS 1998). Kit fox home ranges vary in size from approximately 2.6 square kilometers to 31.2 square kilometers (Spiegel and Tom 1996; USFWS 1998). Knapp (1979) estimated that a home range in agricultural areas is approximately 2.5 square kilometers. Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel 1996).

Movements and Habitat Use

Although most young kit foxes disperse less than 8 kilometers (Scrivner *et al.* 1987b), dispersal distances of up to 122 kilometers have been documented for the San Joaquin kit fox (Scrivner *et al.* 1993; USFWS 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4 to 32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49 percent of the males dispersed from natal home ranges while 24 percent of the females dispersed (Koopman *et al.* 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell *et al.* 1937). A mated pair of kit foxes and their current litter of pups usually occupy each home range. Other adults, usually offspring from previous litters, also may be present (Koopman *et al.* 2000), but individuals often move independently within their home range (Cypher 2000). Average distances traveled each night range from 9.3 to 14.6 kilometers and are greatest during the breeding season (Cypher 2000).

Kit foxes maintain core home range areas that are exclusive to mated pairs and their offspring (White and Ralls 1993, Spiegel 1996, White and Garrott 1997). This territorial spacing behavior eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 1998). The kit fox is often associated with open grasslands, which form large contiguous blocks within the eastern portions of the range of the animal. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by humans. The listed canine can utilize some types of agriculture (e.g. orchards and alfalfa), although the long-term suitability of these habitats is unknown (Jensen 1972; USFWS 1998). Orchards sometimes support prey species if the grounds are not manicured; however, denning potential is typically low and kit foxes can be more susceptible to predation by coyotes within the orchards (Orloff 2000). Alfalfa fields provide an easily accessible prey base (Woodbridge 1998; Young 1989), and berms adjacent to alfalfa fields sometimes provide good denning habitat (Orloff 2000).

Kit foxes use some types of agricultural land where uncultivated land is maintained, allowing for denning sites and a suitable prey base (Knapp 1978, Hansen 1988, Warrick *et al.* 2005). In the Lost Hills area, radio collared kit foxes predominantly used natural habitat remaining in the California Aqueduct right-of-way (Warrick *et al.* 2005), even though this habitat had lower availability relative to other habitats. Orchards were the second most frequently used habitats, followed by row crops and other habitats (residential, grassland, and fallow fields). Kit foxes were documented to travel a maximum distance of 1.5 kilometers into orchards and 1.1 kilometers into row crops (Warrick *et al.* 2005). No dens were observed in the agricultural areas. Kit foxes appear reluctant to cross these lands due to insufficient refugia from predators (Cypher *et al.* 2005). The lack of kit fox occupancy in farmland is in contrast to observations of the closely related swift fox in western Kansas (Jackson and Choate 2000, Matlack *et al.* 2000). Differences in habitat use between the species may be due to differences in farming practices (Warrick *et al.* 2005). Farmland in the San Joaquin Valley is more heavily disturbed. The farmlands are irrigated, and fields are not left fallow for as long as a duration as the farmlands in Kansas. These practices in California likely result in a sparse prey base and unsuitable habitat for denning, discouraging the kit fox from occupying agricultural lands.

Dens are used by kit foxes for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1984). However, the depth and complexity of their dens suggest that they possess good digging abilities, and kit fox dens have been observed on a variety of soil types (USFWS 1998). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels (*Spermophilus beecheyi*) or badgers (*Taxidea taxus*) (Jensen 1972; Morrell 1972; Orloff *et al.* 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff *et al.* 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below midslope (O'Farrell 1984), with the average slope at den sites ranging from 0 to 22 degrees (CDFG 1980; O'Farrell 1984; Orloff *et al.* 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1984; Spiegel and Tom 1996).

Natal and pupping dens may include from two to 18 entrances and are usually larger than dens not used for reproduction (O'Farrell *et al.* 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1984). Active natal dens are generally 1.9 to 3.2 kilometers from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e., ramps) outside the dens (O'Farrell 1984). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff *et al.* 1986). During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains) (Orloff *et al.* 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher *et al.* 2001). Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls *et al.* 1990). Possible reasons for changing dens include infestation by ectoparasites, local depletion of prey, or avoidance of coyotes. Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 129 to 195 hectares (Morrell 1972). An average den density of one den per 28 to 37 hectares was reported by O'Farrell (1984) in the southern San Joaquin Valley.

Reasons for Decline and Threats to Survival

The distribution and abundance of the kit fox have decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following paragraphs.

Loss of Habitat. Less than 20 percent of the habitat within the historical range of the kit fox remained when the subspecies was listed as endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930s, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell *et al.* 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970, Jensen 1972; Morrell 1972 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (USFWS 1980).

This rate of loss accelerated following the completion of the CVP and the State Water Project SWP), which diverted and imported new water supplies for irrigated agriculture (USFWS 1995). Approximately 7,972 square kilometers of habitat, or about 267 square kilometers per year, were converted in the San Joaquin region between 1950 and 1980 (CDFG 1988). The counties specifically noted as having the highest wildland conversion rates included Kern, Tulare, Kings and Fresno, all of which are occupied by kit foxes. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

The majority of the documented loss of essential habitat has been the result of conversion to irrigated agriculture. By 1979, only approximately 1497 square kilometers out of a total of approximately 34,400 square kilometers on the San Joaquin Valley floor remained as undeveloped land (Williams 1985, USFWS 1980). During 1990 to 1996, a gross total of approximately 71,500 acres of habitat were converted to farmland in 30 counties (total area 23.1 million acres) within the Conservation Program Focus area of the CVP. This figure includes 42,520 acres of grazing land and 28,854 acres of "other" land, which was predominantly comprised of native habitat. During this same time period, approximately 101,700 acres were converted to urban land use within the Conservation Program Focus area (California Department of Conservation [CDC] 1994, 1996, 1998). Because these assessments included a substantial portion of the Central Valley and adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range.

In summary, more than one million acres of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox in 1967. In contrast, less than 500,000 acres have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (USFWS 1998).

Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn Job, pers. comm.; 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972, Morrell 1975).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape, and in the spring for rearing young. Kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. Denning opportunities on land converted to agriculture are limited due to agricultural practices, such as cultivation, irrigation, chemical treatments, and other disturbances. The loss of denning habitat can impede successful migration of kit fox across agricultural lands because of greater vulnerability to predation resulting from a lack of possible escapes.

Kit foxes use some types of agricultural land where uncultivated land is maintained, allowing for denning sites and a suitable prey base (Jensen 1972, Knapp 1979, Hansen 1988). Kit foxes also den on small parcels of native habitat surrounded by intensively maintained agricultural lands (Knapp 1979), and adjacent to dryland farms (Jensen 1972, Kato 1986, Orloff *et al.* 1986).

Extensive habitat destruction and fragmentation have contributed to smaller, more isolated populations of kit foxes. Small populations have a higher probability of extinction than large populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988, Frankham and Ralls 1998, Saccheri *et al.* 1998). Similarly, isolated populations are more susceptible to extirpation by accidental or natural catastrophes because the likelihood of recolonization has been diminished. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually go extinct when faced with these stochastic risks (Caughley and Gunn 1996).

Competitive Interactions with Other Canids. Several species prey upon San Joaquin kit foxes. Predators (such as coyotes, bobcats, non-native red foxes, badgers (*Taxidea taxus*), and golden eagles (*Aquila chrysaetos*)) will kill kit foxes. Badgers, coyotes, and red foxes also may compete for den sites (USFWS 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts (which are quite common in semi-arid, central California). Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Coyotes occur in most areas with abundant populations of kit foxes and, during the past few decades, coyote abundance has increased in many areas owing to a decrease in ranching operations, favorable landscape changes, and reduced control efforts (Orloff *et al.* 1986, Cypher and Scrivner 1992, White and Ralls 1993, White *et al.* 1995). Although coyotes are common in both natural and agricultural landscapes, they pose a greater predation threat to the kit fox on agricultural lands because of the decreased availability or absence of escape dens and vegetative cover (Cypher *et al.* 2005). Coyotes may kill kit foxes in an attempt to reduce resource competition. Coyote-related injuries accounted for 50 to 87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992, Standley *et al.* 1992, Ralls and White 1995, Spiegel 1996). Coyote-related deaths of adult foxes appear to be largely additive (i.e., in addition to deaths caused by other mortality factors such as disease and starvation) rather than compensatory (i.e., tending to replace deaths due to other mortality factors; White and Garrott 1997). The survival rates of adult foxes decrease significantly as the proportion of mortalities caused by coyotes increase (Cypher and Spencer 1998, White and Garrott 1997), and increases in coyote abundance may contribute to significant declines in kit fox abundance (Cypher and Scrivner 1992, Ralls and White 1995, White *et al.* 1996). There is some evidence that the proportion of juvenile foxes killed by coyotes increases as fox density increases (White and Garrott 1999). This density-dependent relationship would provide a feedback mechanism that reduces the amplitude of kit fox population dynamics and keeps foxes at lower densities than they might otherwise attain. In other words, coyote-related mortalities may prevent fox population growth, and may instead prolong population declines.

Land-use changes have also contributed to the expansion of nonnative red foxes into areas inhabited by kit foxes. Historically, the geographic range of the red fox did not overlap with that of the San Joaquin kit fox. By the 1970s, however, introduced and escaped red foxes had established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis *et al.* 1993). Red foxes are rarely observed in natural settings, and are much more abundant on agricultural lands. They appear to be dependent on the presence of water (Cypher *et al.* 2001), a resource readily available on irrigated farmlands, while kit foxes do not drink free water (Golightly and Ohmart 1983). Thus, there is no concern here that contaminated water may be directly ingested by kit fox. The larger and more aggressive red foxes are known to kill kit foxes (Ralls and White 1995), and could displace them, as has been observed in the arctic when red foxes expanded into the ranges of smaller arctic foxes (Hersteinsson and Macdonald 1982). The increased abundance and distribution of nonnative red foxes is perhaps a greater threat to kit foxes than coyotes because red foxes and kit foxes are closer morphologically and taxonomically.

and would likely have higher dietary overlap, potentially resulting in more intense competition for resources. Two documented deaths of kit foxes due to red foxes have been reported (Ralls and White 1995), and red foxes appear to be displacing kit foxes in the northwestern part of their range (Lewis *et al.* 1993). At Camp Roberts, red foxes have usurped several dens that were used by kit foxes during previous years (California Army National Guard, Camp Roberts Environmental Office, unpubl. data). In fact, opportunistic observations of red foxes in the cantonment area of Camp Roberts have increased 5-fold since 1993, and no kit foxes have been sighted or captured in this area since October 1997. Also, a telemetry study of sympatric red foxes and kit foxes in the Lost Hills area has detected spatial segregation between these species, suggesting that kit foxes may avoid or be excluded from red fox-inhabited areas (P. Kelly, pers. comm.; April 6, 2000). Such avoidance would limit the resources available to local populations of kit foxes and possibly result in decreased fox abundance and distribution.

Disease. Wildlife diseases do not appear to be a primary mortality factor that consistently limits kit fox populations throughout their range (McCue and O'Farrell 1988, Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Barrett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could potentially cause substantial mortality or contribute to reduced fertility in seropositive females, as was noted in closely-related swift foxes (*Vulpes velox*).

For example, there are some indications that rabies virus may have contributed to a catastrophic decrease in kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990s. San Luis Obispo County had the highest incidence of wildlife rabies cases in California during 1989 to 1991, and striped skunks (*Mephitis mephitis*) were the primary vector (Barrett 1990, Schultz and Barrett 1991, Reilly and Mangiamele 1992). A rabid skunk was trapped at Camp Roberts during 1989 and two foxes were found dead due to rabies in 1990 (Standley *et al.* 1992). Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. Captures of kit foxes were positively correlated with captures of skunks during 1988 to 1997, suggesting that some factor(s) such as rabies virus was contributing to concurrent decreases in the abundances of these species. Also, captures of kit foxes at Camp Roberts were negatively correlated with the proportion of skunks that were rabid when trapped by County Public Health Department personnel two years previously. These data suggest that a rabies outbreak may have occurred in the skunk population and spread into the fox population. A similar time lag in disease transmission and subsequent population reductions was observed in Ontario, Canada, although in this instance the transmission was from red foxes to striped skunks (Macdonald and Voigt 1985).

Pesticides and Rodenticides. Some methods of pest and rodent control pose a threat to kit foxes through direct or secondary poisoning, and these threats are often encountered in agricultural settings. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species. For example, the California ground squirrel, which is the staple prey of kit foxes in the northern portion of their range and on agricultural lands, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff *et al.* 1986).

