FOR CONTRACT NO.: 06-442524

INFORMATION HANDOUT

CALIFORNIA DEPARTMENT OF FISH AND GAME

UNITED STATES FISH AND WILDLIFE SERVICE
(Biological Opinion and Amended Biological Opinion)

REVISED FOUNDATION RECOMMENDATION
(Bridge No. 50-0506 R/L, dated Feb 8, 2010)

FOUNDATION REVIEW
(Bridge No. 50-0506 R/L, dated July 13, 2009)

FINAL HYDRAULIC REPORT
(Bridge No. 50-0506 R/L, dated Feb 9, 2010)

REVISED SEISMIC DESIGN RECOMMENDATIONS
(Bridge No. 50-0506 R/L, dated Feb 8, 2010)

POTENTIAL IMPORTED BORROW MATERIAL AOURCES.

ROUTE: 06-Ker-46-6.8/19.8

AGREEMENT

California Fish and Game Code Section 1602
Stream Alteration Agreement No. 2009-0176-R4
California Department of Transportation
Franciscan and Bitterwater Creeks - Kern County
KER 46 PM 6.8-19.8 EA 06-442521

Parties:

California Department of Fish and Game
Central Region
1234 East Shaw Avenue
Fresno, California 93710

California Department of Transportation
Tamra Nunes
2015 East Shields Avenue, Suite 100
Fresno, California 93728

WHEREAS:

1. Ms. Tamra Nunes, representing the California Department of Transportation (referred to as "Caltrans") on October 22, 2009, notified ("Notification" No. 2009-0176-R4) the Department of Fish and Game ("Department") of their intent to divert or obstruct the natural flow of, or change the bed or banks of, or use materials from Franciscan and Bitterwater Creeks in Kern County, waters over which the Department asserts jurisdiction pursuant to Division 2, Chapter 6 of the California Fish and Game Code.

2. Caltrans may not commence any activity that is subject to Fish and Game Code Sections 1600 et seq. until the Department has found that such Project shall not substantially adversely affect an existing fish or wildlife resource or until the Department's proposals, or the decisions of a panel of arbitrators, have been incorporated into such projects.

3. Fish and Game Code Sections 1600 et seq. make provisions for the negotiation of agreements regarding the delineation and definition of appropriate activities, Project modifications and/or specific measures necessary to protect fish and wildlife resources.

4. The Department has determined that without the protective features identified in this Agreement, the activities proposed in the Notification could substantially adversely affect fish and wildlife.

NOW THEREFORE, IT IS AGREED THAT:

1. The receipt of this document ("Agreement"), by Caltrans, satisfies the Department's requirement to notify Caltrans of the existence of an existing fish and wildlife resource that may be substantially adversely affected by the Project that is described in the Notification.

2. The contents of this Agreement constitute the Department's proposals as to measures necessary to protect fish and wildlife resources, and satisfy the Department's requirement to submit these proposals to Caltrans.

3. The signature of Caltrans' representative on this Agreement constitutes Caltrans' commitment to incorporate the Department's proposals into the Project that is described in the Notification.

4. This Agreement does not exempt Caltrans from complying with all other applicable local, State and Federal law, or other legal obligations.

5. This Agreement, alone, does not constitute or imply the approval or endorsement of a Project, or of specific Project features, by the Department, beyond the Department's limited scope of responsibility, established by Code Sections 1600 et seq. This Agreement does not therefore assure concurrence, by the Department, with the issuance of permits from this or any other agency. Independent review and recommendations shall be provided by the Department as appropriate on those projects where local, State or Federal permits or environmental reports are required.

6. This Agreement does not authorize the "take" (defined in Fish and Game Code Section 86 as hunt, pursue, catch, capture, kill; or attempt to hunt, pursue, catch, capture, or kill) of State-listed threatened or endangered species. If the Operator, in the performance of the agreed work, discovers the presence of a listed species in the Project work area, work shall stop immediately. Caltrans shall not resume activities authorized by this Agreement until such time as valid "take" permits are obtained from the Department pursuant to Fish and Game Code Sections 2081(a) and 2081(b) as appropriate. Incidental Take Permit 2081-2008-006-04 has been obtained for the parent Project, the Route 46 Expressway Project.

7. To the extent that the Provisions of this Agreement provide for the diversion of water, they are agreed to with the understanding that Caltrans possesses the legal right to so divert such water.

8. To the extent that the Provisions of this Agreement provide for activities that require Caltrans to trespass on another owner's property, they are agreed to with the understanding that Caltrans possesses the legal right to so trespass.

9. To the extent that the Provisions of this Agreement provide for activities that are subject to the authority of other public agencies, said activities are agreed to with the understanding that all appropriate permits and authorizations shall be obtained prior to commencing agreed activities.

10. All Provisions of this Agreement remain in force throughout the term of the Agreement. Any Provision of the Agreement may be amended at any time, provided such amendment is agreed to in writing by both parties. Mutually approved amendments become part of the original Agreement and are subject to all previously negotiated Provisions. The Agreement may be terminated by either party, subject to 30 days written notification.

11. Caltrans shall provide a copy of the Agreement to the Project supervisors and all contractors and subcontractors. Copies of the Agreement shall be available at work sites during all periods of active work and shall be presented to Department personnel upon demand.

12. Caltrans agrees to provide the Department access to the Project site at any time to ensure compliance with the terms, conditions, and Provisions of this Agreement.

13. Caltrans and any contractor or subcontractor, working on activities covered by this Agreement, are jointly and separately liable for compliance with the Provisions of this Agreement. Any violation of the Provisions of this Agreement is cause to stop all work immediately until the problem is reconciled. Failure to comply with the Provisions and requirements of this Agreement may result in prosecution.

14. Caltrans assumes responsibility for the restoration of any fish and wildlife habitat which may be impaired or damaged either directly or, incidental to the Project, as a result of failure to properly implement or complete the mitigation features of this Agreement, or from activities which were not included in Caltrans' Notification.

15. It is understood that the Department enters into this Agreement for purposes of establishing protective features for fish and wildlife, in the event that a Project is implemented. The decision to proceed with the Project is the sole responsibility of Caltrans, and is not required by this Agreement. It is agreed that all liability and/or incurred costs, related to or arising out of Caltrans' Project and the fish and wildlife protective conditions of this Agreement, remain the sole responsibility of Caltrans. Caltrans agrees to hold harmless and defend the Department of Fish and Game against any related claim made by any party or parties for personal injury or other damage.

16. The terms, conditions, and Provisions contained herein constitute the limit of activities agreed to and resolved by this Agreement. The signing of this Agreement does not imply that Caltrans is precluded from doing other activities at the site. However, activities not specifically agreed to and resolved by this Agreement are subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq.

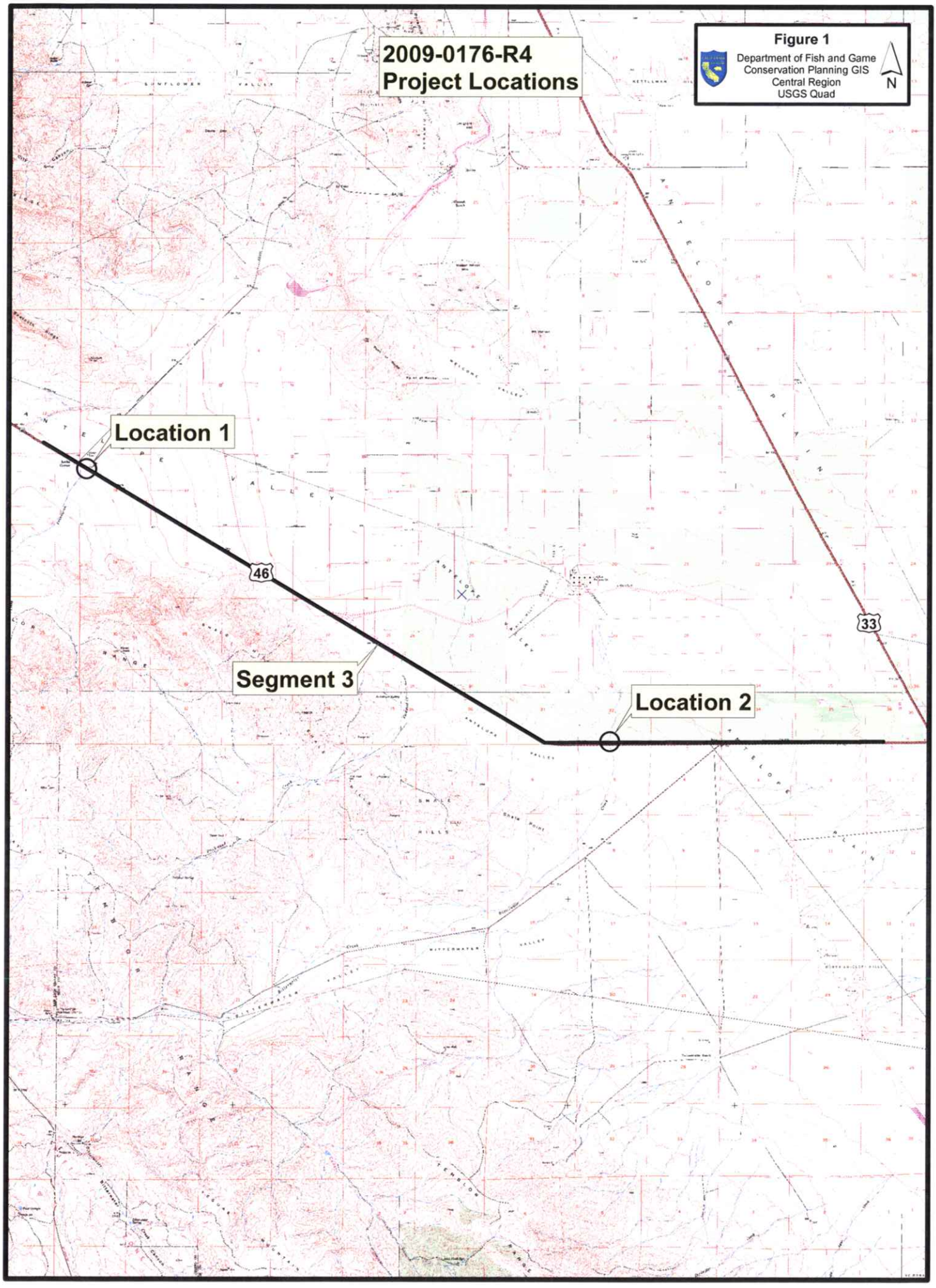
California Environmental Quality Act (CEQA) Compliance: In approving this Agreement, the Department is independently required to assess the applicability of CEQA. The features of this Agreement shall be considered as part of the overall Project description. Caltrans' concurrence signature on this Agreement serves as confirmation to the Department that the activities that shall be conducted under the terms of this Agreement are consistent with the Project described in Notification No. 2009-0176-R4. Caltrans submitted a Negative Declaration May 12, 2005, State Clearinghouse No. 2003041036, for the parent Project the State Route (SR) 46 Expressway, then referred to as the 4-Lane Widening or Expansion Project. A copy of the Notice of Determination for the Project was provided with the Section 1602 Notification. The Department, as a CEQA Responsible Agency, shall make findings and submit a Notice of Determination to the State Clearinghouse upon signing this Agreement.

This Agreement contains a Monitoring and Reporting Program (MRP), to incorporate monitoring and reporting requirements for the activities authorized in this Agreement.

Project Location: The work authorized by this Agreement will occur at two (2) locations along SR 46 between Keck's Corner and SR 33 within the Project limits of the third Segment of the SR 46 Expressway from PM 6.8 to 19.8, approximately 14 miles west of the City of Lost Hills. Location 1 is at Franciscan Creek in Township 26 South, Range 18 East, Section 18; and Location 2 is at Bitterwater Creek in Township 27 South, Range 19 East, Section 5, in Kern County (**Figure 1**).

Project Description: Caltrans' Notification includes Fish and Game Notification Form FG2023 and construction plans. The Notification comprises Caltrans' Project description, and it is used as the basis for establishing the protective Provisions that are included in this Agreement. Any changes or additions to the Project, as described in the Notification, shall require additional consultation and protective Provisions. The Department's concurrence with Caltrans' CEQA Determination is based upon Caltrans' commitment to full implementation of the Provisions of this Agreement. Caltrans has proposed the following scope of work. The bulleted items comprise the activities authorized by this Agreement.

- Location 1 – The existing box culvert at Franciscan Creek will be removed and replaced with a larger (12 foot by 10 foot) box culvert that will span the width of the new four-lane expressway. The channel will be realigned at the new culvert entrance and exit. Realignment will require approximately 283 cubic yards (cy) of excavation and 260 cy of fill material. Rock Slope Protection (RSP) will be added to the exit and the drop inlet at the entrance will be paved with concrete. The new box culvert will be large enough to serve as a wildlife crossing corridor.


2009-0176-R4
Project Locations
Figure 1
Department of Fish and Game
Conservation Planning GIS
Central Region
USGS Quad
N
Location 1
46
33
Segment 3
Location 2

- Location 2 – The existing box culvert at Bitterwater Creek will be removed and replaced with two (2) new span bridges. Drainage inlets will be added to drain the median and equalize the ditches on both sides of SR 46. The northern bridge will require approximately 360 cy of excavation and 550 cy of fill; the southern bridge will require approximately 685 cy of excavation and 560 cy of fill. RSP will be added at the ends of the new drainage culverts.

- No water will be diverted or drafted during the proposed Project activities. A total of 3,790 square yards of RSP will be used for the entire Project.