Kit foxes occupying habitats adjacent to agricultural lands are also likely to come into contact with insecticides applied to crops owing to runoff or aerial drift. Kit foxes could be affected through direct contact with sprays and treated soils, or through consumption of contaminated prey. Data from the California Department of Pesticide Regulation (CDPR 2006) indicate that acephate, aldicarb, azinphos methyl, bendiocarb, carbofuran, chlorpyrifos, endosulfan, s-fenvalerate, naled, parathion, permethrin, phorate, and trifluralin are used within one mile of kit fox habitat. A wide variety of crops, as well as buildings, Christmas tree plantations, commercial/industrial areas, greenhouses, nurseries, landscape maintenance, ornamental turf, rangeland, rights of way, and uncultivated agricultural and non-agricultural land, occur in close proximity to San Joaquin kit fox habitat.

Efforts have been underway to reduce the risk of rodenticides to kit foxes (USFWS 1993a). The Federal government began controlling the use of rodenticides in 1972 with a ban of Compound 1080 on Federal lands pursuant to Executive Order. Above-ground application of strychnine within the geographic ranges of listed species was prohibited in 1988. A July 28, 1992, biological opinion regarding the Animal Damage Control (now known as Wildlife Services) Program by the U.S. Department of Agriculture found that this program was likely to jeopardize the continued existence of the kit fox owing to the potential for rodent control activities to take the fox. As a result, several reasonable and prudent measures were implemented, including a ban on the use of M-44 devices, toxicants, and fumigants within the recognized occupied range of the kit fox. Also, the only chemical authorized for use by Wildlife Services within the occupied range of the kit fox was zinc phosphide, a compound known to be minimally toxic to kit foxes (USFWS 1993a).

Despite these efforts, the use of other pesticides and rodenticides still pose a significant threat to the kit fox, as evidenced by the death of two kit foxes at Camp Roberts in 1992 owing to secondary poisoning from chlorophacinone applied as a rodenticide (Berry *et al.* 1992, Standley *et al.* 1992). Also, the livers of three foxes that were recovered in the City of Bakersfield during 1999 were found to contain detectable residues of the anticoagulant rodenticides chlorophacinone, brodifacoum, and bromadiolone (CDFG 1999a).

To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (USFWS 1998). This lack of information is problematic because Williams (1990) documented widespread pesticide use in known kit fox and Fresno kangaroo rat habitat adjoining agricultural lands in Madera County. Also, farmers have been allowed to place bait on Bureau of Reclamation property to maximize the potential for killing rodents before they entered adjoining fields (Biological Opinion for the Interim Water Contract Renewal, Ref. No. 1-1-00-F-0056, February 29, 2000).

A September 22, 1993, biological opinion issued by the Service to the Environmental Protection Agency (EPA) regarding the regulation of pesticide use (31 registered chemicals) through administration of the Federal Insecticide, Fungicide, and Rodenticide Act found that use of the following chemicals would likely jeopardize the continued existence of the kit fox: (1) aluminum and magnesium phosphide fumigants; (2) chlorophacinone anticoagulants; (3) diphacinone anticoagulants; (4) pival anticoagulants; (5) potassium nitrate and sodium nitrate gas cartridges; and (6) sodium cyanide capsules (USFWS 1993). Reasonable and prudent alternatives to avoid jeopardy included restricting the use of aluminum/magnesium phosphide, potassium/sodium nitrate within the geographic range of the kit fox to qualified individuals, and prohibiting the use of chlorophacinone, diphacinone, pival, and sodium cyanide within the geographic range of the kit fox, with certain exceptions (e.g., agricultural areas that are greater than 1 mile from any kit fox habitat) (USFWS 1999a).

Risk of Chance Extinction. Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (USFWS 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations, thereby increasing the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased ten-fold during 1981 to 1983, increased seven-fold during 1991 to 1994, and then decreased two-fold during 1995 (Cypher and Scrivner 1992, Cypher and Spencer 1998).

Many populations of kit fox are at risk of chance extinction owing to small population size and isolation. This risk has been prominently illustrated during recent, drastic declines in the populations of kit foxes at Camp Roberts and Fort Hunter Liggett. Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. This decrease continued through 1997 when only three kit foxes were captured (White *et al.* 2000). A similar decrease in kit fox abundance occurred at nearby Fort Hunter Liggett, and only 2 kit foxes have been observed on this installation since 1995 (L. Clark, pers. comm.; February 15, 2000). It is unlikely that the current numbers of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future because there is limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 16 miles) and separated from these installations by barriers to kit fox movement such as roads, developments, and irrigated agricultural areas. Also, there is a relatively high abundance of sympatric predators and competitors on these installations that contribute to low survival rates for kit foxes and, as a result, may limit population growth (White *et al.* 2000). These populations may therefore be on the verge of extinction

The destruction and fragmentation of habitat could also eventually lead to reduced genetic variation in populations of kit foxes that are small and geographically isolated. Genetic assessments indicate that historic gene flow among populations was quite high, and that gene flow between populations is still occurring (Schwartz *et al.* 2005). Kit fox dispersal likely still maintains genetic variation throughout the range of the kit fox. Disruption of kit fox dispersal abilities through habitat loss, however, could result in an increase in inbreeding and a loss of genetic variation. These factors could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988, Frankham and Ralls 1998, Saccheri *et al.* 1998).

The impacts of genetic isolation may already be apparent in the Camp Roberts and Panoche populations. Genetic data revealed low allelic diversity at these locations. The population in the Camp Roberts region may have been historically small, as evidenced by the lack of historical occurrences. Relatively low allelic diversity could be the result of a few individuals recolonizing the Camp Roberts area (founder event), and a subsequent low number of migrants contributing to genetic diversity. The Panoche population is located in a small, relatively isolated valley, and also appears to be experiencing a low number of migrants into the population (Schwartz *et al.* 2005).

Arid systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes (Goldingay *et al.* 1997, White and Garrott 1999). Because the reproductive and neonatal survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity owing to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999). Frequent, rapid decreases in kit fox density can increase the extinction risk for small, isolated populations.

Recovery Status

A recovery plan approved in 1983 proposed interim objectives of halting the decline of the San Joaquin kit fox and increasing population sizes above 1981 levels (USFWS 1983). Conservation efforts subsequent to the 1983 recovery plan have included habitat acquisition by U.S. Bureau of Land Management, California Department of Fish and Game, California Energy Commission, Bureau of Reclamation, the Service, and The Nature Conservancy. Purchases most significant to conservation efforts were the acquisitions in the Carrizo Plain, Ciervo-Panoche Natural Area, and the Lokern Natural Area. Other lands have been acquired as mitigation for land conversions, both temporary and permanent.

An updated recovery plan covering upland species of the San Joaquin Valley, including the kit fox, was written in 1998. The primary goal of the recovery strategy for kit foxes identified in the Recovery Plan is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. Therefore, kit fox movement corridors between these populations must be preserved and maintained (Map 9). In the northern range, from the Ciervo Panoche in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. The core populations are the Ciervo Panoche area, the Carrizo Plain area, and the western Kern County population. Satellite populations are found in the urban Bakersfield area, Porterville/Lake Success area, Creighton Ranch/Pixley Wildlife Refuge, Allensworth Ecological Reserve, Semitropic/Kern NWR, Antelope Plain, eastern Kern grasslands, Pleasant Valley, western Madera County, Santa Nella, Kesterson NWR, and Contra Costa County. Major corridors connecting these population areas are on the east and west side of the San Joaquin Valley, around the bottom of the Valley, and cross-valley corridors in Kern, Fresno, and Merced Counties.

Conservation Needs. The recovery plan for the San Joaquin kit fox includes strategies for habitat protection that will maintain population interchange between areas adjacent to the action area. Connecting corridors for movement of kit foxes around the western edge of the Pleasant Valley and Coalinga in Fresno County should be maintained and enhanced. Existing natural lands in the Mendota area should be expanded and connected with the Ciervo-Panoche area, through restoration of habitat on retired, drainage-problem farmland. Natural lands that would provide a connection are scarce, because the land between these two populations is dominated by agriculture. Although kit fox will move up to 1.5 kilometers into farmland, they appear reluctant to cross large expanses of agricultural land due to the lack of escapes from predators (Cypher *et al.* 2005). Six occurrences of kit fox in the lands connecting these populations were recorded in 1920; there have been no subsequent recorded observations in the agricultural lands connecting Ciervo-Panoche and the Mendota area. Retired agricultural lands may provide important stepping stones to maintain connectivity throughout the action area.

Giant Garter Snake

Listing. The Service published a proposal to list the giant garter snake as an endangered species on December 27, 1991 (56 FR 67046). The Service reevaluated the status of the snake before adopting the final rule. The snake was listed as a threatened species on October 20, 1993 (58 FR 54053).

Description. The giant garter snake is one of the largest garter snake species reaching a total length of approximately 64 inches. Females tend to be slightly longer and proportionately heavier than males. The weight of adult female snakes is typically 1.1-1.5 pounds. Dorsal background coloration varies from brown to olive with a cream, yellow, or orange dorsal stripe and two light-colored lateral stripes. Some individuals have a checkered pattern of black spots between the dorsal and lateral stripes. Background coloration and prominence of the checkered pattern and three yellow stripes are geographically and individually variable; individuals in the northern Sacramento Valley tend to be darker with more pronounced mid-dorsal and lateral stripes (Hansen 1980; Rossman *et al.* 1996). Ventral coloration is variable from cream to orange to olive-brown to pale blue with or without ventral markings (Hansen 1980).

Historical and Current Range. Giant garter snakes formerly occurred throughout the wetlands that were extensive and widely distributed in the Sacramento and San Joaquin Valley floors of California (Fitch 1940; Hansen and Brode 1980; Rossman and Stewart 1987). The historical range of the snake is thought to have extended from the vicinity of Chico, Butte County, southward to Buena Vista Lake, near Bakersfield, in Kern County (Fitch 1940; Fox 1948; Hansen and Brode 1980; Rossman and Stewart 1987). Early collecting localities of the giant garter snake coincide with the distribution of large flood basins, particularly riparian marsh or slough habitats and associated tributary streams (Hansen and Brode 1980).

Loss of habitat due to agricultural activities and flood control have extirpated the snake from the southern one third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lake beds (Hansen 1980; Hansen and Brode 1980). By 1971, so much wetland habitat had been reclaimed, that the California Department of Fish and Game (CDFG) classified the giant garter snake as a rare animal and conducted a series of field surveys. The results of these surveys indicated that snake populations were distributed in marsh wetlands, tributary streams, and portions of the rice production zones of the Sacramento Valley in Butte, Glenn, Colusa, Sutter, Yolo and Sacramento Counties, in the Delta region along the eastern fringes of the Sacramento-San Joaquin River Delta in Solano, Contra Costa, Sacramento, and San Joaquin Counties, and in the San Joaquin Valley in San Joaquin, Stanislaus, Merced, Mendota, and Fresno Counties (Hansen 1988; Hansen and Brode 1980).

Upon federal listing in 1993, the Service identified 13 separate populations of giant garter snakes, with each population representing a cluster of discrete locality records (USFWS 1993). The 13 populations largely coincide with historical flood basins and tributary streams throughout the Central Valley: (1) Butte Basin, (2) Colusa Basin, (3) Sutter Basin, (4) American Basin, (5) Yolo Basin/Willow Slough, (6) Yolo Basin/Liberty Farms, (7) Sacramento Basin, (8) Badger Creek/Willow Creek, (9) Caldoni Marsh/White Slough, (10) East Stockton--Diverting Canal & Duck Creek, (11) North and South Grasslands, (12) Mendota, and (13) Burrel/Lanare. Although these groups were defined as populations in the final rule, the breeding patterns and genetic relationships between the groups are unknown. Therefore, these groups are more accurately characterized as sub-populations (USFWS 2003 [See Unpublished Literature section for complete reference]).

Surveys over the last 25 years suggest that sub-populations of giant garter snakes in the northern parts of its range (*i.e.*, Butte, Colusa, and Sutter Counties) are relatively large and stable (Wylie Casazza & Daugherty 1997; Wylie Casazza Martin & Carpenter 2003, 2004). Habitat corridors connecting sub-populations, however, are either not present or not protected, and urban encroachment is an increased threat (USFWS 2003). Sub-populations in Yolo, Sacramento, Solano, and San Joaquin Counties areas are small, fragmented, and threatened by urbanization (Hansen 2004; USFWS 2003). Those sub-populations in the San Joaquin Valley, however, are most vulnerable, having suffered near-devastating declines and possible extirpations over the last two decades (including populations in Stanislaus, Merced, Madera and Fresno Counties) (Dickert 2002, 2003; Hansen 1988; Williams and Wunderlich 2003). The southern sub-populations are extremely small, distributed discontinuously in isolated patches, and therefore are highly vulnerable to extinction by random environmental, demographic, and genetic processes (Goodman 1987).

Essential Habitat Components. Endemic to wetlands in the Sacramento and San Joaquin valleys, the giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals, rice fields and the adjacent uplands (USFWS 2003). Essential habitat components consist of: (1) wetlands with adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) upland habitat with grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for over-wintering habitat with escape cover and underground refugia (Hansen 1988). Snakes are typically absent from large rivers and other bodies of water that support introduced populations of large, predatory fish, and from wetlands with sand, gravel, or rock substrates (Hansen 1988; Hansen and Brode 1980; Rossman and Stewart 1987). Riparian woodlands do not provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations (Hansen 1988).