Plant and Animal Species of Concern: This Agreement is intended to avoid, minimize, and mitigate adverse impacts to the fish and wildlife resources that occupy the area of Franciscan and Bitterwater Creeks, and the immediate adjacent riparian habitat. The protective measures described in this Agreement must be implemented in order to avoid impacts, within the area covered by this Agreement, to the following species: the Federal endangered, State endangered and fully protected blunt-nosed leopard lizard *(Gambelia sila*); Federal endangered and State threatened San Joaquin kit fox (V*ulpes macrotis mutica*); and State threatened San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), as well as the other birds, mammals, fish, reptiles, amphibians, invertebrates, and plants that comprise the local riparian ecosystem. Departmental files contain lists of species that could be subject to potential generated impacts from this Project.

California Endangered Species Act (CESA) Compliance: Incidental Take Permit (ITP) 2081-2008-006-04 has been obtained for the parent Project the Route 46 Four-Lane Expansion Project. The ITP covers the following species:

1. San Joaquin kit fox (*Vulpes macrotis mutica*)
2. San Joaquin antelope squirrel (*Ammospermophilus nelsoni*)
3. Giant kangaroo rat (*Dipodomys ingens*)

Fully Protected Species: Neither this Agreement nor ITP 2081-2008-006-04 authorizes the "take" of any fully protected species. See Fish and Game Code section 3511, section 4700, section 5050, and section 5515. The Department finds that the Project can likely be carried out without "take" of blunt-nosed leopard lizard provided the conditions in this Agreement, the ITP, and in all other approvals are fully implemented and adhered to. The Department therefore finds that the Project as conditioned can be carried out in compliance with Fish and Game Code.

PROVISIONS:

General

1. The Notification, together with all supporting documents, is hereby incorporated into this Agreement to describe the location and features of the proposed Project. Caltrans agrees that all work shall be done as described in the Notification and

supporting documents, incorporating all wildlife resource protection features, mitigation measures, and provisions as described in this Agreement. Caltrans further agrees to notify the Department of any modifications that need to be made to the Project plans submitted to the Department. At the discretion of the Department, modifications may be deemed minor, requiring an amendment to this Agreement, or substantial requiring the submission of a new notification application. If the latter is the case, this Agreement becomes null and void. Failure to notify the Department of changes to the original plans or subsequent amendments to this Agreement may result in the Department suspending or canceling this Agreement.

2. Before the start of construction/work activities covered under this Agreement, all workers shall have received training from Caltrans' staff, or approved alternate trainer, on the content of this Agreement, the resources at stake, and the legal consequences of non-compliance.

3. When known, prior to beginning work, Caltrans shall provide a construction/work schedule to the Department (fax to Laura Peterson-Diaz, Environmental Scientist, at (559) 243-4020). Please reference the Agreement number. Caltrans shall also notify the Department upon the completion of the activities covered by this Agreement.

4. Agreed activities within the bed, bank, or channel may commence any time after the Department has signed this Agreement. This Agreement shall remain in effect for five (5) years beginning on the date signed by the Department. If the Project is not completed prior to the expiration date defined above, Caltrans shall contact the Department to negotiate a new expiration date and any new requirements.

Flagging/Fencing

5. Within the riparian corridor, Caltrans shall identify the upstream and downstream limits of the minimum work area required, access routes, the Project footprint, plus all Environmentally Sensitive Areas (ESA). These boundaries shall be defined by Caltrans' Project engineer and biologist, and flagged/fenced prior to the beginning of construction. These limits shall not extend beyond Caltrans' right-of-way and/or the construction easement, and shall be confined to the minimal area needed to accomplish the proposed work. Flagging/fencing shall be maintained in good repair for the duration of the Project.

Wildlife

6. An approved biologist shall perform general wildlife surveys of the Project area (including access routes and storage areas) prior to Project construction start with special attention being paid to the sensitive species noted above and shall report any possible adverse affect to fish and wildlife resources not originally reported. If the survey shows presence of any wildlife species which could be impacted, Caltrans shall contact the Department and mitigation, specific to each incident, shall be developed. If

any State- or Federal-listed threatened or endangered species are found within the proposed work area that are not covered by ITP 2081-2008-006-04 or could be impacted by the work proposed, a new Agreement and/or a new or amended 2081(b) State Incidental Take Permit may be necessary and a new CEQA analysis may need to be conducted, before work can begin.

7. To protect nesting birds, Caltrans' biologist shall make a survey for nesting activity in and adjacent to the defined "work area", before construction begins. If any nesting activity is observed, Caltrans shall contact the Department and mitigation, specific to each incident, shall be developed.

8. All the Conditions of Approval for ITP 2081-2008-006-04 must also be followed during the work on the portions of the Project also covered by this Agreement.

9. If any wildlife is encountered during the course of construction, said wildlife shall be allowed to leave the construction area unharmed.

Vegetation

10. For this Project, there will be impacts to the following native sunflower (*Helianthus annuua*) and bladder pod (*isomeris arborea*) as a result of planned construction activities. Precautions shall be taken to avoid any unnecessary damage to native plants and vegetation by people or equipment for the duration of the Project. No native trees will be removed for any of Segment 3 of the SR 46 Expressway Project.

11. There is no restriction on the removal of non-native plants including black mustard, Russian thistle, and tree tobacco provided the removal will not cause impacts to nesting birds. Removal of additional non-native plants, beyond what is required for the Project, will be beneficial to native plants becoming established in the area.

Vehicles

12. Construction vehicle access to the stream banks and bed shall be limited to predetermined ingress and egress corridors. Heavy equipment will need to access the creek during the course of the Project, but will do so when the creek is dry. All other areas adjacent to the work site shall be considered an ESA and shall remain off-limits to construction equipment.

Pollution

13. Caltrans and all contractors and subcontractors shall be subject to the pollution protective and other features of Department of Transportation Standard Specifications Section 7-1.01G and Fish and Game Code Sections 5650 and 12015.

14. Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the stream channel and banks. Any equipment or vehicles driven and/or operated within or adjacent to the creek shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic life. If a spill should occur, cleanup shall begin immediately. The Department shall be notified as soon as possible by Caltrans and shall be consulted regarding further cleanup procedures.

15. Raw cement, concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to fish or wildlife resulting from or disturbed by Project-related activities, shall be prevented from contaminating the soil and/or entering the stream channel.

Erosion

16. All disturbed soils shall be stabilized to reduce erosion potential, both during and following construction. Erosion control Best Management Practices (BMPs) shall be applied to all disturbed areas.

Fill/Spoil

17. Rock, gravel, and/or other materials shall not be imported into or moved within the stream, except as otherwise addressed in this Agreement. Only on-site materials and clean imported fill shall be used to complete the Project.

18. Fill shall be limited to the minimal amount necessary to accomplish the agreed activities. Excess fill material shall be moved off-site at Project completion.

Restoration

19. Excess material must be removed from the Project site pursuant to Department of Transportation Standard Specifications Section 7-1.13.

20. Caltrans shall make the final contour of the site match the adjacent slope of the land and provide the appropriate surface water drainage. All areas subject to temporary ground disturbance, including storage and staging areas, temporary roads, pipeline corridors, etc., shall be recontoured, if necessary, and revegetated to promote restoration of the area.

21. All areas subject to ground disturbance on the bank shall be stabilized. Planting, seeding with native species, and mulching is conditionally acceptable. Where suitable vegetation cannot reasonably be expected to become established, non-erodible material shall be used for such stabilization. Any installation of non-erodible material,

not included in the original Project description, shall be coordinated with the Department. Coordination may include the negotiation of additional Agreement provisions for this activity

MONITORING AND REPORTING PROGRAM (MRP):

PURPOSE

The purpose of the MRP is to ensure that the protective measures required by the Department are properly implemented, and to monitor the effectiveness of those measures.

OBLIGATIONS OF THE OPERATOR

Caltrans shall have primary responsibility for monitoring compliance with all protective measures included as "Provisions" in this Agreement. Protective measures must be implemented within the time periods indicated in the Agreement and the program described below.

Caltrans shall submit the following Reports to the Department:

- Verification of employee training (Provision 2).
- Construction/work schedule (Provision 3).
- Wildlife survey results (Provisions 6 and 7).
- A Final Project Report submitted within 30 days after the Project is completed. The final report shall summarize the Project construction, including any problems relating to the protective measures of this Agreement. "Before and After" photo documentation of the Project site shall be required.

In addition to the above monitoring and reporting requirements, the Department requires as part of this MRP that Caltrans:

- Immediately notify the Department in writing if monitoring reveals that any of the protective measures were not implemented during the period indicated in this program, or if it anticipates that measures will not be implemented within the time period specified.
- Immediately notify the Department if any of the protective measures are not providing the level of protection that is appropriate for the impact that is occurring, and recommendations, if any, for alternative protective measures.

VERIFICATION OF COMPLIANCE:

The Department shall verify compliance with protective measures to ensure the accuracy of Caltrans' monitoring and reporting efforts. The Department may, at its sole discretion, review relevant Project documents maintained by Caltrans, interview Caltrans' employees and agents, inspect the Project area, and take other actions to assess compliance with or effectiveness of protective measures for the Project.

CONCURRENCE:

APPROVED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME

on 12/10, 2009.

Jeffrey R. Single, Ph.D.
Regional Manager
Central Region

ACKNOWLEDGMENT

The undersigned acknowledges receipt of this Agreement and, by signing, accepts and agrees to comply with all terms and conditions contained herein. The undersigned also acknowledges that adequate funding shall be made available to implement the measures required by this Agreement.

By: _____ Date: 12/10/2009

Zachary Parker
California Department of Transportation

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:
1-1-07-F-0113

APR 4 2007

Gene K. Fong
Division Administrator
Federal Highway Administration
U.S. Department of Transportation
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Subject: Amendment of the Biological Opinion (File # 1-1-03-F-0367) for the Proposed State Route 46 4-Lane Widening Project from the San Luis Obispo County/Kern County line to mile post 37.5 in Kern County, California.

Dear Mr. Fong:

This letter is in response to your February 13, 2007 request to amend the Biological Opinion (BO) for the Proposed State Route (SR) 46 4-Lane Widening Project (Project). The U.S. Fish and Wildlife Service (Service) issued the BO (1-1-03-F-0367; change from 1-1-03-F-0208) for the State Route 46 Widening Project on September 22, 2003. The Service provided concurrence that the proposed project is likely to adversely affect the San Joaquin kit fox (*Vupes macrotis mutica*), Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*), blunt-nosed leopard lizard (*Gambellia sila*), Hoover's wooly-star (*Eriastrum hooveri*), San Joaquin wooly-threads (*Monolopia congdonii*), California jewelflower (*Caulanthus californicus*), and Buena Vista Lake shrew (*Sorex inornatus relictus*). The Federal Highway Administration (FHWA) and the California Department of Transportation (Caltrans) are requesting that the Service amend the BO for the Project in order to account for (1) additional impacts that have been proposed to address road safety and utility company (ConocoPhilips, Pacific Gas and Electric [PG&E], and Verizon) needs during Phase 2 construction (post-mile [PM] 0.0 to 7.3), and (2) revised compensation for impacts to the Buena Vista Lake shrew (*Sorex ornatus relictus*).

Phase 2 Additional Work

North of the existing SR 46 from San Luis Obispo/Kern County line (PM 0.0 to PM 4.2)
The new alignment was adjusted to avoid the ConocoPhillips storage tanks located at the Antelope Pump Station and minimize highway crossings over the Department of Water Resources (DWR) facilities. At the request of ConocoPhillips, a 20-foot utility easement and a 100-foot temporary construction easement (TCE) will be required for relocation and construction of their facilities. The installation of their facilities will be accomplished by trenching, installing

pipe and then backfilling and compacting the topsoil. The impacts associated with the utility easement consist of temporary ground disturbance for placement of relocated utilities underground. The impact associated with TCE is grading. At the request of PG&E, a permanent easement will be added within the ConocoPhillips TCE. The proposed PG&E work includes relocation of transmission line poles, which will result in permanent impacts to the habitat totaling 0.002 acre. A total of 26 two-foot diameter poles spaced every 328 feet will be installed within a 1.3 miles section (PM 0.5 to 1.8); one pole will be located south of the existing SR 46.

Due to the minimal permanent impact associated with this work, compensation is not proposed. The impact is not likely to affect listed species and prior to the pole installation, pre-construction surveys will be conducted to avoid potential habitat. Temporary impacts north of SR 46 will be 31 acres and will be compensated for at a rate of preservation of 1.1:1.

South of the existing SR 46 between PM 0.0 and PM 7.3
Due to the erosion of a natural creek the runs parallel to SR 46 and into the Caltrans right-of-way, riprap will be placed at seven locations to prevent further deterioration of side slopes. Temporary impacts associated with this work include clearing and re-grading existing side slopes at 1:1.5 within identified areas and stacking 2-ton rock parallel to the slope at a thickness of 5 feet. Additional work to be conducted within this segment of SR 46 is to improve vertical and horizontal curves to meet Caltrans' stopping sight distance requirements. Permanent impacts associated with this work include backfilling in low points with soil and constructing a new structural section over the filled area. As a result of this change, the width of the cross-sectional area affected increased. Associated with these improvements is grading for cross culvert outlets at 12 spot locations. Temporary impacts at these 12 locations will consist of grading the proposed flow line to match the existing flow line. Additional temporary impacts include the relocation of PG&E power poles and Verizon fiber optic cable to utility easements south of existing SR 46. Work associated with the relocation of these utilities includes digging (with an auger) for power poles and trenching for underground fiber optic cable then backfilling in and compacting soil. The anticipated impacts from this additional work south of the existing SR 46 are 11.1 acres of permanent impacts and 11.5 acres of temporary impacts.

Phase 2 Habitat

The habitat that will be affected by the additional proposed construction consists entirely of non-native grassland, which is the same as described in the April 2002 Biological Assessment (BA). Proposed compensation for temporary impacts will include the restoration of the non-native grassland after disturbance to its previous condition within two years, along with a rate of preservation of 1.1:1.