Foraging Ecology. Giant garter snakes are the most aquatic garter snake species and are active foragers, feeding primarily on aquatic prey such as fish and amphibians (Fitch 1941). Historically, giant garter snake prey likely consisted of Sacramento blackfish (*Orthodon microlepidots*), thick-tailed chub (*Gila crassicauda*), and red-legged frog (*Rana aurora*) (Rossman *et al.* 1996; USFWS 2003). Because these prey species are no longer available (due to drastic declines or extirpation), the predominant food items are now introduced species such as carp (*Cyprinus carpio*), mosquito-fish (*Gambusia affinis*), larval and sub-adult bullfrogs (*Rana catesbiana*), and Pacific chorus frogs (*Pseudacris regilla*) (Fitch 1941; Hansen and Brode 1993; Rossman *et al.* 1996).

Reproductive Ecology. The giant garter snake breeding season extends through March and April, and females give birth to live young from late July through early September (Hansen and Hansen 1990). Brood size is variable, ranging from 10 to 46 individual young, with a mean of 23 individuals (Hansen and Hansen 1990). At birth, young average about 8.1 inches snout-to-vent length and 3 to 5 grams. Although growth rates are variable, young typically more than double in size by one year of age, and sexual maturity averages three years in males and five years for females (USFWS 1993b).

Movements and Habitat Use. The giant garter snake is highly aquatic but also occupies a terrestrial niche (USFWS 2003; Wylie Casazza Martin & Carpenter 2004). Aquatic habitat includes remnant native marshes and sloughs, restored wetlands, low gradient streams, and agricultural wetlands including rice fields and irrigation and drainage canals. Terrestrial habitat includes adjacent uplands which provide areas for basking, retreats, and over-wintering. Basking takes place in tules, cattails, saltbush, and shrubs over-hanging the water, patches of floating vegetation including waterweed, on rice checks, and on grassy banks (USFWS 2003). The snake typically inhabits small mammal burrows and other soil and/or rock crevices during the colder months of winter (i.e., October to April) (Hansen and Brode 1993; Wylie Graham Casazza Paquin & Daugherty 1996; Wylie Casazza Martin & Carpenter 2003). It also uses burrows as refuge from extreme heat during its active period (Wylie Casazza & Daugherty 1997; Wylie Casazza Martin & Carpenter 2004). While individuals usually remain in close proximity to wetland habitats, the Biological Resources Division of the U.S. Geological Survey has documented snakes using burrows as much as 165 feet (50 meters) away from the marsh edge to escape extreme heat, and as far as 820 feet (250 meters) from the edge of marsh habitat for over-wintering habitat (Wylie Casazza & Daugherty 1997). Snakes typically select burrows with sunny exposures along south and west facing slopes (USFWS 1993b).

In studies of marked snakes in the Natomas Basin, snakes moved about 0.25 to 0.5 mile (0.4 to 0.8 kilometer) per day (Hansen and Brode 1993). Home range (area of daily activity) averages about 0.1 square mile (25 hectares) in both the Natomas Basin and the Colusa NWR (Wylie 1998; Wylie Casazza & Carpenter 2002). Total activity, however, varies widely between individuals. Individual snakes have been documented to move up to 5 miles (8 kilometers) over a few days in response to dewatering of habitat (Wylie Casazza & Daugherty 1997) and to use up to eight miles (12.9 kilometers) of linear aquatic habitat over the course of a few months, with a home range as large as 14.5 square miles (3744 hectares) (Wylie and Martin 2004).

In agricultural areas, snakes were documented using rice fields in 19-20 percent of the observations, marsh habitat in 20-23 percent of observations, and canal and agricultural waterway habitats in 50-56 percent of the observations (Wylie 1998). In the Natomas Basin, used habitat consisted almost entirely of irrigation ditches and established rice fields (Wylie 1998; Wylie Casazza & Martin 2004b). In the Colusa NWR, snakes were regularly found on or near edges of wetlands and ditches with vegetative cover (Wylie Casazza Martin & Carpenter 2003). Telemetry studies also indicate that active snakes use uplands extensively; more than 31 percent of observations were in uplands (Wylie 1998). Snakes observed in uplands during the active season were consistently near vegetative cover, particularly where cover exceeded 50 percent in the area within 1.6 feet (0.5 meter) of the snake (Wylie 1998).

Snakes will move into restored habitat. At the Colusa NWR, after two years, restoration area population estimates increased from 30 snakes per kilometer to 59-95 snakes per kilometer (Wylie Casazza Martin & Carpenter 2004). At the Colusa Basin Drainage Canal, snakes were given three upland restoration treatments: 1) soil planted with native grasses over rock riprap, 2) soil planted with native grasses without rock riprap, and 3) rock riprap only. Snakes were most commonly found at the soil over rock riprap treatment (Wylie and Martin 2004).

Predators. Giant garter snakes are eaten by a variety of predators, including raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiansa*), bull frogs (*Rana catesbiana*), hawks (*Buteo* spp.), egrets (*Casmerodius albus, Egretta thula*), and great blue herons (*Ardea herodias*) (Dickert 2003; USFWS 2003; Wylie Casazza & Carpenter 2003). Many areas supporting snakes have abundant predators; however, predation does not seem to be a limiting factor in areas that provide abundant cover, high concentrations of prey items, and connectivity to a permanent water source (Hansen and Brode 1993; Wylie Graham Casazza Paquin & Daugherty 1996).

Reasons for Decline and Threats to Survival. The current distribution and abundance of the giant garter snake is much reduced from former times (USFWS 2003). Less than 10 percent, or approximately 319,000 acres (129,000 hectares), of the historic 4.5 million acres (1.8 million hectares) of Central Valley wetlands remain (U.S. Department of Interior 1994), of which very little provides habitat suitable for the giant garter snake. Loss of habitat due to agricultural activities and flood control have extirpated the snake from the southern one-third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds (Hansen 1980; Hansen and Brode 1980). These lakebeds once supported vast expanses of ideal snake habitat, consisting of cattail and bulrush dominated marshes (USFWS 2003). Cattail and bulrush floodplain habitat also historically typified much of the Sacramento Valley (Hinds 1952). Prior to reclamation activities beginning in the mid- to late-1800s, about 60 percent of the Sacramento Valley was subject to seasonal overflow flooding providing expansive areas of snake habitat (Hinds 1952). Valley flood wetlands are now subject to cumulative effects of upstream watershed modifications, water storage and diversion projects, as well as urban and agricultural development.

The CVP, planned by the State of California, and built and operated by the U.S. Bureau of Reclamation, is the largest water management system in California. CVP, the SWP, and the historic water development activities that preceded them have not only resulted in the loss of approximately 90 percent of wetlands, they have created an ecosystem altered to such an extent that remaining wetlands, like agriculture, depend on managed water (U.S. Department of Interior 1994). The historic disturbance events associated with seasonal inundation that occur naturally in dynamic riverine, riparian, and wetland ecosystems have been largely eliminated. In addition to the highly managed water regimes, implementation of CVP has resulted in conversion of native habitats to agriculture, and has facilitated urban development throughout the Central Valley (USFWS 2003). In 1992, Congress enacted the CVPIA, the concerns of which include pricing and management of Central Valley water and attempting to mitigate for project impacts on fish, wildlife, and associated habitat

Residential and commercial growth within the Central Valley is consuming an estimated 15,000 acres of Central Valley farmland each year (American Farmland Trust 1999). In the future, this transformation is expected to accelerate. Rice fields have become important habitat for giant garter snake, particularly associated canals and their banks for both spring and summer active behavior and winter hibernation (Hansen 2004). While within the rice fields, snakes forage in the shallow water for prey, utilizing rice plants and vegetated berms dividing rice checks for shelter and basking sites (Hansen and Brode 1993). The loss of rice land resulting from residential and commercial growth compounds the impact of direct habitat loss resulting from development itself.

Ongoing maintenance of aquatic habitats for flood control and agricultural purposes eliminates or prevents the establishment of habitat characteristics required by snakes (Hansen 1988). Such practices can fragment and isolate available habitat, prevent dispersal of snakes among habitat units, and adversely affect the availability of the snake's food items (Hansen 1988; Brode and Hansen 1992). For example, tilling, grading, harvesting and mowing may kill or injure giant garter snake (USFWS 2003; Wylie Casazza & Daugherty 1997). Biocides applied to control aquatic vegetation reduce cover for the snake and may harm prey species (Wylie Graham Casazza Paquin & Daugherty 1996). Rodent control threatens the snake's upland aestivation habitat (Wylie Graham Casazza Paquin & Daugherty 1996; Wylie Casazza Martin & Carpenter 2004). Restriction of suitable habitat to water canals bordered by roadways and levee tops renders snakes vulnerable to vehicular mortality (Wylie Casazza & Daugherty 1997). Materials used in construction projects (e.g., erosion control netting) can entangle and kill snakes (Stuart *et al.* 2001). Livestock grazing along the edges of water sources degrades water quality and can contribute to the elimination and reduction of available quality snake habitat (Hansen 1988). Fluctuation in rice and agricultural production affects stability and availability of habitat (Wylie and Casazza 2001; Wylie Casazza & Martin 2003, 2004).

Other land use practices also currently threaten the survival of the snake. Nonnative predators, including introduced predatory game fish, bullfrogs, and domestic cats, can threaten snake populations (Dickert 2003; Wylie Graham Casazza Paquin & Daugherty 1996; Wylie Casazza & Carpenter 2003). Nonnative competitors, such as the introduced water snake (*Nerodia fasciata*) in the American River and associated tributaries near Folsom, may also threaten the giant garter snake (Stitt *et al.* 2005). Recreational activities, such as fishing, may disturb snakes and disrupt basking and foraging activities. While large areas of seemingly suitable snake habitat exist in the form of duck clubs and waterfowl management areas, water management of these areas typically does not provide the summer water needed by the species.

The disappearance of giant garter snake from much of the west side of the San Joaquin Valley was approximately contemporaneous with the expansion of subsurface drainage systems in this area, providing circumstantial evidence that the resulting contamination of ditches and sloughs with drainwater constituents (principally selenium) may have contributed to the demise of giant garter snake populations. Dietary uptake is the principal route of toxic exposure to selenium in wildlife, including giant garter snake (Beckon *et al.* 2003). Many open ditches in the northern San Joaquin Valley carry subsurface drainwater with elevated concentrations of selenium. Green sunfish (*Lepomis cyanellus*) in this drainwater have been found to have concentrations of selenium ranging from 12 to 23 µg/g (Saiki 1998), within the range of concentrations associated with adverse affects on predatory aquatic reptiles (Hopkins *et al.* 2002). This toxic level of exposure may have adverse effects on giant garter snakes caused by predation on contaminated fish.

The Central Valley contains a number of endangered ecosystems due to its fertile soils, amiable climates, easy terrains, and other factors that historically have encouraged human settlement and exploitation (Noss *et al.* 2003). Environmental impacts associated with urbanization include loss of biodiversity and habitat, alteration of natural fire regimes, fragmentation of habitat from road construction, and degradation due to pollutants (USFWS 2003). Rapidly expanding cities within the snake's range include Chico, Yuba City, the Sacramento area, Galt, Stockton, Gustine, and Los Banos.

Status with Respect to Recovery. The revised draft recovery plan for the giant garter snake subdivides its range into three proposed recovery units (USFWS 2003): (1) Northern Sacramento Valley Recovery Unit; (2) Southern Sacramento Valley Recovery Unit; and (3) San Joaquin Valley Recovery Unit.

The Northern Sacramento Valley Unit at the northern end of the species' range contains sub-populations in the Butte Basin, Colusa Basin, and Sutter Basin (USFWS 2003). Protected snake habitat is located on State refuges and refuges of the Sacramento NWR Complex in the Colusa and Sutter Basins. Suitable snake habitat is also found in low gradient streams and along waterways associated with rice farming. This northernmost recovery unit is known to support relatively large, stable sub-populations of giant garter snakes (Wylie Graham Casazza Paquin & Daugherty 1996; Wylie Casazza & Carpenter 2002; Wylie Casazza Martin & Carpenter 2004). Habitat corridors connecting subpopulations, however, are either not present or not protected.

The Southern Sacramento Valley Unit includes sub-populations in the American Basin, Yolo Basin, and Delta Basin (USFWS 2003). The status of Southern Sacramento Valley sub-populations is uncertain; each is small, highly fragmented, isolated, and threatened by urbanization (Hansen 2004; USFWS 2003; Wylie Casazza & Martin 2004). The American Basin sub-population, although threatened by urban development, receives protection from the Metro Air Park and Natomas Basin Habitat Conservation Plans, which share a regional strategy to maintain a viable snake sub-population in the basin.