Incidental Take

According to the BO (page 58), the Service quantified take incidental to the project as all of the listed species inhabiting 489.8 acres between the San Luis Obispo/Kern County line and Interstate 5 (I-5), and 62.14 acres between I-5 and PM 37.5. As a result of the additional work

proposed between PM 0.0 and PM 7.3. The amount of incidental take of federally listed species that exceeds the original acreage is 53.6 acres, making for a total of 605.54 acres.

The following compensation ratios are proposed based on similar ratios approved by the Service in the BO.

Habitat Impacts	Acres of Impact	3:1	1.1:1	
Permanent impacts to non-native grassland	11.1 acres	33.3 acres	--	
Temporary impacts to non-native grassland	42.5 acres	--	46.75 acres	

Total area of compensation required for the additional activities described in this amendment is 80 acres.

As stated in the BO (page 63), fee title or conservation easements for 1108.59 acres for the portion of the project located between I-5 and the Kern/San Luis Obispo County line shall be acquired. Based on the table above, an additional 80 acres would also be included in the acquisition for the additional work proposed during Phase 2 construction. Caltrans will purchase fee title for at least 1188.59 acres owned by the Berrenda Mesa Water District. If acquired, the fee title for 1188.59 acres will then be transferred to the California Department of Fish and Game (CDFG) to be conserved in perpetuity.

<u>The following shall be amended to the BO (File # 1-1-03-F-0367):</u>

Of the **Terms and Conditions,** under part 2, Reasonable and Prudent Measures "O" (page 63):
"...fee title or conservation easements for 1108.59 acres..."

Shall be changed to:
"...fee title or conservation easements for 1188.59 acres..."

This change is made in order to reflect the additional proposed compensation for the impacts by the revised construction requirements for the project.

Of the **Terms and Conditions**, under part 2, Reasonable and Prudent Measures "P" (page 63): The inclusion of the Buena Vista lake shrew in this section shall be withdrawn, the fee title acquisition will exclude habitat for the Buena Vista Lake shrew due to minimal impacts (0.2 acre) anticipated to occur at the Kern River Channel during Phase 4 of construction. Caltrans proposes to compensate for the impacts to the shrew by the habitat restoration of an area, at minimum, 3 times that of the area of impact.

The following provision shall be added to the **Terms and Conditions,** part 2, Reasonable and Prudent Measures:

"Prior to construction Caltrans shall conduct a pre-construction survey for the Buena Vista Lake shrew following Service approved protocol at the Main Flood Canal-Kern River (first drainage with vegetation east of Interstate 5). The survey effort will serve as one conservation strategy for the Buena Vista Lake shrew that may aid in the location and protection of additional extant populations within the Tulare Basin. If the survey confirms presence of the Buena Vista Lake shrew within the project area, additional avoidance and minimization measures, along with additional compensation will be discussed with the Service. Caltrans shall compensate on-site for potential loss of habitat of the Buena Vista Lake shrew. Compensation shall include the restoration and re-vegetation of in-kind riparian vegetation of the impacted riparian habitat along the Main Flood Canal-Kern River in the amount of a minimum of 0.25 acres of riparian habitat."

A new species has not been listed or critical habitat designated that may be affected by the action. Critical habitat for the California tiger salamander (*Ambystoma californiense*) central population has been designated within the Orchard Peak quadrangle (Unit 6, **FR**; August 23, 2005). However, the designated area will not be affected, as it is located approximately 4 miles southwest of the San Luis Obispo/Kern County line, which is the project limit. Critical habitat for the California red-legged frog (*Rana draytonii*) has been designated within the Orchard Peak quadrangle (Unit SLO-1, **FR**; April 13, 2006). However, the primary constituent elements for this species do not occur within the project area.

All pre-construction requirements mandated within the biological opinion will need to be completed as prescribed before the start of construction. In response to a June 28, 2006 electronic mail sent to the Service requesting written approval that the fee title for 1108.59 or more acres owned by the Berenda Mesa Water District, would be appropriate habitat to compensate for adverse effects resulting from this project, the Service did concur. With the above additional work the total number of acres proposed for compensation will be 1188.59 acres. The fee title shall be obtained by Caltrans at least sixty (60) days prior to the date of initial groundbreaking (item 2; o, Page 63). The fee title for the1188.59 acres will then be transferred to the California Department of Fish and Game and be conserved in perpetuity.

If you have any questions pertaining to this letter regarding the amending of the biological opinion for the proposed State Route 46 Widening Project, please contact Richard Montgomery or Susan P. Jones at (916) 414-6630.

Sincerely,

Kenneth Sanchez
Assistant Field Supervisor

cc:
Zachary Parker, Caltrans, Fresno, California
Steve Juarez, California Department of Fish and Game, Fresno, California

United States Department of the Interior

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

IN REPLY REFER TO:
1-1-03-F-0208

September 22, 2003

Mr. Gary Hamby
Division Administrator
Federal Highways Administration
Department of Transportation
980 Ninth Street, Suite 400
Sacramento, California 95814-2724

Subject: Section 7 Formal Consultation on the Proposed State Route 46 4-Lane Widening Project from the San Luis Obispo County/Kern County line to post mile 37.5 in Kern County, California

Dear Mr. Hamby:

This is in response to your August 30, 2001, and May 9, 2002, requests for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act) on the proposed State Route 46 4-lane Widening Project from the San Luis Obispo County/Kern County line east to post mile 37.5 in Kern County, California. Your September 30, 2001, letter requesting the initiation of formal consultation on the State Route 46 project on the east side of Interstate 5 was received in our office on September 4, 2001; your May 9, 2002, letter requesting the initiation of formal consultation on the State Route 46 project on the west side of Interstate 5 was received in our office on or about May 11, 2002. In a letter dated May 14, 2003, that was received by the Service on May 15, 2003, the California Department of Transportation (Caltrans) requested that the 2 projects be combined in a single biological opinion. On September 15, 2003, the Service received an electronic mail message from Carrie Bowen of Caltrans, and a telephone message from her on September 18, 2003, in which she stressed Caltrans wants the biological opinion for this project issued as expeditiously as possible.

Your August 30, 2001, letter stated that the proposed project on the east side of Interstate 5 is likely to adversely affect the endangered San Joaquin kit fox (*Vulpes macrotis mutica*), endangered blunt-nosed leopard lizard (*Crotaphytus silus*), and the endangered tipton kangaroo rat (*Dipodomys nitroides nitroides*); your letter also requested concurrence that the proposed project is not likely to adversely affect the threatened Hoover's woolly-star (*Eriastrum hooveri*) and the endangered San Joaquin woolly-threads (*Lembertia congdonii*). Your May 9, 2002, letter

stated that the proposed project on the west side of Interstate 5 is likely to adversely affect the endangered San Joaquin kit fox, and is not likely to adversely affect the endangered blunt-nosed leopard lizard, endangered tipton kangaroo rat, endangered giant kangaroo rat (*Dipodomys ingens*), endangered California jewelflower (*Caulanthus californicus*), threatened Hoover's woolly-star, and the endangered San Joaquin woolly-threads.

The Service has made concurrences and non-concurrences on the effects of this project on several listed species based on the information provided in the *California Department of Transportation Natural Environment Study and Biological Assessment State Route 46 Kern County, California EA 06-338300 PM 32.8/37.5*, dated June 7, 2001 (Biological Assessment 1), that was prepared by the California Department of Transportation (Caltrans); *California Department of Transportation Biological Assessment Location: Kern County, California Route 46 Post Miles 0.0/11.74, 11/74/53.91, 0.0/32.99 (Orchard Peak, Sawtooth Ridge, Emmigrant Hill, Shale Point, Blackwells Corner, Lost Hills Quadrangle Maps) Expenditure Authorizations: 0.6-35341, 06-44250, 06-35330)* dated April 2002 (Biological Assessment 2), that was prepared by Caltrans; *San Luis Obispo and Kern Counties State Route 46 4-Lane Widening Project Environmental Assessment/Initial Study State Route 46 through San Luis Obispo and Kern Counties 05-SLO-46 EA OC6500: From kilometer posts 88.67 to 97.9 (post miles 55.1 to 60.9) 06-KERN-46 EA 353410: From kilometer posts 0.00 to 11.75 (post miles 0.00 to 7.3) 06-KERN-46 EA 442500: From kilometer posts 11.75 to 53.9 (post miles 7.3 to 33.5)* dated January 2003 (EA) that was prepared by the Federal Highways Administration (FHWA) and Caltrans; a field visit to the project location on June 13, 2003, by Chris Nagano and Brian Peterson of the Service and David Armes and Terry Marshall of Caltrans; a field visit to the project site by Chris Nagano and Brian Peterson and a representative from the California Cattlemen's Association on August 21, 2003; and other information available to the Service.

We concur the proposed project is likely to adversely affect the San Joaquin kit fox, Tipton kangaroo rat, and the blunt-nosed leopard lizard; and we do not concur that the proposed project is not likely to adversely affect Hoover's woolly star, San Joaquin woolly-threads, endangered giant kangaroo rat, and the California jewelflower. The Service does not concur with the not likely to adversely affect determinations for several reasons. As discussed in the appropriate portions of *Status of the Species and Environmental Baseline* section of this biological opinion, suitable habitat for all of these listed species are found in and adjacent to the action area; although no observations of the species and/or their sign are reported in Biological Assessment 1 or 2, the surveys were either of unknown methodology, duration and extant, or they were not focused surveys approved by the Service or the California Department of Fish and Game; and as described under the appropriate *Effects of the Proposed Action* section of this biological opinion, Caltrans has proposed to mitigate for effects on these species resulting from the State Route 46 project (Biological Assessment 1; Biological Assessment 2). Under normal circumstances, the Service would recommend to Caltrans that additional information, including the results of focused or protocol surveys for these listed species, be provided for us to review prior to initiation of formal consultation as stated in the regulations at 50 CFR 402.14. However, the Service has assumed the presence of the giant kangaroo rat, Hoover's woolly-star, San Joaquin

woolly-threads, and the California jewelflower in the action area of the State Route 46 project, given the biology and ecology of these animals and plants, the presence of suitable habitat in and adjacent to the project, as well as the observations of these listed species to the vicinity of the action area, but especially because of Caltrans' request for an expedited biological opinion, as described in the September 5 and 16, 2003, electronic mail messages from Carrie Bowen of Caltrans to the Service, and her September 18, 2003, telephone message to the Service (see *Consultation History* section of this biological opinion). In addition, Biological Assessment 1 stated the proposed State Route 46 project will result in no effect to the endangered Buena Vista Lake shrew (*Sorex ornatus relictus*) that there are no known occurrences of the species near the project, and the project is outside of the range of the then one known extant population. The Service does not concur with this determination because this listed animal has recently been documented to occur at the Kern National Wildlife Refuge, which is located approximately 7.3 miles north of project site, the biology and ecology of the animal, and the presence of suitable habitat in the action area.

This biological opinion is based on information provided in the following sources: 1) Biological Assessment 1; 2) Biological Assessment 2; 3) the EA; 4) a field meeting at the project between Chris Nagano, Brian Peterson, Terry Marshall, and David Armes on June 13, 2003; 5) a field meeting at the project site by Chris Nagano and Brian Peterson and a representative of the California Cattlemen's Association on August 21, 2003; 6) a meeting between Gary Hamby, his deputy, Maser Khalid, and Larry Vinzant of the FHWA, Gary Winters and Greg Erickson of Caltrans, and Wayne White, Susan Moore, Mike Hoover, and Chris Nagano of the Service on August 22, 2003; 7) a telephone conversation between Chris Nagano and Gary Winters on August 25, 2003; 8) electronic mail messages from Carrie Bowen of Caltrans to the Service dated September 5, 2003, and September 16, 2003; 9) an electronic mail message from Chris Nagano of the Service to Caltrans dated September 7, 2003; 10) several telephone calls between Service and Caltrans staff; 11) a number of electronic mail messages between Caltrans and the Service; and 12) aerial photographs of the project that were provided by Caltrans; and 13) other information contained in the Service's files.

Consultation History

September 4, 2001: The Service received a letter from FHWA dated August 30, 2001, requesting the initiation of formal consultation on the rehabilitation and widening of State Route 46 from Interstate 5 eastward for approximately 5 miles.

May 9, 2002: FHWA sent a letter to the Service dated May 9, 2002, requesting initiation of formal consultation on the widening of State Route 46 from Interstate 5 westward for 33.5 miles.

May 15, 2003: The Service received a letter from FHWA dated May 14, 2003, requesting that the work on the eastern and western sections of State Route 46 be combined into a single biological opinion.

June 13, 2003: Chris Nagano and Brian Peterson of the Service met with Terry Marshall and David Armes of Caltrans at the proposed project site. Caltrans emphasized the need to implement the proposed project due because of human health and safety. Caltrans advised the Service that they are proposing to acquire lands for the San Joaquin kit fox to compensate, in part, for adverse effects resulting from the State Route 46 project in the Buena Vista Valley, approximately 30 miles south of the action area. The Service advised Caltrans this likely would not adequately offset the adverse effects to the kit fox and its movement corridor caused by the project. The Service recommended Caltrans protect habitat along the State Route 46 corridor. Caltrans showed the Service where kit foxes had been observed during their surveys. Habitat that appeared to be suitable for listed species and other wildlife was observed north of State Route 46 adjacent to Interstate 5. Suitable habitat for the Buena Vista Lake shrew was observed between Interstate 5 and post mile 37.5. Caltrans stated that no surveys for the Buena Vista Lake shrew have been completed in the action area.

June 18, 2003: The Service and Caltrans discussed the State Route 46 project on the telephone. Caltrans stated they are interested in acquiring the undisturbed parcel that contains habitat that is located north of State Route 46 adjacent to the east side of Interstate 5. The Service suggested that due to Caltrans stated time constraints on initiating groundbreaking for the project, they assume the presence of the Buena Vista Lake shrew at the project site; Caltrans stated that they did not object. The Service and Caltrans discussed potential conservation measures for the shrew.