The San Joaquin Valley Unit includes sub-populations in the San Joaquin Basin and Tulare Basin. The San Joaquin Valley Unit formerly supported large snake populations, but numbers have severely declined, and recent survey efforts indicate numbers are extremely low compared to Sacramento Valley sub-populations (Dickert 2002, 2003; Wylie 1998). Giant garter snakes currently occur in the northern and central San Joaquin Basin within the Grassland Wetlands, Mendota Area, and Burrel/Lanare Area. Agricultural and flood control activities are presumed to have extirpated the snake from the Tulare Basin (Hansen 1995); however, comprehensive surveys for this area are lacking and where habitat remains, the giant garter snake may be present (USFWS 2003).

The revised draft recovery criteria require multiple, stable sub-populations within each of the three recovery units, with sub-populations well-connected by corridors of suitable habitat. This requires that corridors of suitable habitat between existing snake sub-populations be maintained or created to enhance sub-population interchange to offset threats to the species (USFWS 2003). Overall, the future availability of habitat in the form of canals, ditches, and flooded fields are subject to market-driven crop choices, agricultural practices, and urban development, and are therefore uncertain and unpredictable.

California Least Tern

Listing.

The California least tern, which is one of three subspecies of least tern in the United States, was listed as endangered in 1970 (35 *FR* 16047). No critical habitat has been designated for this species, a recovery plan was prepared in 1980 (USFWS 1980) and revised in 1985 (USFWS 1985a). The California least tern is a fully protected species under California law. See California Fish and Game Code, Section 3511. The following description of the California least tern's basic ecology was compiled from the revised final recovery plan (USFWS 1985a).

Description.

California least terns are the smallest members of the subfamily Sterninae (family Laridae), measuring about nine inches long with a twenty inch wingspan. Sexes look alike, being characterized by a black cap, gray wings with black wingtips, orange legs, and a black-tipped yellow bill. Immature birds have darker plumage, and a dark bill, and their white heads with dark eye stripe are quite distinctive. The California least tern cannot be reliably differentiated from other races of tern on the basis of plumage characteristics alone (Burleigh and Lowery 1942).

Historical and Current Range.

The California least tern breeds along the Pacific Coast from San Francisco Bay to San Jose del Cabo, Baja California, Mexico. As reported in the 1985 Recovery Plan (USFWS 1985a), the California least tern nest in large nesting colonies which are discontinuous along the California coast and generally are spread out along beaches at the mouths of larger estuaries. At that time, there was no discussion of terns occurring away from the breeding colonies along the coast. Approximately 32 active nesting locations exist from San Francisco Bay south to the Mexican border. There are eight active nesting locations in Santa Barbara and Ventura counties. Although this subspecies is considered a colonial nester, some observations of single pairs nesting have been made at some of these locations. The Santa Margarita River mouth in San Diego County now hosts the largest number of birds among all locations. However, in the

California Least Tern Breeding Survey, 1998 Season, Keane (DFG 1999a) reported that there were 28 locations that reported successfully producing fledglings, and all but 2 were located along the coast. The two non-coastal nesting sites are located at a PGE power plant at Pittsburgh in the western Sacramento-San Joaquin Delta and at Kettleman City in the San Joaquin Valley at the southern boundary of Westlands Water District (WD) and Lemoore NAS is within the district boundaries of Westlands WD. There was one nest reported from the terminal cells of evaporation basins at the Kettleman City location that produced one fledgling from two eggs in 1998 (DFG 1999a).

A few least terns have been observed foraging at the sewage ponds at Lemoore Naval Air Station (LNAS) in 1997 and 1998 but no nesting has been documented there (J. Seay, pers. comm.; 2006). The birds at both LNAS and Kettleman City arrive on site in June or July (J. Seay, pers. comm.; 2006) and are either "second wave" nesters which are first time breeders (2-year old birds) or birds that have nested at a coastal site (either successfully or unsuccessfully) as a "first wave" breeder (DFG 1999a). There is no definitive information that links the Central Valley least terns to any of the coastal colonies, so they may be refugees from a coastal colony or a pair of young birds that got lost on their way to the breeding grounds. There have also been reports of single pairs nesting at evaporation ponds in the Tulare Lake Basin (J. Seay, pers. comm.; 2006).

Reproductive Ecology and Demography

The California least tern breeding season typically begins in April. Most commonly, two eggs are laid in the first part of May and hatching occurs in early June. Fledgling of chicks usually occurs by late June. A second wave of nesting often occurs from early June to late July which is usually instigated by the failure of the first nest. Parents and fledglings remain close to the breeding site before beginning their migration southward, usually no later than mid-September. Their wintering localities are not well known, although some banded birds have been observed in Colima, Mexico. California least terns appear to have strong nesting site fidelity and most return to their natal breeding beach year after year. Mass relocations have been documented when a breeding site has been destroyed or heavy predation has occurred.

For nesting, California least terns require areas that have relatively flat, open, sandy beaches, in proximity to foraging habitat, and have relative seclusion from disturbance and predation. California least terns have been known to nest on artificial surfaces, such as airfields, landfills, and vacant parking lots. During the nesting season, coastal California least terns feed on small fish captured either in ponds, bays and estuaries, or immediately offshore. Prey items include northern anchovy (*Engraulis mordax*), topsmelt (*Atherinops affinis*), California grunion (*Leuresthes tenuis*), and killifish (*Fundulus parvipinnis*). Typically, in these two Central Valley locations, the species forages on inland silversides (*Menidia beryllina*) or *Gambusia*, which was introduced into one of the evaporation ponds near Kettleman City; the *Gambusia* could only persist in the cells with the deepest, least saline water (J. Seay, pers. comm.; 2006). Both the male and female select a suitable site to begin scraping their nest if it is located on sand. If no sand is available in their nesting location, the birds will select a natural depression in the ground, such as a boot or tire depression in dried mud. After the eggs are laid, the nest is sometimes lined with shell fragments and small pebbles. Eggs are incubated primarily by the female for 20 to 25 days.

Least terns hover over standing or flowing water and dive to capture fish. They also may catch aquatic macroinvertebrates. The diet of the California least tern is known to consist mostly of small fish (Tomkins 1959; Atwood and Kelly 1984) and this appears to be true of least terns in the Tulare Basin (J. Seay, pers. comm.; 2006) In some locations, other least terns are known to forage heavily on invertebrates, including shrimp and ants in South Carolina (Thompson *et al.* 1997) and flying insects (nesting birds in Texas) (McDaniel and McDaniel 1963).

Reasons for Decline and Threats to Survival

The decline of the California least tern has been attributed primarily to destruction of breeding and foraging habitat, and human disturbances at nesting locations. Their decline was a gradual process as European settlers began establishing along the California coast. The Pacific Coast Highway, constructed in the early 1900s, is thought to have contributed substantially to the decline of California least terns as the highway paved over many nesting locations, and promoted development and recreation along the coast. At the time of listing, a census revealed only 600 pairs of breeding California least tern in the entire state, but recovery efforts instituted after the time of listing have helped raise numbers of breeding birds. Statewide surveys conducted in 1995 counted 2,598 pairs (Caffrey 1995). Dramatic fluctuations in the number of breeding pairs after listing have been attributed to severe El Niño Southern Oscillations, which affect the birds' food supply.

Recovery Status

The California Least Tern Recovery Plan's primary objective is to restore and maintain the breeding populations to secure levels. To achieve that objective, the breeding population must increase to at least 1,200 breeding pairs distributed among secure colonies in at least 20 secure coastal management areas throughout their breeding range. Concurrent efforts should also be undertaken in the Mexican portion of the breeding population. A requirement for maintaining the population levels would be 1) sufficient habitat to support at least one viable tern colony (defined as consisting of at least 20 breeding pairs with a 5-year mean reproductive rate of at least 1.0 young fledged per year per breeding pair) at each of the 20 coastal management areas (including San Francisco Bay, Mission Bay, and San Diego Bay, which should have 4, 6, and 6 secure colonies respectively), that are managed to conserve least terns; and 2) land ownership and management objectives are such that future habitat management for California least tern at these locations can be assured.

The chief limiting factor influencing the number of least tern breeding pairs is the availability of undisturbed suitable habitat on the breeding grounds.

Environmental Baseline

The environmental baseline is an analysis of past and ongoing human and natural factors leading to the current status of the species, habitats, and ecosystems within the action area. The baseline includes State, tribal, local, and private actions already affecting the species or that will occur at the same time as this consultation. The baseline also includes the consultations completed for the renewal of other long-term water contracts, and consultations related to the operation and maintenance activities of the CVP. Other unrelated Federal actions affecting the species that have completed consultation are also included as part of the baseline.

Terrestrial Habitats

The SLU historically supported California prairie (including vernal pools) and San Joaquin saltbush vegetation on the valley floor, and riparian wetland communities along the San Joaquin River (Moore *et al.* 1990). Today, irrigated agriculture has largely replaced these communities (Maps 7 & 8). There are six general terrestrial habitat types in the project area, including: agricultural and fallowed cropland; San Joaquin saltbush and California prairie/annual grasslands; drainwater reuse areas; restoration sites; and riparian areas. These are discussed in more detail below.

Agricultural lands/Fallowed Cropland

Intensively managed or temporarily fallowed agricultural lands are the predominant land use feature in the SLDFR planning area. The EIS states that cotton is the main crop, followed by tomato and lettuce. Currently, the SLU growers are shifting their cropping patterns to increased acreages of fruit and nut orchards (S. Phillips, pers comm., 2006; Phillips 2006b; Westlands Water District 2004-2005). For the last several years on average, Westlands has fallowed some 70,000-100,000 acres each year (G. Robbins, pers. comm.; 2006). Fallowed land management varies, but much of this land is now allowed to grow plants, followed by sheep grazing (S. Phillips, pers. comm.; December 7, 2004).

San Joaquin Saltbush

San Joaquin saltbush is generally dominated by salt-tolerant shrubs such as perennial and annual saltbush, iodine bush, alkali blite, burning bush, and goldenbush. Grasses and forbs found in alkali desert scrub communities include alkali heath, alkali weed, dock, pickleweed, alkali heliotrope, annual saltbush, alkali sacaton, and saltgrass. As of 1990, about eight percent of the historic San Joaquin saltbush habitat remained in the San Joaquin Valley (Moore *et al.* 1990).

California Prairie/Annual Grassland

California prairie is characterized by native perennial grasses, such as purple needlegrass and alkali sacaton, and is typically found in moist, lightly grazed relict areas within annual grasslands. Less than one percent of historic California prairie remains in the San Joaquin Valley. Most of the historic California prairie habitat is now replaced by annual grassland community. Annual grasslands in the San Joaquin Valley are dominated by introduced annuals such as oats, soft chess, ripgut brome, red brome, barley, and foxtail fescue.

As of 1990, there were about 17,000 acres of California prairie/annual grassland and San Joaquin saltbush habitat remaining in the SLU -- the vast majority of which occur in the western portion of Westlands along the Interstate 5 corridor (USBR 1991). Some wildlife species that use San Joaquin saltbush and California prairie/annual grassland habitats include various species of mice and kangaroo rats, ground squirrels, blunt-nosed leopard lizard (BNLL), Swainson's hawk, red-tailed hawk, and San Joaquin kit fox.

Drainwater Reuse Areas

Currently, nearly 3,000 acres are being managed as reuse facilities in the Northerly Area of the SLU (the San Joaquin River Water Quality Improvement Project, aka "Panoche" facility; *see SFEI 2003 GBP Monitoring Report, chapter 2*). This land is managed as irrigated agriculture, utilizing drainwater to irrigate salt tolerant plants (primarily alfalfa and barley), which are harvested when mature. These facilities function to lower drainwater volume and concentrate salts prior to disposal to the San Joaquin River.

The DEIS states that cultivated plants in the reuse areas consume 3.4 acre feet of water per acre, with an additional 1.1 acre feet of water per acre reaching groundwater for subsequent drainage service. Land management practices on the reuse areas limit their habitat value, however reports do confirm use by area wildlife, including nesting avifauna (see SJRIP monitoring reports).

Restoration Sites

In 1998, the Department of the Interior retired 1,646 acres in the SJVDP's Westlands Subarea through the CVPIA Land Retirement Program. In 2001, an additional 440 acres were added to the project. The sites are located immediately to the west and south of the Mendota Wildlife Management Area (WMA) in western Fresno County. This land was purchased to remove irrigation from impaired lands and reduce drainage problems.

Ten monitoring wells revealed that after 4 years, the perched groundwater level dropped 6 feet, and in all areas was at least 7 feet below the surface. Monitoring several sumps on the Tranquility site (located about 2 miles south of Mendota WMA) revealed that all were dry by October 2000. This project also monitors and evaluates revegetation and restoration of these lands, and will help direct future restoration actions (USDI 2004).

Currently, these 2,086 retired acres, along with the Britz and Sumner Peck lands (for which the Federal government retains non-irrigation covenants through legal settlement), comprise the only area in the SLU that the Service considers permanently removed from irrigated agriculture.

Riparian Systems

The practice of planting crops directly adjacent to the river channel bank has confined riparian vegetation to a narrow band within and alongside the San Joaquin River. As of 1990, about four percent of the historic San Joaquin Valley riparian vegetation acreage remained (Moore *et al.* 1990).

Remnant native forested and scrub-shrub wetlands (commonly referred to as riparian vegetation) are restricted to the San Joaquin River channel, remnant stands along some intermittent tributaries (such as Los Banos Creek, Panoche Creek, and Cantua Creek), and some of the larger sloughs within or adjacent to the study area in the north. Dominant plant species include: cottonwood, California sycamore, and valley oak. Typical shrubs include: wild rose, California blackberry, blue elderberry, and willows. Hoary nettle, poison hemlock, rushes, and grasses are commonly found in the herbaceous layer (USBR 1991).

There are about 500 acres of riparian habitat along Mud and Salt Sloughs (USBR 1991). As stated above, four percent of the historic San Joaquin Valley riparian habitat remains today.

Aquatic Habitat

The San Joaquin Basin is drained by the San Joaquin River, which flowing north, eventually empties into the San Francisco Bay via the Delta. Essentially all natural flows in area streams are diverted for agricultural and municipal use. As of the late 1980's, less than one percent of the San Joaquin Valley's developed water supply was delivered to wetlands (Moore *et al.* 1990). Recently, refuge level 2 actions under the CVPIA have improved wetland water supply reliability, but water supplies are the primary factor dictating the type and condition of wetlands in the Valley.

San Joaquin River flows are currently maintained from tributaries downstream of Mendota Pool through Federal Energy Regulatory Commission (FERC) required instream flows and water quality flow releases from New Melones Reservoir. FERC flow releases are required to maintain viable fishery resources downstream of associated dams. Prior to 1992, agricultural tailwater and drainwater contributed substantial flows to the river. However, today these river flow contributions have decreased due to tailwater recapture, drainwater volume reduction, groundwater pumping, and water transfer programs.

Numerous kinds of wetlands (including vernal pools, free-flowing streams, and permanent and seasonal wetlands) occurred in the San Joaquin Valley in historical times. Many of these natural habitat types have been reduced to tiny remnants of their historic extent (Maps 7 & 8). Existing wetland types are often characterized by man-made or man-modified features such as irrigation canals, managed wetlands (including rice fields), evaporation ponds, and ephemeral groundwater pools.

About eight percent of the historic San Joaquin Valley wetland acreage remains (Moore *et al.* 1990). Since the Moore report, several wetland area additions occurred in the San Joaquin Valley, but overall the wetland area remains below 10 percent of historical acreage.

Vernal Pools

Vernal pools, a type of seasonal wetland, once were commonly interspersed within the California prairie of the San Joaquin Valley. These seasonal pools are usually small (10-165 feet across), although some can be as large as a few hundred acres. They are typically shallow (4-24 inches deep), characterized by shallow depressions underlain by an impervious substrate (e.g., clays) that prevents or greatly hinders the downward percolation of water. They vary in pH from acidic to neutral or subalkaline. Plant composition is largely annual, highly endemic flora, and approximately 70 percent of the documented vernal pool species are native annuals (Holland and Jain 1988).

Two forms of vernal pools are found in the San Joaquin Valley: northern claypan vernal pools, and intergrades with alkali sink pools. Valley pools are typically saline or alkaline, and occur in basins or low-lying plains. Common salt-tolerant flora characteristic of valley pools include: salt grass, *Downingia*, peppergrass, sandwort, locoweed, alkali weed, gum plant, and clover. Terrace vernal pools occur on neutral to slightly acid soils. Characteristic taxa of terrace pools include: foxtail, Blennosperma, primrose, white brodiaea, hairgrass, *Evax caulescens*, hedge hyssop, quillwort, toad rush, rush, meadowfoam, flowering quillwort, *Allocarya stipitata*, loosestrife, Navarretia, woolly marbles, and several species from the genera *Downingia*, *Eryngium*, *Lasthenia*, and *Orcuttia* (Holland and Jain 1988).

Alkali sink habitat, a type of vernal pool or seasonal wetland, occurs in low-lying areas underlain by highly alkaline soils in San Joaquin saltbush habitat. Vernal pool habitat is known to exist in grassland-wetland areas located in the action area (e.g., in San Luis NWR, adjacent to Mud Slough). No CNDDB occurrence records for vernal pool habitat, vernal pool crustaceans, or associated vernal pool plants have been reported in the 37 quads that encompass the drainage project area (CDFG 2004).

Managed Wetlands

Water supplies limit refuge management strategies. Until 1985, wetland managers relied heavily on agricultural drainwater to meet refuge management objectives. This practice was generally discontinued in the fall of 1985 due to water quality concerns (discussed below). In 1992, the CVPIA identified level 2 refuge water supplies as a project component, and these supplies are met when possible.

As a rule of thumb, permanent wetlands managed within the San Luis NWR Complex require 10 to 13 acre feet/acre irrigation water per year, while semi-permanent and seasonal wetlands need an annual average of 7 and 3 acre feet/acre, respectively (K. Forrest, pers. comm.; August 11, 2003). Management of seasonally-flooded emergent wetlands within the State of California's Mendota WMA requires from 1.5 to 10 acre feet/acre of water annually. Here, adjacent to the SLU, swamp timothy requires an application of 1.5 acre feet/acre annually, while watergrass uses 3 acre feet/acre. Natural food crops such as swamp timothy, alkali bulrush, smartweed, and millet are grown for wildlife. The canals are periodically dewatered to manage cattail. Under different conditions, watergrass is managed with 5-6 acre feet/acre annually at Los Banos WMA. Operators of private hunting clubs generally manage their lands less intensively with an average annual application of 3 acre feet/acre.

A common wetland/wildlife management approach in the San Joaquin Valley mimics naturally occurring seasonally-flooded emergent wetlands with the carefully timed delivery of available water supplies. Flat lands are managed as moist soil units, and produce stands of swamp timothy, spikerush, smartweed, watergrass, and wild millet to provide habitat for wintering waterfowl and other aquatic birds. Sites are drained in mid-March to permit spring seed germination. Beginning in mid-April, about 1 acre foot/acre of water is applied to encourage the growth of waterfowl foods. Managers begin to flood sites in mid-August, if water is available, and attempt to maintain a depth of 8 inches of water from mid-September through mid-March (primarily for dabbling duck species).

A less common wetland management strategy attempts to provide winter roosting, nesting, and brooding habitat for water birds by providing permanent water. Technically, these are semi-permanently and permanently flooded emergent and unconsolidated bottom wetlands (Cowardin *et al.* 1979), and are limited to sites with uneven terrain that can support a combination of deep ponds, islands, and shallows. Common plants found in deep ponds include common cattail, hardstem bulrush, alkali bulrush, widgeongrass, and horned pondweed. Swamp timothy, spikerush, smartweed, and watergrass are found in the shallows.

Wetland managers attempt to maximize water depths at 3-4 feet from mid-September through early May. Ponds are then drawn down to permit seed germination in exposed shallows. Food plants are then irrigated in early June and again in early July. Relatively few of these "permanent" wetlands contain water year-round. On an annual basis, about one quarter of water use (2.5 acre feet/acre) is dedicated to filling and maintaining flooded conditions from mid-September through February. An additional 2.5 acre feet/acre is required to maintain these conditions from March through May. The remaining one-half of the water budget (5 acre feet/acre) is used for irrigation and counteracting evapotranspiration losses from June through mid-September.

Non-natural Surface Waters (Storage and Conveyance Systems) and Natural Surface Waterways

Water-related habitat resources begin with the water impoundments, water storage, and water conveyance to respective use areas. Following Delta diversion and conveyance, irrigation water used on the SLDFR planning area agricultural lands results in groundwater with high concentrations of salts and trace elements such as boron and selenium. In the Northerly Area, much of this contaminated water is collected using a tile drain system, conveyed through open ditches and canals, then ultimately disposed into the San Joaquin River.

The Northerly Area of the SLU includes intensively managed agricultural land, irrigation water delivery canals, and drainage canals. It is currently serviced by the Grassland Bypass Project, and subsurface agricultural drainwater (drainwater) generated from these fields eventually flows to the San Joaquin River via Mud Slough. In 13 years of monitoring, the GBP has documented elevated concentrations of selenium in fish and invertebrates in the natural waterways where drainwater is being released. These loads may be harming fish in Mud Slough and the lower San Joaquin River, as well as higher vertebrates, such as the giant garter snake, that consume these organisms. San Joaquin River tributaries and releases from New Melones Reservoir dilute the drainwater discharges prior to reaching the Delta. The Grassland Bypass Project has been permitted by means of a Waste Discharge Permit from the Central Valley Regional Water Board to continue these discharges through 2009. By 2010 other drainage service options or drainwater management strategies will need to be employed by area growers to meet the more stringent water quality objectives for selenium in the San Joaquin River that will be in effect in all water year types (including dry water years).

Additionally, sumps and check drains in the Northerly area discharge drainwater to the DMC — flowing to the Mendota Pool. The Mendota Pool provides water to public and private managed wetlands within the region. Westlands currently does not have a disposal outlet, so the contaminated water remains in the groundwater system (except for subsurface drainage accretion flows to the San Joaquin River and lateral flow to adjacent downslope agricultural districts; {sources: (1) State Water Resources Control Board, March 2000. Water Rights Decision D-1641, downloaded from URL: http://www.waterrights.ca.gov/hearings/decisions/WRD1641.pdf; (2) U.S. Bureau of Reclamation, San Luis Drainage Feature Re-evaluation [SLDFR] Draft Environmental Impact Statement [DEIS], May 2005 [USBR 2005a]; (3) U.S. Bureau of Reclamation, Broadview Water Contract Assignment Project Environmental Assessment Draft FONSI [Broadview DEA], April 2004}).

Unlined canals and drains provide marginal wetland and aquatic habitat throughout the project area. The habitat quality varies depending on the degree and frequency of maintenance, water quality, habitat type of adjacent lands, consistency of flows, and other factors. Some canal and drain reaches contain emergent and aquatic plants such as bulrushes, cattails, and pondweed, as well as undesirable invasives such as perennial pepperweed. Larger canals and drains support warmwater fish.

Under existing conditions, subsurface, agricultural drainwater also enters and affects water quality in the Grassland wetland supply channels from:

1) uncontrolled discharges associated with heavy rainfall events -- drainage water ends up being pumped into the Grassland Wetland Supply channels directly. This occurs during periods of heavy rainfall. Since 1995, such events occurred in

water years 1995, 1997, 1998 and 2005 and have resulted in significant spikes in selenium concentrations in the Grassland wetland supply channels and selenium loading into the San Joaquin River. (Luoma and Presser 2000, McGahan 2005).

2) lands outside the Grassland Bypass Project Drainage Project Area that have drainage problems. As was noted in a 2002 Regional Board Report by Eppinger and Chilcott:

"Two areas have been identified where agricultural subsurface drainage can enter wetland water supply canals from farmland not contained in the DPA [Grasslands Drainage Area]. One area is west of the wetland water supply channels and historically drained into the Almond Drive Drain. Since Water Year 1999, these discharges have been collected in the CCID Main Drain and diverted into the CCID Main Canal downstream of internal supply channels. Data for Water Years 1999 and 2000 is not available for the Almond Drain site.

The second area where agricultural subsurface drainage can enter wetland water supply canals from outside the DPA is a triangle-shaped area of approximately 7,000 acres south of the Poso Drain (also known as the Rice Drain) and north of the DPA. This area historically drained into the Poso Drain, entering South Grassland Water District from the east. Three sites on the Poso (Rice) Drain were monitored for selenium during Water Years 1999 and 2000. Selenium concentrations at all three sites were above 2 ug/L a majority of the time, though a change in tail water management after June 1999 has apparently helped to reduce and stabilize concentrations."

These sites will not be serviced by SLDFR and will continue to impact water quality on an annual basis in the Grassland wetland supply channels with or without SLDFR implementation.

Evaporation Ponds

Evaporation ponds exploit a simple technology whereby drainwater is collected and then reduced in volume by sun and wind action. Existing ponds in the Tulare Basin generally take advantage of high evaporation rates (2.8 to 5 feet per acre annually) using a shallow (2-3 feet), open basin design with gradual side slopes (up to 8:1) to concentrate salts and toxic elements within the ponds. The development of evaporation ponds has created a new and unique habitat that is attractive to the wildlife adapted to the San Joaquin Valley's historic wetlands.