June 24, 2003: The Service sent Caltrans an electronic mail message inquiring about the status of the proposal to place 5-foot pipes under the highway to enable the San Joaquin kit foes to safely cross the road.

June 24, 2003: Caltrans sent the Service an electronic mail message stating they were working with their engineers to obtain information on all the existing and proposed culverts for the entire stretch of State Route 46. They had informed the engineers this was a priority.

June 24, 2003: The Service sent Caltrans an electronic mail message which stated that the movement corridor for the San Joaquin kit fox would be enhanced if the culverts could be combined with the acquisition lands. The Service asked Caltrans if they had investigated ways to "encourage" the foxes to use the culverts.

June 24, 2003: Caltrans sent the Service an electronic mail message regarding the use of fencing to funnel the San Joaquin kit foxes into the culverts, and they expressed concern if the animals did not use the corssing as frequently as planned or not all, and then the movement could be cut off due to the fencing. Caltrans stated they "...like the idea of acquiring mitigation lands adjacent to the culverts. This would always insure connectivity. We are attempting to research any available mitigation lands in the areas we discussed."

June 25, 2003: Chris Nagano sent Caltrans an electronic mail message describing the Service's involvement with the proposed use of the lands in Buena Vista Valley for the conservation of the

San Joaquin kit fox; and that the Service had not suggested it was suitable for the State Route 46 project. The Service reiterated the importance of maintaining a movement corridor for the kit fox across State Route 46, including the recommendation the use of 5' tall pipes or culverts under the highway to increase the conservation value of the movement corridor.

June 25, 2003: Caltrans sent the Service and electronic mail message stating they are looking into land around the State Route 46/Interstate 5 area and on State Route 46 between Highway 33 and Interstate 5 that is for sale. They stated they will propose that culverts be placed in the vicinity of the kit fox sightings, however, they indicated that roadway design and costs may be prohibitive.

June 25, 2003: The Service sent Caltrans an electronic mail message requesting they investigate other potential means of reducing vehicle-strike caused mortality of the San Joaquin kit fox.

June 27, 2003: Caltrans sent the Service an electronic mail message describing how they are investigating how to get the kit foxes into culverts, assuming culverts can be included in the project, as opposed to the animals going over the highway. They stated that the kit foxes may not use culverts if the elevation of the roadway is low and there is not some mechanism to force them into the culverts. Caltrans said overcrossings are not possible due to a lack of topography; undercrossings would be problematic due to ponding.

July 17, 2003: The Service and Caltrans discussed the State Route 46 project on the telephone. The Service reiterated its concerns regarding the potential adverse effects of the proposed project on the San Joaquin kit fox and its movement corridor. The Service inquired if Caltrans was proposing to place concrete dividers on State Route 46; Caltrans responding that concrete dividers will not be used on this highway. The Service inquired about the status of protecting lands east of Interstate 5; Caltrans responded that they had made calls to realtors in the Bakersfield area and they also had been checking the internet.

July 30, 2003: The Service sent Caltrans an electronic mail message inquiring about the status of protecting habitat east of Interstate 5.

August 1, 2003: Caltrans sent the Service an electronic mail message that they had contacted realtors in the area, but they had not received any responses. They stated they were going to visit the action area to check if there were any new "for sale" signs.

August 1, 2003: The Service sent Caltrans an electronic mail message stating that there was going to be a meeting with representatives of the California Cattlemen's Association to discuss the potential for conservation easements on ranch lands west of Interstate 5. The Service contacted the California Cattlemen's Association because of the apparent inability to locate suitable properties with willing sellers and Caltrans stated desire to the Service that they want to initiate groundbreaking on the project as soon as possible.

August 1, 2003: Caltrans sent the Service an electronic mail message that stated the Service should let them know if their participation was desired in any of the talks with the California Cattlemen's Association.

August 5, 2003: The Service sent Caltrans an electronic mail message requesting the attendance of Caltrans at the meeting with the representatives of the California Cattlemen's Association. The Service requested information on Caltrans' efforts to locate lands that could be protected east of Interstate 5, and if those lands were not available, if they had proposals for other suitable lands. The Service emphasized they were interested in ideas from Caltrans.

August 5, 2003: Caltrans sent the Service an electronic mail message that the other person who may be interested in attending the meeting with the California Cattlemen's Association was currently on vacation but would return on August 11, 2003. Caltrans stated they were going out to the site to check for any new opportunities for compensation lands.

August 5, 2003: The Service sent Caltrans an electronic mail message that the meeting with the representatives with the California Cattlemen's Association would be on August 21, 2003, and would start between 1030 a.m. and 1130 a.m. at a specific restaurant in the Town of Lost Hills.

August 21, 2003: The Service met with a representative of the California Cattlemen's Association at the project site. The biology and ecology of the San Joaquin kit fox was discussed, as well as the potential for the use of conservation easements on ranchlands. They stated that there are some ranchers in the area who had approached them about their interest in selling conservation easements.

August 22, 2003: Wayne White, Susan Moore, Mike Hoover, and Chris Nagano of the Service meet with Gary Winters, Chief of Caltrans' Environmental Analysis Division, and Greg Erickson of Caltrans, and Gary Hamby of the FHWA and his staff. Caltrans emphasized that all three agencies should try and use creative and innovative ways to compensate for adverse effects resulting from highway projects on listed species.

August 25, 2003: In a telephone conversation, Gary Winters and Chris Nagano discussed the potential use of conservation easements, especially on ranchlands, for listed species including the San Joaquin kit fox at the State Route 46 project. Mr. Winters stated there is considerable potential for the use of conservation easements to offset the effects of Caltrans projects on listed species

September 2, 2003: The Service sent Gary Winters an electronic mail requesting information on landownership along State Route 46.

September 2, 2003: Gary Winters sent an electronic mail message to Caltrans' Fresno Office requesting that they provide the Service with landownership on State Route 46, if possible.

September 2, 2003: The Service sent Gary Winters an electronic mail message regarding his September 2, 2003, electronic mail message to his Fresno office stating that "...This will help keep the formal consultation for 46 on track."

September 5, 2003: Carrie Bowen of Caltrans sent the Service an electronic mail message questioning how conservation easements are relevant to the completion of the biological opinion and she stated " ...mitigation funds for this project may not be available for several years..."

September 7, 2003: The Service sent Caltrans an electronic mail message that explained the use of conservation easements, the recent history of the State Route 46 project, and the Service's understanding that this is a priority project for Caltrans.

September 15, 2003: The Service received information from Caltrans regarding land ownership and aerial photographs of the State Route 46 corridor.

September 16, 2003: Carrie Bowen sent the Service an electronic mail message stating, in part, that Caltrans was concerned about delays in the consultation, and she wanted the biological opinion for the State Route 46 project as soon as possible.

September 18, 2003: Carrie Bowen left a telephone message for the Service that stated, in part, her concern about the formal consultation and that the Service would not be able to complete the biological opinion in an expeditious manner.

BIOLOGICAL OPINION

Description of the Proposed Action

State Route 46 beginning at State Route 1 near Cambria in San Luis Obispo County and extending to State Route 99 near Famosa in Kern County, was added to the State Highway System by legislative action in 1915. This highway, also known as the "Paso Robles Highway," is predominantly an east-west highway running through the central San Joaquin Valley. It is a Federal Aid Route on the National Highway System functionally classified as a principle arterial between the San Luis Obispo County Line and Interstate 5, and as a minor arterial between Interstate 5 and State Route 99. Truck traffic currently comprises nearly 40% of the average daily traffic volume. State Route 46 also is heavily used on weekends as a corridor for recreational vehicles traveling between the San Joaquin Valley and communities on the Central Coast.

According the Biological Assessment 1, Biological Assessment 2, and the EA, the Federal Highways Administration and Caltrans are proposing to rehabilitate and widen State Route 46 from the San Luis Obispo County/Kern County line east to post mile 37.7 (kilopost 60.35). Biological Assessment 1 and 2 describe a number of actions that will be completed including: asphalt concrete overlay of the roadbed; widening of the pavement to provide 7.0 feet (2.4 meter)

shoulders with 3.3 feet (1.0 meter) backing in each direction of travel; widening of two bridges; and improvements to increase safety at 2 intersections; dig out and repair localized areas of severe failure on the existing roadbed; seal cracks larger than 5 millimeters on existing roadbed; overlay existing roadbed and bridges with asphalt concrete; cul-de-sac at McCombs Road with no access from the highway ; realignment of Corcoran Road; widening of Main Drain Canal Bridge and Goose Lake Canal Bridge; construct approach metal beam guard rail and upgrade existing bridge railing at Main Drain Canal and Goose Lake Canal; and relocation of fiber optic, water/petroleum, and power utilities. All of the work described in the two biological assessments will be done under Caltrans authority by a subcontractor. This contract is proposed to be awarded in April 2005 and the construction would be completed by March 2007

The second portion of this project extends from the San Luis Obispo County/Kern County line west to kilometer post 88.67 (post mile 55.1) in San Luis Obispo County. It is our understanding that Caltrans, through FHWA, has entered in formal consultation for this segment with the Service's Ventura Fish and Wildlife Office.

Proposed Conservation Measures

According to the Biological Assessment 1, Biological Assessment 2, the EA, and other sources of information available to the Service, the Federal Highways Administration and Caltrans propose to avoid, minimize, and compensate for effects to listed species through the following measures:

1. An employee education program regarding listed species will be included in the pre-construction meeting. A Caltrans biologist or other qualified biologist will conduct this portion of the meeting.

2. Pre-construction surveys will occur within 60 days prior to construction, if it is during the appropriate flowering period of the Hoover's woolly-star or the San Joaquin woolly-threads. Areas along the project length with the potential to support these two species will be surveyed on foot. If either plant is observed within the impact area, the Service will be immediately notified regarding the procedure for transplantation of the specimen.

3. As described in Biological Assessment 1, areas along the project length with the potential to support the Tipton kangaroo rat, bluntnosed leopard lizard, and the State threatened San Joaquin antelope squirrel (*Ammospermophilus nelsoni*) will be walked on foot within one month prior to construction. These pre-construction surveys will look for the presence or recent activity of these animals. If presence or recent activity is observed, special attention will be paid to that area by the biology construction monitor as described in the biological assessment.

4. As described in Biological Assessment 2, restoration and re-vegetation work will be completed for all areas of temporary disturbance. Plant material found in the habitat

specific to that of the disturbed area preferably local source, or material approved by the Caltrans biologist, will be utilized.

5. Project employees will be provided with training and written giudance governing vehicle use when commuting within listed species habitats. A 20-MPH speed limit would be strongly encouraged on unpaved roads within listed species habitats. Cross-country travel by vehicles would be prohibited, unless authorized by the Service or Caltrans biologist.

6. All food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once a week from the site.

7. No pets or firearms will be permitted at the construction site to avoid harassment or killing of listed species.

8. Use of rodenticides and herbicides in the project area during construction would be permitted only if it is part of a California Department of Fish and Game or Service approved management plan or unless such use is otherwise approved on a case-by-case basis.

9. All construction pipe, culverts, or similar structures with a diameter of 7.6 centimeters (3 inches) or greater that are stored at the construction site for more than one or more overnight periods will be thoroughly inspected for kit foxes, blunt-nosed leopard lizards, and kangaroo rats before the pipe is subsequently moved, buried, or capped. If during inspection one of these animals is discovered inside a pipe, that section of pipe would not be moved, or wopuld be moved once to remove it from the path of construction, until the animal had escaped.

10. All grindings and asphaltic-concrete waste would be stored within previously disturbed areas and no closer than 45.7 meters (150 feet) from any culvert, wash, pond, or stream crossing.

11. The resident engineer or the resident engineer's designee would be responsible for implementing a number of these mitigation measures and would be the contact for this project.

12. As described in Biological Assessment 2, the priorities in considering site selection for land acquisition for the 1108.59 acres of compensation lands for the adverse effects of the project between the San Luis Obispo County/Kern County line to Interstate 5 are: 1) the proposed mitigation site will be of equal or superior habitat to that of the disturbed habitat; 2) the proposed mitigation site will contain the aspects vital to the continued existence of San Joaquin kit foxes, giant kangaroo rats, Tipton kangaroo rats, blunt-nosed leopard lizards, and San Joaquin ground squirrels; 3) The proposed mitigation site will be of similar habitat type and will attempt to include salt bush scrub, valley and foothill

grasslands, and non-native grasslands; 4) The proposed mitigation site will maintain close geographical connection to disturbed areas. The proposed mitigation site will be natural lands in the vicinity of western Kern County or eastern San Luis Obispo County; 5) The proposed mitigation site will attempt to enhance movement corridors, link natural lands, and protect existing listed species habitat.

13. A Caltrans biologist or other qualified biologist will monitor the construction of the project. This individual will visit the site once each week to assure all construction personnel and activities are in compliance with the Service's biological opinion as well as other permits.

14. According to the EA, final mitigation measures on endangered and threatened species would be mitigated by implementation of the measures specified in each of biological opinions rendered by the Service and the California Department of Fish and Game.

15. According to Biological Assessment 1, impacts to special-status species habitat between Interstate Highway 5 and post mile 37.5 will be compensated for by acquiring land or conservation easements at a 3:1 ratio for permanent impacts and 1.1:1 ratio for temporary impacts. Land acquired will be in kind with the potential to support the special-status species discussed in Biological Assessment 1.

16. All pipe culverts to be extended or replaced will be done so with 24-36 inch pipe culverts. Additionally, Caltrans will evaluate the potential for installing several new culverts to help facilitate the safe crossing of wildlife.

17. As described in Biological Assessment 1, to address the potential cumulative impacts that this project could have on the natural environment, portions of the mitigation funds allotted for this project will go toward the effects of roads on San Joaquin kit foxes study currently being undertaken by Brian Cypher and Endangered Species Recovery Program.

Status of the Species and Environmental Baseline

San Joaquin Kit Fox

The San Joaquin kit fox was listed as endangered on March 11, 1967 (32 **FR** 4001) and listed by the State of California as a threatened species on June 27, 1971. The recovery of the animal is addressed in the recovery plan issued by the Service in 1998. The San Joaquin kit fox is a small canid, with an average body length of 20 inches and weighing about 5 pounds. They are lightly built, with long legs and large ears. Pelage color ranges from tan to buffy gray in the summer to silvery gray in the winter. The belly is whitish and the tail is black-tipped. Kit foxes are active year round, and are primarily nocturnal. The grizzled coloration and black-tipped tail aid in distinguishing the San Joaquin kit fox from the much larger (4-5 kilogram; 9-11 pound) red fox

(*Vulpes vulpes*). Gray foxes (*Urocyon cinereoargenteus*) are similar in coloration to the San Joaquin kit fox, but are heavier (about 3.6 kilograms; 8 pounds) and have a dark stripe running along the top of their tail (Grinnell *et al.* 1937).

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; U.S. Fish and Wildlife Service 1998). Historically, the animal 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. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man. The animals are present in many oil fields, grazed pasture lands, and "wind farms" (Cypher 2000). Kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (U.S. Fish and Wildlife Service 19998). The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance and terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 19998).

Dens are used by the fox for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes excavate their own dens, use those constructed by other animals, and use human-made structures (culverts, abandoned pipelines, and banks in sumps or roadbeds). Kit foxes often change dens and may use many dens throughout the year; however, evidence that a den is being used by kit foxes may be absent. San Joaquin kit fox dens have multiple dens within their home range and individual animals have been reported to use up to 70 different dens (Hall 1983). At the Naval Petroleum Reserve, individual kit foxes used an average of 11.8 dens per year (Koopman *et al.* 1998). Kit foxes are subject to competitive exclusion or predation by other species, such as the non-native red fox, coyote (*Canis latrans)*, domestic dog (*Canis familiaris*), bobcat (*Felis rufus*), and large raptors. Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956).

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 *(Dipodomys* spp.), pocket mice (*Perognathus* spp.), white-footed mice (*Peromyscus* spp.), and other nocturnal rodents comprise about one-third or more of their diets. Kit foxes also prey on California ground squirrels, black-tailed hares (*Lepus californicus)*, San Joaquin antelope squirrels (*Ammospermophilus nelsoni)*, desert cottontails (*Sylvilagus audubonii)*, ground-nesting birds, and insects.

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 50-87 per cent 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).

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). Kit foxes occupy home ranges that vary in size from 4.3-11.6 square kilometers (1.7-4.5 square miles)(White and Ralls 1993). Each home range is usually occupied by a mated pair of kit foxes and their current litter of pups. 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 9.4-14.6 kilometers (5.8-9.1 miles) 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/or 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 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

San Joaquin kit foxes usually breed in December and January, and are primarily monogamous. After a gestation of 48-54 days, pups are born during late January-March (Zoellick *et al.* 1987). Mean litter sizes reported for San Joaquin kit foxes include 2.0 on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer *et al.* 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval petroleum reserve (Cypher *et al.* 2000). Pups being appearing above ground at about age 3-4 weeks, and are weaned at age 6-8 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 0-100%, and reported mean rates include 61% at the Naval Petroleum Reserve (Cypher *et al.* 2000), 64% in the Lokern area (Spiegel and Tom 1996), and 32% 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 raising raisin the following year's litter of pups (Spiegel and Tom 1996)

Juvenile San Joaquin kit foxes begin dispersing as early as June with a peak dispersal occurring in July. The age at dispersal rages from 4-32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49% of the males dispersed from natal home ranges while 24% of the females dispersed (Koopman *et al.* 2000). Among dispersing kit foxes, 87% did so during their first year of age. Most, 65.2%, of the dispersing juveniles at the Naval petroleum reserve died within 10 days of leaving their natal home den (Koopman *et al.* 2000). Some kit foxes delay dispersal and may inherit their natal home range. Dispersal distances of up

to 123 kilometers (76.3 miles) have been documented for the San Joaquin kit fox (Scrivner *et al.* 1993).

Mean annual survival rates reported for adult San Joaquin kit foxes include 0.44 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.53 at Camp Roberts (Standley *et al.* 1992), 0.56 at the Lokern area (Spiegel ad Disney 1996), and 0.60 on the Carrizo Plain (Ralls and White 1995). However, survival rates widely vary 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 was 0.14 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.20 at Camp Roberts (Standley *et al.* 1992), and 0.21 on the Carrizo Plain (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), but most kit foxes do not live past 2-3 years of age.

Several species prey upon the San Joaquin kit foxes. Other 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 (U.S. Fish and Wildlife Service 1998).

Since the listing of the San Joaquin kit fox in 1967, several other threats that limit and/or regulate their populations have been identified. These threats are described in further detail in the following paragraphs:

1) Loss of the habitat of the San Joaquin kit fox: Less than 20 percent of the habitat within the historical range of the kit fox remained when the subspecies was listed as federally-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 1930's, 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 (Service 1980a).

This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service in litt. 1995a). Approximately 1.97 million acres of habitat, or about 66,000 acres per year, were converted in the San Joaquin region between 1950 and 1980 (California Department of Forestry and Fire Protection 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).

By 1979, only approximately 370,000 acres out of a total of approximately 8.5 million acres on the San Joaquin Valley floor remained as non-developed land (Williams 1985, Service 1980a). Data from the California Department of Fish and Game (1985) and Service file information indicate that between 1977 and 1988, essential habitat for the blunt-nosed leopard lizard (*Gambelia sila*), a species that occupies habitat that is also suitable for kit foxes, declined by about 80 percent – from 311,680 acres to 63,060 acres, an average of about 22,000 acres per year (Biological Opinion for the Interim Water Contract Renewal, Ref. No. 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

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 Central Valley Project. This figure includes 42,520 acres of grazing land and 28,854 acres of "other" land, which is 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 1994, 1996, 1998). This figure includes 49,705 acres of farmland, 20,476 acres of grazing land, and 31,366 acres of "other" land, which is predominantly comprised of native habitat. 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 contrast, less than 500,000 acres have been preserved and/or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 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 (Knapp and Chesemore 1987; C. Van Horn, Endangered Species Recovery Program, Bakersfield, pers. comm. to S. Jones, Fish and Wildlife Service, Sacramento), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972, Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1998). Likewise, the California Energy Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel 1996). Researchers from both studies inferred that the most significant effect of oil development was the lowered carrying capacity for populations of both foxes and their prey species owing to the changes in habitat characteristics or the loss and fragmentation of habitat (Spiegel 1996, Warrick and Cypher 1998).

Dens are essential for the survival and reproduction of kit foxes which use them year-round for shelter and escape, and in the spring for rearing young. Hence, 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. For example, the average density of typical, earthen kit fox dens at the Naval Hills Petroleum Reserve was negatively correlated with the intensity of petroleum development (Zoellick *et al.* 1987), and almost 20 percent of the dens in developed areas were found to be in well casings, culverts, abandoned pipelines, oil well cellars, or in the banks of sumps or roads (O'Farrell 1983). These results are important because the California Energy Commission found that, even though kit foxes frequently used pipes and culverts as dens in oil-developed areas of western Kern County, only earthen dens were used to birth and wean pups (Spiegel 1996). Similarly, kit foxes in Bakersfield use atypical dens, but have only been found to rear pups in earthen dens (P. Kelly, Endangered Species Recovery Program, Fresno, pers. comm. to P. White, Fish and Wildlife Service, Sacramento, April 6, 2000). Hence, the fragmentation of habitat and destruction of earthen dens could adversely impact the reproductive success of kit foxes. Furthermore, the destruction of earthen dens may also affect kit fox survival by reducing the number and distribution of escape refuges from predators.

Land conversions and associated human activities can lead to widespread changes in the availability and composition of mammalian prey for kit foxes. For example, oil field disturbances in western Kern County have resulted in shifts in the small mammal community from the primarily granivorous species (e.g., *Dipodomys*) that are the staple prey of kit foxes (Spiegel 1996; Cypher *et al.*, in press), to species adapted to early successional stages and disturbed areas (e.g., California ground squirrels (Spiegel 1996; Cypher *et al.*, in press). Because more than 70 percent of the diets of kit foxes usually consist of abundant leporids (*Lepus*, *Sylvilagus*) and rodents (e. g., *Dipodomys spp.*), and kit foxes often continue to feed on their staple prey during ephemeral periods of prey scarcity, such changes in the availability and/or selection of foraging sites by kit foxes could influence their reproductive rates, which are strongly influenced by food supply and decrease during periods of prey scarcity (White and Garrott 1997, 1999).

Extensive habitat destruction and fragmentation have contributed to smaller, more-isolated populations of kit foxes. Small populations have a higher probability of extinction than larger 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 their recolonization has been hampered. These chance events can adversely affect small, isolated populations with devastating results, as evidenced by the decimation of the sole colony of black-footed ferrets (*Mustela nigripes*) following its infection with canine distemper (May 1986). 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 raw chance (sampling probabilities). Owing to

the probabilistic nature of extinction, many small populations will eventually lose out and go extinct when faced with these stochastic risks (Caughley and Gunn 1996).

Oil fields in the southern half of the San Joaquin Valley also continue to be an area of expansion and development activity (Sunrise Cogeneration and Power Project Biological Assessment, June 23, 1999). This expansion is reasonably certain to increase in the near future owing to market-driven increases in the price of oil. The cumulative and long-term effects of oil extraction activities on kit fox populations are not fully known, but recent studies indicate that moderate- to high-density oil fields may contribute to a decrease in carrying capacity for kit foxes owing to habitat loss or changes in habitat characteristics (Spiegel 1996, Warrick and Cypher 1998).

In summary, the new infrastructure and increased reserve capacity necessary for continued population growth and development within the Central Valley is currently being provided. There are no limiting factors or regulations that are likely to retard this development or force it to other areas which are already served. Hence, it is reasonably certain that development will continue to destroy and fragment kit fox habitat into the foreseeable future.

2) Competitive Interactions with Other Canids: The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (White *et al.* 1995, 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). Coyotes may attempt to lessen resource competition with kit foxes by killing them. Coyote-related injuries accounted for 50-87 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). Hence, 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 dampen or prevent fox population growth, and/or accentuate, hasten, or prolong population declines.

Land-use changes 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 1970's, however, introduced and escaped red foxes had established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis *et al.* 1993). 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 1992). The increased abundance and distribution of nonnative red foxes will also likely adversely impact the status of kit foxes because they are closer morphologically and taxonomically, and would likely have higher dietary overlap than coyotes; 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, Endangered Species Recovery Program, Fresno, pers. comm. to P. White, Fish and Wildlife Service, Sacramento, 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.

3) 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, Miller *et al.* 1998). 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, Miller *et al.* 1998). 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*)(Miller *et al.* 1998). 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 1990's. 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 livetrapping 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).

4) Pesticides and rodenticides: Pesticides and rodenticides pose a threat to kit foxes through direct or secondary poisoning. 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 (*Spermophilus beecheyi*), which is the staple prey of kit foxes in the northern portion of their range, 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 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 (alfalfa, almonds, apples, apricots, asparagus, avocados, barley, beans, beets, bok choy, broccoli, cantaloupe, carrots, cauliflower, celery, cherries, chestnuts, chicory, Chinese cabbage, Chinese greens, Chinese radish, collards, corn, cotton, cucumbers, eggplants, endive, figs, garlic, grapefruit, grapes, hay, kale, kiwi fruit, kohlrabi, leeks, lemons, lettuce, melons, mustard, nectarines, oats, okra, olives, onions, oranges, parsley, parsnips, peaches, peanuts, pears, peas, pecans, peppers, persimmons, pimentos, pistachios, plums, pomegranates, potatoes, prunes, pumpkins, quinces, radishes, raspberries, rice, safflower, sorghum, spinach, squash, strawberries, sugar beets, sweet potatoes, Swiss chard, tomatoes, walnuts, watermelons, and wheat), 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 (Service in litt. 1993). 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 (Service 1992).

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 2 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 3 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 (California Department of Fish and Game 1999).

To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (Service 1998). This lack of information is problematic because Williams (in litt., 1989) documented widespread pesticide use in known kit fox and Fresno kangaroo rat (*Dipodomys nitratoides exilis*) habitat adjoining agricultural lands in Madera County. In a separate report, Williams (in litt., 1989) documented another case of pesticide use near Raisin City, Fresno County, where treated grain was placed within an active Fresno kangaroo rat precinct. Also, farmers have been allowed to place bait on 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 with 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 (Service 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). (1999 National Pesticide Consultation with EPA) However, the EPA's position on the use of rodenticides within the geographic range of the kit fox is that rodent control compounds will have no adverse effects on the kit fox provided that EPA registered compounds are applied with strict observance of EPA approved label restrictions (April 11, 2000, personal communication from L. Turner, EPA, Washington, D.C., to V. Campbell, Service, Sacramento, California). Even the minimal evidence provided above tends to refute this position.

5) Section 9 Violations and Noncompliance with the Terms and Conditions of Existing Biological Opinions: The intentional or unintentional destruction of areas occupied by kit foxes is an issue of serious concern. Section 9 of the Act prohibits the "take" (e.g., harm, harass, pursue, injure, kill) of federally-listed wildlife species. "Harm" (i.e., "take") is further defined to

include habitat modification or degradation that kills or injures wildlife by impairing essential behavioral patterns including breeding, feeding, or sheltering. Congress established two provisions (sections 7 and 10) that allow for the "incidental take" of listed species of wildlife by Federal agencies, non-Federal government agencies, and private interests. Incidental take is defined as "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Such take requires a permit from the Secretary of the Interior that anticipates a specific level of take for each listed species. If no permit is obtained for the incidental take of listed species, the individuals or entities responsible for these actions could be liable under the enforcement provisions of section 9 of the Act if any unauthorized take occurs. There are numerous examples of potential section 9 violations and noncompliance with the terms and conditions of existing biological opinions.