Evaporation ponds are generally highly saline environments and existing ponds contain an estimated 31.9 parts per thousand (ppth) TDS, on average (Moore *et al.* 1990). Extreme salinity conditions within the ponds limit biological diversity. Organisms that can tolerate high and fluctuating salinity and temperatures and low dissolved oxygen exploit a situation in which there is reduced competition and predation. Productivity of some aquatic food-chain organisms such as widgeongrass, water boatman, midge flies, brine flies, and brine shrimp is often quite high, and primary production at some ponds has been several orders of magnitude higher than natural saline aquatic systems. The presence of surface water in an arid landscape and abundant food make evaporation ponds very attractive to aquatic birds. Kesterson Reservoir, which essentially functioned as an evaporation basin between 1981 and 1986, demonstrated the threats these ponds pose to aquatic birds.

Within the San Joaquin Valley, there are about 4,700 acres of evaporation ponds currently in operation. Associated with these evaporation ponds are about 550 acres of mitigation habitat (A. Toto, pers. comm.; November 15, 2005). Evaporation ponds are regulated under Waste Discharge Requirements issued by the Regional Board. Currently, there are no permitted evaporation ponds within the SLDFR planning area. In 1992, the Sumner Peck ponds were closed, and the drainage impaired lands that they served were subsequently retired from irrigated agriculture in 2002 by a settlement with Interior. The Britz-Deavenport Five Points facility was converted to IFDM in 2005. Water quality data from these former SLU facilities are provided in Table 2 for reference.

Table 2. Selenium Concentrations at Inflow and Within Historic Evaporation Ponds Located Within The SLDFR Planning Area.

Pond Name	Mean Inflow Concentration[a] (ppb)	Mean Pond Concentration (ppb)
Sumner Peck[b] (pond owners)	619.3	1014.0
Britz Deavenport Five Points	81.8	49.7

[a] Concentrations are presented as aggregate geometric means.
[b] Sumner Peck is somewhat atypical in that values for selenium are the highest concentrations discovered to date within the entire San Joaquin Valley, and mean pond concentrations exceeded California State toxic waste criteria

Species Baselines

San Joaquin Kit Fox

All proposed facility sites (with the exception of Reuse Area A, B Part 2) are currently dominated by annual crops, and would provide kit foxes with occasional foraging habitat only. The reuse area of exception is dominated by water and wetlands, providing unsuitable habitat for kit fox.

One of the three core kit fox populations identified in *Recovery Plan for Upland Species of the San Joaquin Valley, California* is located west of the action area. The Ciervo-Panoche Natural Area of western Fresno and eastern San Benito Counties is located more than 160 kilometers

(100 miles) northwest of the other two core populations (Carrizo Plain, and western Kern County). Ciervo-Panoche has significant numbers of foxes, and large expanses of land are in public ownership. It has been estimated that the Ciervo-Panoche area contains 312 square kilometers of suitable habitat (slope < 10%) on public land, and over 600 square kilometers of suitable habitat in private ownership (Haight *et al.* 2002). The Ciervo-Panoche area also experiences a different environmental regime compared to the other two core populations. Preliminary metapopulation viability analyses indicate that recovery probabilities for the kit fox increase if a population is maintained in this area, apparently because of its different environmental regime (USFWS 1998). The configuration of these three core populations also allows for their connectivity by grazing lands. Kit foxes occur at varying densities in the areas between the core populations (e.g., Kettleman Hills), providing linkages between core populations, and also probably with smaller, more isolated populations in adjacent valleys. Satellite populations near the action area include populations in western Madera County, Santa Nella, and Pleasant Valley.

Value of Retired Agricultural Lands for Kit Foxes

The CVPIA Land Retirement Program Demonstration Project (LRP Demo Project) has retired (via fee title acquisition) just over 2,000 acres of land within the SLDFR project area. All of these lands are within Westlands Water district. The LRP Demo Project has monitored the effect of cessation of irrigation on the groundwater elevations below the retired lands and selenium in the plants and small rodents found on retired lands. Monitoring results have shown a significant drop in shallow groundwater table below the retired lands, and selenium concentrations in plants and small mammals that are below levels of concern (CVPIA Land Retirement Demo Project 2002 Annual Report).

An additional 34,100 acres (Sumner Peck) and 3,006 acres (Britz) are permanently retired in the SLDFR project area (all within Westlands) as part of a drainage settlement. The settlement included setting aside these lands by means of "non-irrigation" covenants that prevents any future irrigation with CVP water. The Westlands Water District has also retired about 65,000 acres of land (as part of the Sagouspe settlement) within the SLDFR project area that are assumed will be brought back into production when a drainage solution becomes available (SLDFR DEIS).

Most retired lands within the action area probably do not currently support kit fox populations. This assumption is based on the absence of reports of kit foxes from these areas (e.g., sightings, roadkills, etc.). The possible absence of kit foxes in these areas is likely a function of two main factors: lack of proximity to natural lands with existing fox populations and poor habitat conditions on the retired lands. However, kit fox surveys have not been conducted on the currently retired lands.

The closest known kit fox populations on natural lands probably are west of I-5 in saltbush scrub and grassland habitats. These populations are at least 5 miles from most retired lands. Although this distance is well within the dispersal potential of kit foxes, intensive agriculture on the intervening lands significantly inhibits the ability of kit foxes to disperse from the natural lands to the retired lands (Cypher 2006).

Habitat conditions on most retired agricultural lands are suboptimal for kit foxes for a variety of reasons:

1. On many parcels, dense growths of weedy species are present, such as mustards (e.g., *Brassica nigra*, *Sisymbrium irio*), five-hook bassia (*Bassia hyssopifolia*), and silverscale (*Atriplex argentea*). This dense growth hinders kit fox movements and their ability to detect predators, and also may preclude preferred prey (Culbertson 1946; Williams and Germano 1992; Warrick *et al.* in Cypher 2005). Kit foxes tend to avoid tall and/or dense cover (Smith *et al.* 2005), presumably because it makes it more difficult to locate prey and avoid predators. Optimal habitat for kit foxes consists of arid shrublands and grasslands, characterized by sandy or sandy loam soils, an open vegetative structure with little tall (> 18 inches) herbaceous vegetation, and the presence of kangaroo rats (Cypher 2006). Wetlands are not suitable habitat. Agricultural lands are of much lower value than arid shrublands and grasslands (Cypher 2006). Irrigation can flood and destroy dens and pesticide applications may be harmful to foxes. Annual crops are especially subject to disturbance by tilling, etc. and generally have a low prey base (except alfalfa). Orchards and vineyards have a more open structure and often have a layer of herbaceous vegetation that can support a prey base. Croplands do not support kangaroo rats (Culbertson 1946; Williams and Germano 1992). In general, agricultural lands are more often utilized by red foxes and dogs which may compete with or prey upon kit foxes. Without dens to escape predators, kit foxes may temporarily use agricultural lands for foraging but will not occupy them permanently (Warrick *et al.* in Cypher *et al.* 2005). Where more suitable habitat borders croplands, kit foxes may occasionally travel up to 1.5 km into the fields (Warrick *et al.* in Cypher *et al.* 2005).
2. Some of these lands also tend to have soil saturation problems as a function of their poor drainage, and this could result in seasonal flooding of fox dens, particularly in the winter and spring. This would make it difficult for foxes to establish cover, which is necessary for avoiding predators.
3. Depending upon how long lands have been retired, a sufficient prey base may not have established to support kit foxes. Colonization by prey species would depend upon habitat conditions and proximity to source populations, and could be further affected by rodenticide use on adjacent lands.
4. Finally, the size and juxtaposition of the retired parcels will affect establishment by kit foxes. Each kit fox family group requires about 1,200 acres, based on studies in optimal habitat. Space requirements could be even higher in suboptimal habitats. If lands are retired in a manner that results in isolated parcels lacking connectivity, kit foxes may have difficulty getting established.

Conservation Needs of San Joaquin Kit Fox in the Action Area

Kit fox core population and corridors. A potential core population of kit foxes has been identified in close proximity to the action area (USFWS 1998). This "Panoche Core Population" is generally located on lands west of I-5 in the Panoche Valley and suitable lands to the north and south, such as the Silver Creek Ranch and lands from Little Panoche Creek up to Route 152. Because of the amount of available optimal habitat (e.g., saltbush scrub, arid grasslands), this population is probably not as extensive as the Western Kern County and Carrizo Plain Core Populations. Thus, it is critical that connectivity be maintained between the Panoche Core Population and the 2 core populations further south. This necessitates that a viable corridor be maintained on remaining natural lands between I-5 and the foothills of the Coast Ranges (Map 9). The need to conserve this corridor in the vicinity of the study area is identified prominently in Tasks 5.3.4, 5.3.5, 5.3.6, and 5.3.7 in the Recovery Plan for Upland Species of the San Joaquin Valley, California (USFWS 1998).

Giant Garter Snake

The proposed project is located within the San Joaquin Basin snake sub-population, in the San Joaquin Valley Recovery Unit (USFWS 1999). Thirty-six California Natural Diversity Database (CNDDB 2005) records are known from the San Joaquin Basin. These records include Los Banos Creek, Agatha Canal, Mud Slough, Fresno Slough, Volta Wildlife Area, Mendota Wildlife Area, and other locations within the area.

The giant garter snake is rare in the San Joaquin Valley where it is believed to occur only at sites in the northern end of the valley. In 1980, it was determined that the snakes could no longer be found south of Fresno (Hansen and Brode 1980). The CDFG is currently conducting studies in the Los Banos Wildlife Complex and the Mendota Wildlife Area to better understand the status of giant garter snake in the San Joaquin Valley Recovery Unit (Dickert 2002, 2003). San Joaquin Valley subpopulations of giant garter snakes have suffered severe declines and possible extirpations over the last two decades. Prior to 1980, several areas within the San Joaquin Valley supported populations of giant garter snakes. Until recently, there were no post-1980 sightings from Stockton, San Joaquin County, southward, despite several survey efforts (G. Hansen, 1988), and surveys during 1986 of prior localities did not detect any giant garter snakes. During 1995 surveys of prior locality records and adjacent waterways, one road killed giant garter snake was found, and three presumed giant garter snakes were observed, but not captured (G. Hansen, 1996). Two sightings occurred at Mendota Wildlife Area, and two occurred several miles south of the town of Los Banos. These data indicated that giant garter snakes were still extant in two localities within the San Joaquin, but in extremely low to undetectable numbers.

Since 1995, however, surveys conducted by CDFG in cooperation with U.S. Geological Survey, Biological Resources Division, around Los Banos and the Volta Wildlife Area in the Grasslands, and Mendota Wildlife Area in the Mendota Area have detected snakes, but in numbers much lower than those found in Sacramento Valley sub-populations (Dickert 2002, 2003; Williams and Wunderlich 2003; Wylie 1998). The estimated total population size for the Volta Wildlife Area is 45 individuals, approximately only 5.6 snakes per square mile (3.5 snakes per square kilometer. Giant garter snakes have been found at Volta Wildlife Area in the Los Banos Wildlife Complex; however, giant garter snakes have not been found in the San Luis NWR (Williams and Wunderlich 2003). The estimated total population size for Volta is 45 individuals, approximately 5.6 snakes per mile (3.5 snakes per kilometer). The total Mendota catch was only 14 garter snakes in Fresno Slough. Five of the 14 snakes had lumps on their bodies suggestive of a parasitic nematode infection; further study is underway (Dickert 2002, 2003). Snakes neither as small nor large as those found in the Sacramento Valley were captured in the San Joaquin Basin. This may be due to the much smaller population size, or could reflect a true scarcity of these size classes in the northern San Joaquin Valley sub-populations. Such low snake numbers are illustrative of a tenuously small population, much smaller than found in Sacramento Valley. These results demonstrate that giant garter snakes are still extant in the northern San Joaquin Valley, but probably in extremely low numbers/densities. All sub-populations are isolated from each other with no protected dispersal corridors. Few opportunities for re-colonization of small sub-populations that may become extirpated exist, given the isolation from larger populations and lack of dispersal corridors between them.

Recent genetic work on giant garter snake population structure indicates three genetic management units within the species which correspond to the pattern of subdivision revealed by color pattern variants, north, central, and south (Paquin 2001). The southern proposed management unit, analogous to the San Joaquin Basin, was found to have very low snake numbers and severely degraded habitat (i.e., 60% of sites which supported giant garter snakes in the 1970s now have inadequate habitat). Paquin (2001) proposes that concordance of the genetic data showing isolation of southern populations and their unique color pattern should afford giant garter snake populations in the southern extent of their range greater protection.

Los Banos Creek, Agatha Canal, Mud Slough, Fresno Slough, Volta Wildlife Area, and Mendota Wildlife Area are important as snake habitat and movement corridors for the animal. The recovery strategy for the snake includes maintenance and/or creation of habitat corridors between existing sub-populations to enhance population interchange and offset threats to the species (USFWS 1999). Much of the land use within the SLU is dominated by agriculture and is not suitable for the giant garter snake. Establishment of non-native predators, such as the bullfrog (*Rana catesbiana*), human alteration of water regimes, and outright habitat destruction such as wetland draining, as well as stream channelization, have reduced giant garter snake populations (Wylie Casazza & Carpenter 2003). Water pollution in the form of agricultural runoff and drift from aerial application of pesticides and herbicides as well as subsurface agricultural draining, which carries toxic loads of selenium, may also affect snake sub-populations adjacent to the SLU (USFWS 1999). The scarcity of remaining suitable habitat, flooding, stochastic processes, and continued threats of habitat loss pose a severe and imminent threat to snakes in the San Joaquin Basin.