6) Risk of Chance Extinction Owing to Small Population Size, Isolation, and High Natural Fluctuations in Abundance: Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation (e.g. loss of movement corridors), smaller population sizes, and reduced genetic exchange among populations; all of which increase 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 10-fold during 1981 to 1983, increased 7-fold during 1991 to 1994, and then decreased 2-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 livetrapping 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 (approximately 20 km) Fort Hunter Liggett, and only 2 kit foxes have been observed on this installation since 1995 (L. Clark, Wildlife Biologist, Fort Hunter Liggett, pers. comm. to P. White, Fish and Wildlife Service, Sacramento, February 15, 2000). It is unlikely that the current low abundances of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future owing to the limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 80 km) and separated from these installations by barriers to 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). Hence, these populations may 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. Historically, kit foxes likely existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Preliminary genetic assessments indicate that historic gene flow among populations was quite high, with effective dispersal rates of at least one to 4 dispersers per generation (M. Schwartz, University of Montana, Missoula, pers. comm. on March 23, 2000, to P. White, Fish and Wildlife Service, Sacramento, California). This level of genetic dispersal should allow for local adaptation while preventing the loss of any rare alleles. Based on these results, it is likely that northern populations of kit foxes were once panmictic (i.e., randomly mating in a genetic sense), or nearly so, with southern populations. In other words, there were no major barriers to dispersal among populations. Current levels of gene flow also appear to be adequate, however, extensive habitat loss and fragmentation continues to form more or less geographically distinct populations of foxes, which could potentially reduce genetic exchange among them. An increase in inbreeding and the loss of genetic variation 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). One area of particular concern is Santa Nella in western Merced County where pending development plans threaten to eliminate the little suitable habitat that remains and provides a dispersal corridor for kit foxes between the northern and southern portions of their range. Preliminary estimates of expected heterozygosity from foxes in this area indicate that this population may already have reduced genetic variation. Other populations that may be showing the initial signs of genetic isolation are the Lost Hills area and populations in the Salinas-Pajaro River watershed (i.e., Camp Roberts and Fort Hunter Liggett). Preliminary estimates of the mean number of alleles per locus from foxes in these populations indicate that allelic diversity is lower than expected. Although these results may, in part, be due to the small number of foxes sampled in these areas, they may also be indicative of an increase in the amount of inbreeding due to population subdivision (M. Schwartz, University of Montana, Missoula, pers. comm. on March 23, 2000, to P. J. White, Fish and Wildlife Service, Sacramento, California). Further sampling and analyses are necessary to adequately assess the effects of these potential genetic bottlenecks.

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 (Williams and Germano 1992, Goldingay *et al.* 1997, White and Garrott 1999, Cypher *et al.* 1992). 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). In other words, unpredictable, short-term fluctuations in precipitation and, in turn, prey abundance can generate frequent, rapid decreases in kit fox density that increase the extinction risk for small, isolated populations.

There are several recent sightings of San Joaquin kit foxes within 1 mile of the project site (CNDDB 2003). Twenty-one individuals were observed along State Route 46 between the Kern

County/San Luis Obispo County line and the State Route 33/State Route 46 interchange during the surveys that were conducted by a Caltrans biologist between July 24, 2000 and August 3, 2000 (Biological Assessment 2; David Armes, pers. comm. to C. Nagano and Brian Petersen, June 13, 2003). In addition, San Joaquin kit foxes may move 9 miles or more in a single night (Service 1998). Suitable habitat is found in and adjacent to the proposed project. Areas of suitable habitat exist within the project footprint in the form of scrub, ruderal grasslands and agricultural lands. Therefore, the Service believes that the San Joaquin kit fox is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the project, as well as the recent observations of this listed species.

Giant Kangaroo Rat

The giant kangaroo rat was listed as endangered by the Service in 1987 (Federal Register 52:283-288) and by the State of California in 1980. In 1998 a recovery plan for San Joaquin Valley arid upland and riparian terrestrial species was issued that includes the giant kangaroo rat (Service 1998). The giant kangaroo rat is distinguishable from the sympatric San Joaquin kangaroo rat (*Dipodomys nitrtoides*) by size and the number of toes on the hind feet. The hind feet of adult giant kangaroo rats each have five toes and are longer than 47 millimeters (1.85 inches) (Best 1993). The giant kangaroo rat is the largest of more than 20 species in the genus (Best 1993; Grinnell 1922; Hall 1981).

Up to the 1950s colonies of the giant kangaroo rat were spread over hundreds of thousands of acres of continuous habitat in the western San Joaquin Valley, Carrizo Plain, and Cuyama Valley (Grinnell 1932a; Shaw 1934; Hawbecker 1944, 1951). The historical distribution of giant kangaroo rats encompassed a narrow band of gently sloping ground along the western edge of the San Joaquin Valley from the base of the Tehachapi Mountains in the south to a point 16 kilometers (10 miles) south of Los Banos in Merced County in the north (Service 1998). Within this geographic range that was about 701,916 to 755,844 hectares (1,734,465 to 1,867,723 acres), which included different estimates of the amount of nonhabitat depending on various assumptions. The most liberal estimate of historical habitat is 631,724 hectares (1,561,017 acres)(Williams 1992).

The giant kangaroo rat is currently fragmented into six major geographic units: 1) the Panoches region in western Fresno and eastern San Benito counties; 2) Kettleman Hills in Kings County; 3) San Juan Creek Valley in San Luis Obispo County; 4) the Lokern, Elk Hills, McKittrick, Taft and Maricopa areas in western Kern County; 5) Carrizo Plain Natural Area in eastern San Luis Obispo County; and 6) Cuyama Valley in Santa Barbara and San Luis Obispo counties (Williams 1980; O'Farrell *et al.* 1987a; Williams *et al.* 1995). The major units are fragmented into more than 100 smaller populations, many of whom are isolated by several miles of barriers such as steep terrain, with plant communities that are unsuitable as habitat, agriculture, industrial, or urban lands. Extant habitat is estimated to be 11,145 hectares (27,540 acres), which is about 1.8 percent of historical habitat (Williams 1992).

Historically, giant kangaroo rats were believed to inhabit annual grassland communities with few or no shrubs, well-drained sandy loam soils located on gentle slopes (less than 11 percent) in areas with about 16 centimeters (6.3 inches) or less of annual precipitation, and free from flooding in winter (Grinnell 1932a; Shgaw 1934; Hawbecker 1951). However, more recent studies in the remaining fragments of historical habitat found that the species inhabits both grassland and shrub communities on a variety of soil types, on slopes up to about 22 percent, and up to 868 meters (2,850 feet) above sea level. This broader concept of habitat requirements probably reflects the fact that most remaining populations are on poorer and marginal habitats com pared to the habitats of the large, historical populations that existed in areas that are now no longer suitable for the animals. Yet, these studies demonstrate that the preferred habitat of the giant kangaroo rat still was annual grassland communities on gentle slopes of generally less than 10 percent, with friable, sandy-loam soils. Few plots in flat areas were inhabited, probably because of periodic flooding during heavy rainfall (Williams 1992; Williams *et al.* 1995).

Below 400 meters (1,300 feet) at Panoche Creek in western Fresno County and in the Lokern, Buena Vista Valley, and Elk Hills regions of the southern San Joaquin Valley, giant kangaroo rats are found in annual grassland and saltbrush scrub. Scattered common saltbush (*Atriplex polycara*) and spiny saltbush (*Atriplex spinifera*) characterize areas where giant kangaroo rats are associated with shrubs. The most common herbaceous plants are red brome (*Bromus madritensis* ssp. *rubens*), annual fescue (*Vulpia microstachys*), and red-stemmed filaree(Erodium cicutarium) (Williams 1992).

Upper Sonoran subscrub associations support relatively large populations of giant kangaroo rats at elevations above about 400 meters. In the southern portion of the extant geographic range of giant kangaroo rats, these communities are characterised by open stands of the dominant shrub, California ephredra (*Ephedra californica*). Annual grasses and forbs, particularly red-stemmed filaree, peppergrass (*Lepidium nitidium*), and Arabian grass (*Schismus arabicus*) dominate areas between shrubs. Giant kangaroo rats are most numerous where annual grasses and forbs predominate, with scattered California ephedra and fewer shrubs, such as Anderson desert thorn (*Lysium andersonii*) eastwoodia (*Eastwoodia elegans*), and pale-leaf goldenbush (*Isocoma acradenia* var. *bracteosa*) (Williams 1992).

Within the area currently occupied by the giant kangaroo rat, populations of the animal have expanded and declined with changing weather patterns since 1979. At their peak in 1992 to 1993, there probably were about 6 to 10 times more individuals than there were at their low point in the spring of 1991 when a majority of the 11,145 hectares (27,540 acres) probably was uninhabited by the animals and most of the rest of the range was inhabited by less than 10 percent of peak numbers (Williams 1992; Williams *et al.* 1993b, 1995) .

Giant kangarro rats are primarily seed eaters, but they also feed on green plants and insects. They cut the ripening heads of grasses and forbs and then cure them in small surface pits located on the area over their burrow system (Shaw 1934; Williams *et al.* 1993b). They also gather individual seeds scattered over the ground's surface and mixed in the upper layer of the soil. Surface pits

are uniform in diameter and depth (about 2.5 centimeters, or 1 inch), placed vertically in form soil, and filled with seed pods. After placing seeds and seed heads in pits, the animal covers them with a layer of loose, dry dirt. Pits are filled with the contents of the cheek pouches after a single trip to harvest seeds. Before being moved undergroun, the seeds, including filaree and peppergrass, are sun-dried which prevents molding (Shaw 1934).

Giant kangaroo rats forage on the surface from around sunset to near sunrise, though most activity takes place in the first 2 hours after dark. Foraging activity is greatest in the spring as the seeds of annual plants are ripening. Typically, plants, such as peppergrass, ripen first, early caches, mostly in pits instead of stacks, consist of pieces of the seed-bearing stalks of this and other early-ripening species. The ability to transport large quantities of seeds and other food in cheek pouches and their highly developed caching behaviors, coupled with relatively high longevity of adults with established burrow systems, probably allow giant kangaroo rats to survive severe droughts for 1 or 2 years without substantial risk of extirpation (Williams *et al.* 1993b).

Results of studies conducted between 1987 and 1995 in colonies on the Elkhorn Plain and Carrizo Plain indicate that giant kangaroo rats have an adaptable reproductive pattern that is affected by both population density and availability of food. During times of high density, females have a short, winter reproductive season with only one litter produced and there is no breeding by young-of-the-year. This occurred in years of high plant productivity and drought. In contrast, populations at low densities continued to breed into summer during drought. In 1990, a year of severe drought and no seed production, most females appeared to not reproduce; the few that bred apparently failed to successfully raise young. In most years, females were reproductive between December and March or April, but in colonies with low densities, reproduction extended into August or September (Williams *et al.* 1993b).

Estimated home range size range of the giant kangaroo rat from about 60 to 350 square meters (71.8 to 418.6 square yards). There is no significant differences in size of home range between sexes. The core area of the territory, located over the burrow system, or precinct, is the most intensely used location in the home range (Braun 1985). Grinnell (1932a) and Shaw (1934) suggested that territories were occupied by a single animal. More recent studies indicated that multiple individuals may live in precincts. These appeared to be family groups of females and offspring of different ages (Randall 1997).

Estimates of density, employing both trapping and counts of preceincts ranged from 1 animal to 110 animals per hectare (1 to 44 animals per acre)(Grinnell 1932a; Braun 1985; Williams 1992). Changes in density generally coincide with the amount of rainfall and herbaceous plant productivity, though numbers in populations studied in 1989 remained high despite drought and low plant productivity. Large seed caches made in spring 1988 probably carried individuals through 1989 and 1990 during drought (Williams *et al.* 1993b).

The partial results of on-going studies of the population genetics of giant kangaroo rats indicate that northern populations of the species in Fresno and San Benito counties are highly differentiated genetically from the southern populations on the Carrizo Plain. The San Joaquin Valley population is genetically closer the Carrizo Plain population than any of the semi-isolated northern populations. The genetic structure of giant kangaroo rat populations shows that the effective dispersal distanc of the species (e.g. dispersal of genes) is much greater than predicted on the basis of capture-mark-recapture and behavioral studies. Results from trapping show most movements are less than 100 meters (330 feet) and rarely as much as 1 kilometer (0.62 mile)(Jones 1988, 1989). However, the genetic data suggest that effective distances are several times greater than 1 kilometer. There are too few data, and analyses are currently incomplete to make a precise estimate, but they do suggest that effective dispersal over several kilometers and through highly inhospitable habitat.

Since the giant kangaroo rats was listed as an endangered species in 1987, conversion of the animal's habitat has substantially slowed, because most tillable land had already been cultivated and due to a lack of water for irrigation. However, urban and industrial developments, petroleum and mineral exploration and extraction, new energy and water conveyance facilities, construction of communication facilities, and highway construction continues to destroy habitat for the giant kangaroo rat, and increase the threats to the species by reducing and further fragmenting populations. Though some of these recent and future losses will be mitigated for by protecting habitat located elsewhere, they still result in habitat loss for this imperilled rodent.