The 1995 report on the status of giant garter snakes in the San Joaquin Valley (G. Hansen, 1996) indicates that Central San Joaquin Valley giant garter snake numbers appear to have declined even more dramatically than has the amount of apparently available habitat. Factors in addition to habitat loss may be contributing to the decline. These are factors which affect giant garter snakes within suitable habitat and include interrupted water supply, poor water quality, and contaminants (G. Hansen, 1996). Selenium contamination and impaired water quality have been identified as a threat to the species and a contributing factor in the decline of giant garter snake populations, particularly for the North and South Grasslands subpopulation (i.e., Kesterson National Wildlife Refuge area) (USFWS 1993b). High levels of selenium contamination have been documented in biota from at least six major canals and water courses in the GBP (Saiki *et al.* 1991, 1992) that have historic giant garter snake records. The bioaccumulative food chain threat of selenium contamination on fish, frogs, and fish-eating birds (Ohlendorf *et al.* 1986, 1988; Saiki and Lowe 1987; Saiki and May 1988; Hothem and Ohlendorf 1989; and Saiki *et al.* 1991, 1992, 1993) in this region has been well documented.

Contaminant studies on aquatic organisms and their habitats in the GBP and neighboring areas documented elevated levels of waterborne selenium in many representative water bodies in this region (San Joaquin Valley Drainage Program 1990, Central Valley Regional Water Quality Control Board 1992, Nakamoto and Hassler 1992), at concentrations in excess of known toxicity thresholds of giant garter snake prey species (Hermanutz 1992, Hermanutz *et al.* 1992, Nakamoto and Hassler 1992). Though there are little data specifically addressing the toxicity of selenium, mercury, or metals to reptiles, it is expected that reptiles would have toxicity thresholds similar to those of fish and birds (USFWS 1993b).

Construction of the initial phases of the GBP in 2002 and the resulting reductions in selenium loading to downslope wetland water supply channels in the South Grasslands area are believed to have improved giant garter snake habitat. At the same time, operation of the GBP has permitted the discharge of selenium-contaminated drainwater from Grasslands' area farmers into Mud Slough, a perennial stream that supports marginal and potential giant garter snake habitat. Here, selenium concentrations in small fish, a prey species of the giant garter snake, frequently reach 10-15 μg/g (Beckon *et al.* 2003). Current GBP operating agreements will expire in December 2009, potentially terminating the beneficial effects of decreased selenium loading in downslope wetlands and the potentially adverse effects of discharging selenium-contaminated water into Mud Slough. Implementation of the proposed action will expand upon the current GBP facilities and replace the current Mud Slough disposal of drainwater with disposal into the proposed Northerly Area evaporation basin. In addition, selenium loading in the DMC (and downstream at Mendota Pool on the San Joaquin River) will decrease as a result of the interception of lateral seepage from the South Grasslands area following construction of the Firebaugh Sumps, a component of the proposed action, collection system.

Conservation Needs of Giant Garter Snake in the Action Area

Decline of giant garter snakes in the action area is due principally to loss and degradation of both aquatic and upland habitat. Conservation measures, therefore, should protect and secure habitat in the Grasslands, Mendota and Burrel/Lanare areas. These measures are listed as priority task one in the revised draft Giant Garter Snake Recovery Plan (1999b). Additional priority task one measures include the development and implementation of management plans, acquisition of water rights for restoration of aquatic habitat, and studies to determine the effects of selenium to the species. Conservation easements in the Grasslands should be re-negotiated to include suitable management of lands to increase population numbers and to broaden distribution. Corridors, primarily aquatic corridors, should either be re-established and/or protected such that suitable habitat may be recolonized throughout the action area. Re-connecting the habitats occupied by the various sub-populations would also allow for an exchange of genetic material as the populations began to interbreed.

California Least Tern

As reported in the 1985 Recovery Plan (USFWS 1985a), the California least tern nest in colonies along the Pacific coast, extending from San Diego to the San Francisco Bay. At that time, there was no discussion of terns occurring away from the 20 breeding colonies along the coast. However, in the California Least Tern Breeding Survey, 1998 Season, Keane (DFG 1999a) reported that there were 28 locations that reported successfully producing fledglings, and all but 2 were located along the coast. The two non-coastal nesting sites are located at a PGE power plant at Pittsburgh in the western Sacramento-San Joaquin Delta and at Kettleman City in the San Joaquin Valley at the southern boundary of Westlands Water District. There was one nest reported from the dry beds of the terminal cells of evaporation basins at the Kettleman City location that produced one fledgling from two eggs in 1998 (DFG 1999a).

A few least terns have also been observed foraging at the sewage ponds at Lemoore Naval Air Station (LNAS) in 1997 and 1998 but no nesting has been documented there (J. Seay, pers. comm. to S. McDonald; 2006). Lemoore NAS is contained within the eastern portion of Westlands Water District. The birds at both LNAS and Kettleman City arrive on site in June or July (J. Seay, pers. comm.; 2006) and are either "second wave" nesters which are first time breeders (2-year old birds) or birds that have nested at a coastal site (either successfully or unsuccessfully) as a "first wave" breeder (DFG 1999a). There is no definitive information that links the Central Valley least terns to any of the coastal colonies, so they may be refugees from a coastal colony or a pair of young birds that got lost on their way to the breeding grounds.

For nesting, California least terns require areas that have relatively flat, open, sandy beaches, in proximity to foraging habitat, and have relative seclusion from disturbance and predation. California least terns have been known to nest on artificial surfaces, such as airfields, landfills, and vacant parking lots. If no sand is available in their nesting location, the birds will select a natural depression in the ground, such as a boot or tire depression in dried mud. After the eggs are laid, the nest is sometimes lined with shell fragments and small pebbles. Eggs are incubated primarily by the female for 20 to 25 days.

During the nesting season, coastal California least terns feed on small fish captured either in ponds, bays and estuaries, or immediately offshore. Prey items include northern anchovy (*Engraulis mordax*), topsmelt (*Atherinops affinis*), California grunion (*Leuresthes tenuis*), and killifish (*Fundulus parvipinnis*). Typically, in these two Central Valley locations, the species forages on inland silversides (*Menidia beryllina*) or *Gambusia*, which was introduced into one of the evaporation ponds near Kettleman City; the *Gambusia* could only persist in the cells with the deepest, least saline water (J. Seay, pers. comm.; 2006). Least terns hover over standing or flowing water and dive to capture fish. They also may catch aquatic macroinvertebrates. The diet of the California least tern is known to consist mostly of small fish (Tomkins 1959; Atwood and Kelly 1984) and this appears to be true of least terns in the Tulare Basin (J. Seay, pers. comm.; 2006) In some locations, other least terns are known to forage heavily on invertebrates, including shrimp and ants in South Carolina (Thompson *et al.* 1997) and flying insects (nesting birds in Texas) (McDaniel and McDaniel 1963). Both the male and female select a suitable site to begin scraping their nest if it is located on sand.

Conservation Needs of California least tern in the Action Area

There are no conservation recommendations in the Revised Recovery Plan (USFWS 1985a) for California least terns in the Central Valley. To assure that least terns foraging or nesting in the action area are not adversely affected by any of the proposed alternatives, the Bureau needs to work with the local mosquito abatement districts to minimize the use of *Gambusia* spp. in the evaporation ponds and to cap the evaporation ponds if they are going to dry during the nesting season.

Related Reclamation Actions

Central Valley Project Improvement Act Programmatic Biological Opinion Commitments. The CVPIA Project Description listed eight significant areas of commitment that provided the basis of the PBO no jeopardy finding (Pages 2-50 to 2-71). One of the eight areas was Commitments Associated with Drainage. We consider these commitments to be relevant to the proposed action because the drainage problems which the Project is addressing are a result of continued operations of the CVP.

The drainage commitments of the CVPIA PBO primarily address compliance with the biological opinion on the California Toxics Rule (Service File No. 1-1-98-F-0021) and water quality standards to ensure that continued operations of the CVP under the CVPIA do not impact the recovery of listed species such as the delta smelt and giant garter snake that depend on waterways in to which contaminated drainage is discharged or conveyed, or in receiving water bodies such as the Delta. Additional commitments of the CVPIA PBO applicable to the proposed action include those to ensure compliance with the Endangered Species Act (p. 2-69), in particular, "*Consistent with their respective authorities and obligations concerning the effective and efficient operation of the CVP and implementation of the CVPIA, the Service and Reclamation will utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species as provided in Section 7(a)(1) of ESA;*"

and

"*Discretionary programs under authority of Section 7(a)(1) have been, or will be, developed by the Service and Reclamation in consultation with the Service and implemented to conserve listed species and address impacts resulting from past and continuing actions related to the operation and maintenance of the CVP and implementation of the CVPIA. The programs implemented pursuant to the CVPIA are intended to provide mitigation for past CVP effects on all fish, wildlife, and associated habitats, including listed species and designated critical habitat;*"

The Conservation Measures included in the **Description of the Proposed Action** are consistent with these provisions of the CVPIA PBO.

Central Valley Project Operations Criteria and Plan. The OCAP describes the coordinated operation of the CVP and State Water Project by Reclamation and the California Department of Water Resources. On July 30, 2004, the Service issued biological opinion 1-1-04-F-0140, which addressed the effects of operating the CVP/SWP and delivering CVP water for renewing water contracts and other actions on the threatened delta smelt (*Hypomesus transpacificus*). On February 15, 2005, the Service issued biological opinion 1-1-05-F-0055 in response to Reclamation's November 3, 2004, request for reinitiation of formal consultation on the OCAP to address potential critical habitat issues and effects of the OCAP on delta smelt (USFWS 2005a).

The OCAP consultation analyzed the effects of numerous new actions on the delta smelt and its designated critical habitat, including storage of CVP and SWP water in reservoirs, water releases from reservoirs, river operations, operation of the Federal/State diversion facilities, and the CVP/SWP export-pumping operations in and through the Delta. The OCAP consultation addressed the operation of the CVP/SWP in the Sacramento Valley, and included all commitments of the SWP and CVP, such as meeting requirements of the CVPIA PBO (USFWS 2000), the obligations contained in the Central Valley Water Quality Control Board water right permits, obligations of CVP water service contracts, Sacramento River Settlement contracts, San Joaquin exchange contracts, and other requirements. Therefore, the OCAP BO addressed all the aquatic effects of operating the CVP/SWP.

Central Valley Project Long-term Water Service Contract Renewals. Reclamation either has, or intends to renew about 119 CVP Water Service contracts throughout the Central Valley. All of the renewing CVP contracts are required by the *Biological Opinion on Implementation of the*

CVPIA (Central Valley Project Improvement Plan) and Continued Operation and Maintenance of the CVP (CVPIA PBO) to incorporate provisions needed to comply with applicable law, including provisions of the CVPIA. Renewal contracts will incorporate applicable provisions of the CVPIA, including payment into the CVP Restoration Fund.

The CVP water service contracts include an annual maximum quantity of approximately 5.6 million acre feet per year of CVP water and provide water service to approximately 3.2 million irrigable acres of land and an urban population in excess of 4.3 million people. The long term water contracts renewals, while authorizing a maximum contract amount, recognize that the delivery of the entire contract amount is subject to the availability of water and other CVP obligations.

For efficiency, Reclamation has grouped the CVP water-service contract renewal environmental-documents by similar regional issues. To date, the Service has completed consultation on long term renewal of approximately 98 CVP water service contracts and 139 settlement contracts for Sacramento River contractors, and interim renewal of 18 additional CVP water service contracts (including some unexecuted contracts which have undergone section 7 review for long term renewal, i.e., the Cross Valley contracts).

Operation and Maintenance of Central Valley Project Water Conveyance. The CVPIA programmatic biological opinion (CVPIA PBO) anticipated that it may be desirable to cover some operations and maintenance (O&M) activities under long term contract renewal biological opinions (page 2-46). Pursuant to pages 2-46 to 2-49 of the CVPIA PBO and requirements of the biological opinions for CVP Interim Water-Service Renewal Contracts (1995, 1998, 2000, 2002), Reclamation has prepared regional O&M plans to describe the general and routine maintenance and operational procedures Reclamation conducts on their CVP facilities throughout California. Because Reclamation aggregated information at different geographic scales and levels of specificity for long term contracts and facility operation and maintenance, the Service determined it was necessary to conduct separate, but concurrent, consultation on operation and maintenance to meet Reclamation's target dates for long term contract renewal. On February 9, 2005 SFWO issued a biological opinion covering the O&M of the Federal features in the American River Division. The service has also completed consultation on the O&M plans for the Northern California Area Office, the Central California Area Office, and the South Central California Area Office, which includes the *Operations and Maintenance Guidelines*, *Integrated Pest Management Plans*, and Reclamation's *Listed Species Manual*. Those consultations analyzed effects of operation and maintenance of the CVP facilities associated with contract renewals, other than those effects analyzed in the OCAP biological opinion. The Service issued the biological opinion for the CCAO on February 9, 2005 (Service file number 1-1-05-F-0038), the biological opinion for the NCAO on February 14, 2005 (Service file number 1-1-05-F-0057) and the biological opinion for the SCCAO on February 17, 2005 (Service file number 1-1-05-F-0368).