There are a number of records of the giant kangaroo rat to the north of the action area in Kings County, and south of the action area in the San Juan Creek Valley and west of Lokern (Service 1998). Suitable habitat is found in and adjacent to the action area in the form of annual grassland and scrub plant communities. No giant kangaroo rats were observed by Caltrans during surveys that were conducted at unknown date(s) and time(s) and whose specific methodology also was not described in the documents they have provided to the Service, however, they have proposed to mitigate for effects on the species resulting from the State Route 46 project (Biological Assessment 1). Under normal circumstances, the Service would recommend to Caltrans that additional information, including the results of specific surveys for this species, be provided for us to review prior to initiation of formal consultation as stated in the regulations at 50 CFR 402.14. However, the Service has assumed the presence of the giant kangaroo rat in the action area of the State Route 46 project given the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the project, as well as the observations of this listed species to the north and south of the action area. but especially because of Caltrans' request for an expedited biological opinion, as described in their September 5 and 16, 2003, electronic mail messages to the Service, and their September 18, 2003, telephone message to the Service.

Tipton Kangaroo Rat

The Tipton kangaroo rat was listed as endangered by the Service in 1988 (53 **FR** 25608) and by the State of California in 1989. In 1998 a recovery plan for San Joaquin Valley arid upland and

riparian terrestrial species was drafted which includes the Tipton kangaroo rat (Service 1998). The Tipton kangaroo rat is one of three subspecies of the San Joaquin kangaroo rat; it is morphologically distinguished by being larger than the Fresno kangaroo rat (*Dipodomys nitratoides exilis*) and smaller than the short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*).

The historic geographic distribution of the Tipton kangaroo rat was estimated to cover approximately 695,174 hectares (1,716,480 acres)(Williams 1985). Tipton kangaroo rats were distributed within an area on the floor of the Tulare Basin, extending from approximately the southern margins of Tulare Lake on the north, eastward and southward approximately along the eastern edge of the Valley floor in Tulare and Kern counties, and the southern and western extent of their range was the foothills of the Tehachapi Mountains and the marshes and open waters of Kern and Buena Vista lakes, and along the Buena Vista Slough of the Kern River channel into Goose Lake. The approximate line on the northwest is marked by the Town of Lost Hills in Kern County, Kettlemen City in Kings County, and Westhaven in Fresno County. Prior to the development of Water-diversion and irrigation systems over the pat several decades, this area bounded three large lakes, Tulare, Kern, and Buena Vista, together with marshlands that were unsuitable habitat for the Tipton kangaroo rat (Boolootian 1954; Hoffman 1974; Hafner 1979; Williams *et al.* 1993; Williams 1985).

By July 1985, the area inhabited by the Tipton kangaroo rat had been reduced, primarily by cultivation and urbanization, to about 25,000 hectares (63,000 acres), only about 3.7 percent of its historical range. Additional small parcels not surveyed by Williams (1985) have been since found to be inhabited. Tipton kangaroo rats also have reinhabited several hundred to a few thousand acres that were in crop production in 1985, but have since been retired because of drainage problems, lack of water, or acquired by State and Federal agencies for threatened and endangered species conservation.

Current occurrences are limited to scattered, isolated areas clustered west of Tipton, Pixley, and Earlimart, around Pixley National Wildlife Refuge, Allensworth Ecological Reserve, and Allensworth State Historical Park, in Tulare County; between the Kern National Wildlife Refuge, Delano, and in natural land surrounding Lamont (southeast of Bakerfield), Coles Levee Ecosystem Preserve; Lost Hills area, and other scattered areas in Kern County (Service 1998).

Tipton kangaroo rats collect and carry seeds in fur-lined cheek pouches. Seeds are a staple in their diet, but they also eat small amounts of green, herbaceous vegetation and insects. Known foods include seeds of annual and perennial grasses, particularly wild oats, red brome grass, ripgut (*Bromus diandrus*), soft chess grass (*Bromus hordeaceus*), wild barley (*Hordeum* species), mouse-tail fescue, alkali sacaton, saltgrass; seeds of annual forbs, including filaree, peppergrass, common spikeweed (*Hemizonia pungens*) and shepherd's purse (*Capsella bursa-pastoris*) (Service 1998). Seeds of the woody and semiwoody shrubs, such as iodine bush (*Allenrolfea occidentalis*) and seepweed (*Sueda moquinii*) also are eaten by Tipton kangaroo rat (Service 1998). Most kangaroo rats gather seeds when they are available and cache them for

consumption later. Typically, caches are made in small pits that hold the contents of the two cheek pouches. Caches are located on the surface of the soil and are often scattered over the home range of the individual.

Most female Tipton kangaroo rats appear to have only a single litter, though some adult females have two or more, and females born early in the year also may breed. Eisenberg (1963) and Eisenberg and Issac (1963) described mating behavior and care of young in a captive colony of short-nosed kangaroo rats. Mating probably takes place on the surface within the territory of the female. Young are born in the burrow, probably within a nest of shredded, dry vegetation. Young remain continuously in the burrow until they are fully furred and able to easily move about. Culbertson (1946) believed that young Fresno kangaroo rats were not found out of the burrow and foraging for themselves until about 6 weeks old. This is consistent with estimates for the Tipton kangaroo rat (Service 1998).

Tipton kangaroo rat burrow systems are located in open areas; only in areas of dense shrub cover are burrows usually located beneath shrubs. Burrows are typically simple, but may include interconnecting tunnels. Most burrows are less than 10 inches deep. Burrows of Tipton kangaroo rats are commonly located in slightly elevated mounds, the berms of roads, canal embankments, railroad beds, and bases of shrubs and fences where wind-blown soils accumulate above the level of surrounding terrain. Areas with standing water during portions of winter and spring (vernal pools) become alkaline playas when the water has evaporated allowing Tipton kangaroo rats to recolonize these areas, even though alkaline water lies close to the surface of the soil during the entire year. Presumably, during flooding, individuals are either drowned or captured by predators after being forced from burrows, or escape to higher ground (Williams 1985).

Although Tipton kangaroo rats occur in terrace grasslands devoid of woody shrubs, sparse to moderate shrub cover is associated with populations of high density. Typically, however, burrow systems are located in open areas; only in areas of dense cover are burrows usually located beneath shrubs. Terrain not subject to flooding is important for permanent occupancy by Tipton kangaroo rats. Burrows of Tipton kangaroo rats are commonly located in slightly elevated mounds, the berms of roads, canal embankments, railroad beds, and bases of shrubs and fences where windblown soils accumulate above the level of surrounding terrain. Soft soils such as fine sands and sandy loams, and powdery soils of finer texture and of higher salinity are generally associated with greater densities of Tipton kangaroo rats than are less saline and alkaline, sandy - loam, loam, and clay-loam soils of portions of the eastern margins of their geographic range, supporting terrace grasslands. This may relate to how crumbly the soils are, the type of plant communities they support, or both (Williams 1985).

Tipton kangaroo rats are nocturnal and active year round. They do not hibernate and can not recover unaided from hypothermia. Tappe (1941) reported seeing Tipton kangaroo rats emerge from their burrows and begin above-ground activities as early as seven minutes before sunset in early spring. Other kangaroo rats in the San Joaquin Valley are sometimes seen above ground by

day in March and April (Service 1998), but this is considered to be rare and a deviation from the typical nocturnal activity.

Density estimates range from 2.8 to 3.6 animals per acre. Habitat type and climatic conditions appear to play a role in density. After the end of a 5.5 year drought in April 1991, populations irrupted, peaking in January 1993. In April 1995, following a higher than average rainfall year, the populations declined. During and following the 1994-1995 winter, biologists noted a decline in abundance of kangaroo rats in the southern San Joaquin Valley. Lower than expected trapping results, and decreased sign of activity were observed at several dispersed sites. Dramatic declines were noted for short-nosed, Tipton, and Heermann's kangaroo rats (*Dipodomys heermani*), although only modest reductions were noted for giant kangaroo rat populations on the valley floor (Single et al. 1996).

The construction of dams and canals that made a dependable supply of water available, which allowed the cultivation of the alkaline soils of the saltbush and valley sink scrub and relictual dune communities, was principally responsible for the decline and endangerment of the Tipton kangaroo rat. Widespread, unrestricted use of rodenticides to control California ground squirrels probably contributed to the decline or extirpation of small populations. Urban and industrial development and petroleum extraction all have contributed to habitat destruction. Except for small, isolated populations, predation is unlikely to threaten Tipton kangaroo rats. The increasing fragmentation of the range of Tipton kangaroo rats, however, increases the vulnerability of small populations to predation. Current threats of habitat destruction or modifications come from industrial and agriculturally-related developments, cultivation, and urbanization, and secondarily from flooding.

There are a number of records of the Tipton kangaroo rat in the immediate vicinity of State Route 46 from the Lost Hills area to approximately 10 miles east of Interstate 5 (Biological Assessment 1; Service 1998). Suitable habitat is found in and adjacent to the action area. Areas of suitable habitat exist within the project footprint. Therefore, the Service believes that the Tipton kangaroo is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the project, as well as the observations of this listed species.

Buena Vista Lake Shrew

The Buena Vista Lake shrew is one of nine subspecies of ornate shrew, eight of which are known to occur in California (Hall 1981; Owen and Hoffmann 1983; Maldonado 1992; Wilson and Reeder 1993). Shrews are primarily insectivorous mammals about the size of a mouse. The Buena Vista Lake shrew's back is predominantly black with a buffy-brown speckling pattern, its sides are more buffy-brown than the upper surface, and its underside is smoke-gray (Grinnell 1932). The tail is faintly bicolor and blackens toward the end. The Buena Vista Lake shrew weighs approximately 4 grams (0.14 ounces) and has a total length ranging from 98 to 105

millimeters (mm) (3.85 to 4.13 inches (in)) with a tail length of 35 to 39 mm (1.38 to 1.54 in) (Grinnell 1932).

Shrews are active during the day and night but are rarely seen due to their small size and cryptic behavior. A few species of shrews can enter a daily state of inactivity (torpor) under extreme environmental conditions (Ingles 1965; Churchfield 1990), such as very low ambient temperatures. Shrews do not hibernate. Shrews have a high rate of metabolism because of their small size (Newman and Rudd 1978; McNab 1991). They lose heat rapidly from the surface of their small bodies, and are continually faced with the problem of getting enough food to maintain their body temperatures, especially in cold conditions (Aitchison 1987; Genoud 1988). Shrews feed indiscriminately on the available larvae and adults of several species of aquatic and terrestrial insects, some of which are detrimental to agricultural crops (Holling 1959; Ingles 1965; Newman 1970; Churchfield 1990). They are also known to consume spiders, centipedes, slugs, snails, and earthworms (Jamerson and Peeters 1988) on a seasonally available basis (Aitchison 1987).

Little is known about the reproduction or longevity of Buena Vista Lake shrews. Shrews, on the average, rarely live more than 12 months, and each generation is largely replaced annually (Rudd 1955b). For Buena Vista Lake shrews, the breeding season begins in February or March, and ends with the onset of the dry season in May or June, or may extend later in the year, based on habitat quality and availability of water. It is likely that this subspecies, like other long-tailed shrews, can give birth to two litters of four to six young each per year; the number of litters is usually dependent on how early or late in the year the young are born, and how soon they become sexually active (Rudd 1955b; Owen and Hoffmann 1983).

Buena Vista Lake shrews prefer moist habitat that has a diversity of terrestrial and aquatic insect prey (Kirkland 1991; Ma and Talmage 2001). During surveys conducted in 1988 and 1990 on the Kern Preserve, Freas (1990) found that shrews were more abundant in moderately mesic habitats versus xeric (drier) habitats, with 25 animals being captured in the moister environments and none in the drier habitat. Maldonado (1992) also found shrews at the Kern Preserve to be closely associated with dense, riparian understories that provide food, cover, and moisture. Capture of two Buena Vista Lake shrews at the Kern National Wildlife Refuge occurred in a 0.46-hectare (ha) (1.13-acre (ac)) area that contained the most undisturbed moist riparian habitat, with a mature tree overstory, abundant invertebrates, and ground cover totaling about 90-95 percent (Maldonado *et al.* 1998; J. Maldonado in litt.1998).

Due to the scarcity of Buena Vista Lake shrews, data about their home range size, breeding territory size, and population densities are lacking. Except for the breeding season, shrews in general are solitary. As juveniles, they establish their home range, which is a small area in which they nest, forage, and explore, and where they remain for most of their life (Churchfield 1990). Accurate estimation of home range size based on mark and recapture techniques requires that a minimal number of recaptures be made (Hawes 1977). Ingles (1961) was able to calculate an average home range size in a closely related species, the vagrant shrew (*Sorex vagrans*), found in

the Sierra Nevada of California. The average home range size was approximately 372 square meters (m^2) (4,000 square feet (ft^2)), with breeding males occupying larger territories than breeding females (Hawes 1977). The distribution, and size, of a shrew's territory varies, and is primarily influenced by the availability of food (Ma and Talmage 2001). In a study on population densities of vagrant shrews in western Washington, Newman (1976) calculated densities of 25.8 shrews/ ha (10.1/ac) in the fall and winter, and 50.2 shrews/ha (20.32/ac) at the height of summer.

The Buena Vista Lake shrew formerly occurred in wetlands around Buena Vista Lake, and presumably throughout the Tulare Basin (Grinnell 1932, 1933; Hall 1981; Williams and Kilburn 1984; Williams 1986; Service 1998). The animals were likely distributed throughout the swampy margins of Kern, Buena Vista, Goose, and Tulare lakes. By the time the first Buena Vista Lake shrews were collected and described, these lakes had already been drained and mostly cultivated with only sparse remnants of the original flora and fauna (Grinnell 1932; Mercer and Morgan 1991; Griggs 1992; Service 1998). Nearly all of the valley floor in the Tulare Basin is cultivated, and most of the lakes and marshes have been drained and cultivated (Williams 1986; Werschkull *et al.* 1992; Williams and Kilburn 1992; Williams and Harpster 2001). The great expansion and conversion of natural lands and pasture to irrigated orchards, vegetable crops, cotton, and dairies was made possible by large increases in ground water pumping and the Central Valley Project's delivery of northern California water to the San Joaquin Valley (Mercer and Morgan 1991). The Buena Vista Lake shrew is now known from four isolated locations along an approximately 113-kilometer (km) (70-mile (mi)) stretch on the west side of the Tulare Basin. The four locations are the former Kern Lake Preserve (Kern Preserve) on the old Kern Lake bed, the Kern Fan recharge area, Cole Levee Ecological Preserve (Cole Levee), and the Kern National Wildlife Refuge.