M&I Shortage Policy: Reclamation has finalized a revised Municipal and Industrial (M&I) Water Shortage Policy for the CVP (October 2005). The purposes of the policy are to: (1) define water shortage terms and conditions applicable to all CVP M&I contractors, as appropriate; (2) establish CVP water supply levels that, together with the M&I contractors' drought water conservation measures and other water supplies, (a) would sustain urban areas during droughts, and (b) during severe or continuing droughts would assist the M&I contractors in their efforts to protect public health and safety; and (3) provide information to M&I contractors for development of drought contingency plans. The Policy identifies an increased quantity of CVP supply given M&I reliability. The effects include reduced availability and increased cost for environmental water supplies including level 4 refuge water supplies.

Federal Projects that May Affect Surface Water Quality in the SLDFR Project Area

Mendota Pool Agreement and Meyers Groundwater Banking Project

The need for the proposed Mendota Pool Group Exchange Agreement and Meyers Groundwater Banking Project is to facilitate improvements in the reliability of irrigation water delivery to the San Luis Canal (SLC) [at Check 13 on the DMC] for specified lands within Westlands Water District and San Luis Water District in western Fresno County without affecting CVP water deliveries at Mendota Pool. These projects exchange CVP contract supply with groundwater pumped into the Mendota Pool from adjacent wells to the Pool. Effects to surface waters include increasing TDS in the Mendota Pool, a source of water for wetlands in the area. Further, the primary adverse effect of the Mendota Pool Exchange Agreement is to increase the cumulative rate of groundwater degradation in wells west of the Pool. These wells are primarily MPG wells.

San Joaquin Exchange Contractor 10-Year Transfer Program

In 2005, Reclamation finalized an EIS/EIR on the San Joaquin Exchange Contractors' 10-year Transfer Program (SJEC EIS/EIR; USBR 2004). This program allows for the transfer of up to 130,000 ac-ft/year of substitute water annually to several potential agricultural, municipal and wetland users for a period of 10 years. The preferred alternative would develop up to 130,000 acre feet of water during non-critical years, with up to 80,000 acre feet of water made available through conservation (including tailwater recovery) and groundwater (up to 20,000 acre feet) and up to 50,000 acre feet of water made available through crop idling/temporary land fallowing. During critical years, up to 50,000 acre feet of water may be made available through crop fallowing, and no water is to be made available from conservation/tailwater recovery and groundwater resources.

Modeling of the effects of the preferred alternative in the SJEC EIS/EIR estimated up to a 47% flow reduction in Mud and Salt Sloughs during the late spring and dry and below normal water years. The largest reductions in flow would occur during April (36 percent) and May (47 percent) as shown in Table 6-5 of that document. Reclamation determined that the flow reduction would not have a significant effect on the extent or quality of the aquatic or upland habitats in Mud and Salt Sloughs because the flow reductions were in the normal range of fluctuation that occurs during normal and dry/below normal years. The Final SJEC EIS/EIR did not, however, compare the frequency of such flow reductions between the "with project" and "without project" conditions. The effect of reduced flows in Mud and Salt Slough on selenium concentrations in these channels was likewise not analyzed (S. Leach, pers. comm.; March 6, 2006). It is reasonable to expect that a reduction of flow in these channels combined with continued selenium inputs from outside the SLDFR Project area (see *Managed Wetlands* write up on Grassland wetland supply channels on page 46) could result in higher selenium concentrations and potentially a greater frequency of occurrence of water quality objective exceedences in these channels.

Modeling of the effect of the preferred alternative in the SJEC EIS/EIR also indicated reduction in flows in the San Joaquin River at Vernalis. These reductions were shown to vary from 0 to 11 percent. During the late spring out-migration period for anadromous fish, flows would be reduced by 3 to 8 percent (Table 4-44 of the SJEC EIS/EIR). Summer flow reductions would be as high as 11 percent in July. Smaller (2 percent) reductions were predicted in the fall when salmonids begin to migrate upstream in the San Joaquin River. Reclamation determined these reductions in flow did not have a significant effect on the flow or water quality in the San Joaquin River because flow reductions were still within the range of inter-annual variations in monthly river flow as shown in Table 4-1 of that document.

Effects of the Proposed Action

The analyses of this Biological Opinion are based on the following assumptions. These assumptions have been developed in consultation with Reclamation. In some cases, these assumptions are not yet supported by full pilot testing and field verification of some Project elements. To the extent that actual project operations do not conform to these assumptions, the effects of Project operation may differ from this analysis, and the amount of incidental take anticipated may change as well. Based on Reclamation's project description, we expect that these assumptions will be calibrated by real time monitoring of project operations. New information that indicates the amount or extent of incidental take is exceeded; or which reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, may require reinitiation of consultation (see **Reinitiation – Closing Statement**).

SLDFR ESA Consultation Assumptions:

1. Facilities (including treatment and evaporation ponds) will be designed to withstand a 100 year flood.
2. As the amount of retired land increases up to 192,000 acres, the entire amount of CVP water that can be delivered (assuming an average of 70% reliability for the analysis) can still be beneficially used on the existing croplands that would remain in production.

3. Continued use of the safe groundwater yield of 175,000 acre-feet of groundwater per year.
4. Reuse areas will not pond applied drainage water. Any ponding on the reuse areas that may occur due to intense storm events will not persist more than a few days beyond the event. Ponding from these two sources is prevented or minimized by the following: the application rate of the drainage water, the infiltration rate of the soil, and the tile drains to be installed beneath the reuse areas.
5. Evaporation ponds will be designed to minimize shallow water habitat by including near vertical (¼:1) internal sides and by maintaining the water level at 4 feet except when operational requirements necessitate the draining and decommissioning of cells. Water level will be at least 2 feet below the retaining wall crest during normal operations. The outer retaining walls will be at 3:1.
6. Under future conditions with the project, selenium levels at Crows Landing are expected to remain below 2 ppb; salt and boron levels at Vernalis are expected to be reduced by 7 and 17%, respectively. Each of these is expected to be significant improvements over existing conditions.
7. During high flood events flows are expected to exceed the capacity of project facilities and discharge through wetlands sloughs and channels as they currently and historically have done.
8. Siting of SLDFR project facilities (except for mitigation ponds) will occur within polygons identified on the maps prepared by Reclamation's Denver Service Center and transmitted to the Service's SFWO in December 2005 and February 2006. Some of these maps were used by the SLDFR Mitigation Workgroup. Reclamation has noted that these maps are not yet final. General locations of reuse areas, treatment facilities, and evaporation ponds have been established, but within those general locations facilities can be placed (with some engineering constraints) to minimize effects to listed species. Mitigation pond siting has yet to be determined.
9. Standard avoidance and minimization measures will be implemented for the San Joaquin kit fox and giant garter snake during construction of facilities.
10. The effluent stream from the biological selenium treatment facilities will be oxidized to reduce bioavailability as much as possible before it is discharged to the evaporation basins.
11. Selenium concentrations in effluent (water flowing into evaporation ponds) will not exceed 10 ppb total selenium on average.
12. The irrigable lands within the San Luis Unit are fully developed. Except for annual fluctuations in fallowed ground, either for crop rotation purposes, because of constrained supplies, or otherwise, the total farmed acreage remains constant.
13. USBR and the water districts will work with the local mosquito abatement districts to minimize the use of Gambusia in the evaporation basins.
14. Evaporation basins will include escape points to allow egress if any species falls in.

15. Any land retirement program undertaken as part of the SLDFR will have explicit objectives to further listed species recovery consistent with meeting drainage related goals.
16. Lands retired will be dryland farmed, grazed, or fallowed, in roughly equal proportions (about ⅓ each). Fallowed lands will be disced twice annually.
17. The mitigation ponds under consideration for effects to migratory birds may have effects to listed species habitat, but are not included in this consultation. The mitigation ponds will be subject to separate section 7 consultation prior to implementation.
18. To minimize the risk of selenium bioaccumulation in the reuse areas the areas will be planted with species designed to reduce the risk of use by San Joaquin kit foxes.
19. Rehabilitation and use of the San Luis Drain is not being considered.
20. A provision in Westlands Water District's water services contract with Reclamation states that in the event the Secretary of the Department of the Interior implements a land retirement program to address drainage in the San Luis Unit, then a new Water Needs Assessment (WNA) would be completed after each quarter of the overall retirement program has been implemented. The results of each new WNA would be evaluated to determine if a reduction in Westlands' total water contract quantity is warranted. Under the contract provision, lands retired through the CVPIA Land Retirement Program and the Britz Settlement would not be considered a part of the land retirement program for purposes of triggering a new WNA, but would be considered in any new WNA's.

Effects of the Action on Listed Species

San Joaquin Kit Fox

Given the current proximity of known kit fox occurrences relative to the action area, the size of kit fox home territories (including the typical extent of nightly foraging movements), and the dispersal range of juvenile kit foxes, it is likely that kit fox foraging and dispersal activities could extend into and through areas to be used as retired lands, conveyance/collection systems, reuse areas, reverse osmosis and biotreatment sites, and evaporation basins. Kit fox dens, although not commonly found in the intensively managed agricultural areas where major construction activity would occur, may currently exist at low densities in these areas. Kit foxes may also attempt to recolonize lands that are retired through implementation of the Project.

The potential adverse effects on the San Joaquin kit fox from all the various Project features include: both temporary and permanent loss of kit fox foraging and denning habitat; disturbance from construction-related activities; disturbance and/or direct injury resulting from the destruction of natal dens when occupied fields within retired lands are disced or ripped; and toxicosis from consuming selenium-contaminated prey in reuse areas. In addition to these adverse effects, there is also the potential for beneficial effects resulting from retired lands being placed under grazing management, and even greater potential for benefit to kit foxes from implementation of strategic land retirement in tandem with directed management of such lands to maximize conditions for kit fox colonization, survival and reproduction. All potential effects, both adverse and beneficial, are described by Project components below, as well as determinations wherein a Project component is neutral with regard to effects.

Retired Lands

Land retirement is a component of all four SLDFR In-Valley alternatives. The total acreage proposed for retirement under each alternative is: 44,106 acres (In-Valley Disposal Alternative, which represents no change from existing conditions), 92,592 acres (In-Valley Ground Water Quality Land Retirement Alternative), 193,956 acres (In-Valley/Water Needs Land Retirement), and 308,000 acres (In-Valley/Drainage Impaired Area Land Retirement). Retired lands that will not be used for project purposes (*e.g.*, reuse areas, evaporation basins, etc.) would be grazed, fallowed, or dryland farmed. Based on estimates from the Westlands Water District, it is assumed that lands will be retired for these three purposes in roughly equal proportions (*i.e.*, 1/3 each). Analyzing the potential effects to the San Joaquin kit fox from the Retired Land component of the Project requires an understanding of the current regional condition and conservation needs of the species. Much of the following information comes from a report by Brian Cypher (Cypher 2006), except where indicated.

Regional Conservation Need: A potential core population of kit foxes has been identified in close proximity to the Project area (USFWS 1998). This "Panoche Core Population" is generally located on lands west of I-5 in the Panoche Valley and suitable lands to the north and south, such as the Silver Creek Ranch and lands from Little Panoche Creek up to Route 152. Because of the limited amount of available optimal habitat (e.g., saltbush scrub, arid grasslands), this population is probably not as extensive as the two other core populations (*i.e.*, Western Kern County and Carrizo Plain) to the south. Thus, it is critical that connectivity be maintained between the Panoche Core Population and the two southern core populations. This necessitates that a viable corridor be maintained on remaining natural lands between I-5 and the foothills of the Coast Ranges. The need to conserve this corridor in the vicinity of the study area is identified prominently in Tasks 5.3.4, 5.3.5, 5.3.6, and 5.3.7 in the Recovery Plan for Upland Species of the San Joaquin Valley, California (USFWS 1998).

A significant concern is that continuing agricultural and suburban development between these core populations potentially threatens to obstruct this corridor. In some locations, this corridor already has been reduced to < 0.5 miles in width. This is particularly true in the areas where the Little Panoche Creek, Panoche Creek, and Cantua Creek intersect I-5. Conversion of some of these croplands to permanent crops such as orchards may improve permeability somewhat for kit foxes, but also increases the likelihood that these lands will stay in agricultural production.

Conservation Strategy with Retired Lands: The potential for retired lands to benefit the kit fox is dependent on a number of variables, including the location, size, and management of the lands.