Buena Vista Lake shrews were trapped on the south side of the Kern National Wildlife Refuge in September 1998 (Maldonado *et al.* 1998). Due to the low amount of morphological variation in ornate shrews, and the potential for the introgression with the southern California ornate shrew, genetic analysis of the potential Buena Vista Lake shrew specimens was completed. Tissue samples taken from shrews from the Kern Preserve and the Kern National Wildlife Refuge were genetically analyzed and found distinct from other ornate shrew populations from California and Baja California. These specimens were determined to be Buena Vista Lake shrews (Maldonado *et al.* 2001).

In February and March of 1999, the Endangered Species Recovery Program surveyed six locations within the historic range of the subspecies (Williams and Harpster 2001). They reported capturing five shrews at the Kern National Wildlife Refuge along levee roads less than 1.2 km (0.5 mi) from the location where shrews were captured in 1998 (Endangered Species Recovery Program 1999a). In March 1999, the Endangered Species Recovery Program found nine more shrews along the banks of an artificial pond adjacent to the nature center at the Cole Levee, and five more at the Kern County's water recharge area along the Kern Fan (Endangered Species Recovery Program 1999b; Williams and Harpster 2001).

Before the 1998 and 1999 surveys, staff of the Kern National Wildlife Refuge reported Buena Vista Lake shrews three other times. In 1992, 1994, and 1998/99, nine live shrews and one dead shrew were found at the Kern National Wildlife Refuge (Service 2002). Seven of the shrews were captured around a 323-ha (800-ac) marsh with emergent vegetation and an overstory of willows and cottonwoods (Maldonado *et al.*, 1998; Endangered Species Recovery Program 1999a).

Over the last 20 years, a number of surveys have taken place in other fresh water marshes and moist riparian areas on private and public lands throughout the range of the subspecies and were all unsuccessful in capturing any Buena Vista Lake shrews. These surveys include: The Nature Conservancy's Paine Wildflower Preserve and the Voice of America site west of Delano (Clark *et al.* 1982); along the Kern River Parkway in 1987 (Beedy *et al.* 1992); the Tule Elk State Reserve (Maldonado 1992); the Goose Lake Slough area of the Semitropic ground water banking project, Kern Water District, Kern County (Germano and Tabor 1993); Pixley National Wildlife Refuge in Tulare County (Williams and Harpster 2001); Lake Woollomes in Kern County; and Buena Vista Lake Aquatic Recreation area at the northern portion of the former Buena Vista Lake bed, Kern County (Endangered Species Recovery Program 1999c; Williams and Harpster 2001).

Other remnant patches of wetland and riparian communities within the Tulare Basin that have not been surveyed and may support the Buena Vista Lake shrew, including the City of Bakersfield's water recharge area near the terminus of the Kern River at Buena Vista Lake (Service 1998; Williams and Harpster 2001); Goose Lake and Jerry Slough, overflow channels of the Kern River, located 10 miles south of Kern National Wildlife Refuge, owned and managed by the Semitropic Water District as a ground water recharge basin (Germano and Tabor 1993); and the privately owned Crighton Ranch, located near the eastern shore of historical Tulare Lake in Tulare County (Williams and Harpster 2001). Privately owned lands that may support Buena Vista Lake shrews are located around Sand Ridge flood basin, Buena Vista Slough, Goose Lake and Goose Lake Slough, Creighton Ranch, and along the Kern River west of Bakersfield, California (Service 1998, 2002; Williams and Harpster 2001).

Rapid agricultural, urban, and energy developments since the early 1900s have severely reduced and fragmented native habitats throughout the San Joaquin Valley (Mercer and Morgan 1991). Historically, the former Tulare, Buena Vista, Goose, and Kern Lakes, along with their respective overflow marshes, covered 19 percent of the Tulare Basin in the southern San Joaquin Valley (Werschkull *et al.* 1992). Around the turn of the 20th century, the Tulare Basin had 104,890 ha (259,189 ac) of valley fresh water marsh, 177,005 ha (437,388 ac) of valley mixed-riparian forests, and 105,333 ha (260,283 ac) of valley sink scrub, for a total of 387,229 ha (956,860 ac) of potentially suitable Buena Vista Lake shrew habitat (Service 1986). By the early 1980s, the combined total had been reduced to 19,019 ha (46,996 ac), less than 5 percent of the original habitat (Service 1986; Werschkull *et al.* 1992). As of 1995, intensive irrigated agriculture

comprised 1,239,961 ha (3,064,000 ac) or about 96 percent of the total lands within the Tulare Basin.

All of the natural plant communities in the Tulare Basin have been affected by the transformation of this area to production of food, fiber, and fuel (Spiegel and Anderson 1992; Griggs *et al.* 1992). As more canals were built, and more water was diverted for irrigation of the floodplains of the major rivers of the southern San Joaquin Valley, less water was available to keep the riparian forests alive, and less water reached the lakes. By the early 1930s, the former Tulare, Buena Vista, Goose, and Kern lakes were virtually dry and open for cultivation (Griggs *et al.* 1992).

Although no cases of disease related to Buena Vista Lake shrews have been documented, the possibility of disease and associated threats exists. The small population size and restricted distribution increases their vulnerability to epidemic diseases. Buena Vista Lake shrews, like most small mammals, are host to numerous internal and external parasites, such as round worms, mites, ticks, and fleas, that may infest individuals and local populations in varying degrees with varying adverse effects (Churchfield 1990; J. Maldonado, pers. comm., 1998). However, the significance of the threat of disease and parasites to the Buena Vista Lake shrew is not known.

Most vertebrate carnivores of the Tulare Basin, such as coyotes, foxes, long-tailed weasels (*Mustela frenata*), raccoons, feral cats (*Felis cattus*), and dogs (*Canis familiaris*), as well as certain avian predators such as hawks, owls, herons, jays, and egrets, are all known predators of small mammals. While many predators find shrews unpalatable because of the distasteful secretion and offensive odor from their flank glands and feces, several of the avian predators, such as barn owls (*Tyto alba*), short eared owls (*Asio flammeus*), long-eared owls (*Asio otus*), and great horned owls (*Bubo virginianus*), have a poor sense of smell and are known to prey on shrews (Ingles 1965; Aitchison 1987; Marti 1992; Holt and Leasure 1993; Marks *et al.* 1994; Houston *et al.* 1998), and probably Buena Vista Lake shrews (J. Maldonado, pers. comm., 1998). The overall impact that predation may have on the number of individuals and densities of Buena Vista Lake shrews remains unknown.

Selenium toxicity represents a serious threat to the continued existence and recovery of the Buena Vista Lake shrew, not only at the two known locations at the Kern Preserve and the Kern National Wildlife Refuge , but any potential locations throughout the Tulare Basin. The soils on the western side of the San Joaquin Valley have naturally elevated selenium concentrations. Due to extensive agricultural irrigation, selenium has been leached from the soils and concentrated in the shallow groundwater along the western side of the San Joaquin Valley. Where this shallow groundwater reaches the surface or subsurface, selenium can accumulate in biota (flora and fauna) and result in adverse effects to growth, reproduction, and survival. Elevated concentrations of selenium have caused major wildlife mortalities in places like Kesterson (Moore *et al.* 1989). The EPA's water quality criterion for the protection of aquatic species is currently 5 micrograms/liter (µg/L) but is being reevaluated by that agency (65 FR 31681). The selenium standard to protect wetlands in the grassland area of the San Joaquin Valley is 2 µg/L.

Some of the highest selenium levels in the western United States (greater than 1,100 µg/L) have been measured from groundwater within the southern San Joaquin Valley, and greater than 200 µg/L have been measured in drainwater evaporation ponds servicing the agricultural lands immediately surrounding the only known populations of Buena Vista Lake shrews in the Tulare Basin (California Regional Water Quality Control Board (RWQCB) 1996; DWR 1997; Seiler et al. 1999).

Buena Vista Lake shrews are exposed to the wide-scale use of pesticides throughout their range, because they currently exist on small remnant patches of natural habitat in and around the margins of an otherwise agriculturally dominated landscape. Buena Vista Lake shrews could be directly exposed to lethal and sublethal concentrations of pesticides from drift or direct spraying of crops, canals and ditch banks, wetland or riparian edges, and roadsides where shrews might exist. Reduced reproduction in Buena Vista Lake shrews could be directly caused by pesticides through grooming, and secondarily from feeding on contaminated insects (Sheffield and Lochmiller 2001). Buena Vista Lake shrews could also die from starvation by the loss of their prey base (Ma and Talmage 2001; Sheffield and Lochmiller 2001). Exposure to organophosphate and carbamate insecticides can inhibit brain acetylcholinesterase activity leading to alterations in behavior and motor activity. Laboratory experiments have shown that behavioral activities such as rearing, exploring for food, and sniffing can be depressed for up to 6 hours in the common shrew (*Sorex araneus*) from environmental and dietary exposure to sublethal doses of a widely used insecticide called dimethoate (Dell'Omo *et al.* 1999). In their natural habitat, depression in such behavioral and motor activities could make the shrews more vulnerable to predation, and starvation. In addition, shrews may feed heavily on intoxicated arthropods after application of insecticides, and, therefore, ingest higher concentrations of pesticides than would normally be available (Stehn et al. 1976; Schauber *et al.* 1997; Sheffield and Lochmiller 2001). Fresno, Kern, and Tulare counties are the three highest users of pesticides in California with 16,773,126 kilograms (kg) (36,978,444 pounds (lb); 10,985,201 kg (24,218,242 lb); and 7,562,064 kg (16,671,512 lb) of pesticide active ingredients used respectively in 1999 (Pesticide Board 2000).

The only known populations of Buena Vista Lake shrews are also vulnerable to environmental risks associated with small, restricted populations. Impacts to populations that can lead to extinction include the loss or alteration of essential elements for breeding, feeding, and sheltering; the introduction of limiting factors into the environment such as poison or predators; and catastrophic random changes or environmental perturbations, such as floods, droughts, or disease (Gilpin and Soulé 1986). Many extinctions are the result of a severe reduction of population size by some deterministic event such as lowered birth rates due to exposure to certain toxins such as selenium, followed by a random natural event such as a crash in insect populations from an extended drought which causes the extirpation of the species. The smaller a population is, the greater its vulnerability to such perturbations (Terbough and Winter 1980; Gilpin and Soulé 1986; Shaffer 1987). The elements of risk that are amplified in very small populations include: (1) the impact of high death rates or low birth rates; (2) the effects of genetic drift (random fluctuations in gene frequencies) and inbreeding; and (3) deterioration in

environmental quality (Gilpin and Soulé 1986; Lande 1999). When the number of individuals in a population of a species or subspecies is sufficiently low, the effects of inbreeding may result in the expression of deleterious genes in the population (Gilpin 1987). Deleterious genes reduce individual fitness in various ways, most typically by decreasing survivorship of young. Genetic drift in small populations decreases genetic variation due to random changes in gene frequency from one generation to the next. This reduction of variability within a population limits the ability of that population to adapt to environmental changes (Lande 1999).

The Buena Vista Lake shrew has been documented to inhabit the Kern National Wildlife Refuge, which is located immediately to the north of the project site on the east site of Interstate 5. Suitable habitat was observed on the east side of Interstate 5 in and adjacent to the action area. Areas of suitable habitat exists within the project footprint at the West Side Kern River Canal located immediately east of Interstate 5. No surveys by Caltrans apparently have been conducted for the Buena Vista Lake shrew in the action area of the State Route 46 project. Under normal circumstances, the Service would recommend to Caltrans that additional information, including the results of focused surveys for this species, be provided to us for review prior to initiation of formal consultation as stated in the regulations at 50 CFR 402.14. However, the Service has assumed the presence of the Buena Vista Lake shrew in the action area of the State Route 46 project given the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the project, as well as the observations of this listed species to the north of the action area, and especially because of Caltrans' request for an expedited biological opinion, as described in their September 5 and 16, 2003, electronic mail messages to the Service, and their September 18, 2003, telephone message to the Service.

Blunt-Nosed Leopard Lizard

The blunt-nosed leopard lizard was listed as endangered by the State of California in 1971. The lizard was listed as an endangered species federally in 1967 (**Federal Register** 32:4001). A recovery plan was first prepared in 1980 and revised in 1985 (Service 1985). In 1998, a recovery plan for San Joaquin Valley upland terrestrial species was issued that includes the blunt-nosed leopard lizard (Service 1998).

The blunt-nosed leopard lizard was described and named by Stejneger (1890) as *Crotaphytus silus*, from a specimen collected in Fresno, California. Cope (1900), however, considered the blunt-nosed leopard lizard to be a subspecies of the long-nosed leopard lizard (*C. wislizenii*), and listed it as *C. w. silus*. Smith (1946) separated the collared from the leopard lizards, placing the latter in the genus *Gambelia*. Montanucci, et al. (1975) again separated *Gambelia* from *Crotaphytus*, resulting in the name *Gambelia silus* (Jennings 1987). Frost and Collins (1988), Collins (1990), and Germano and Williams (1993) used the spelling *sila* to properly agree in gender with the genus *Gambelia*.

The blunt-nosed leopard lizard is a relatively large lizard of the family Iguanidae, with a long, regenerative tail; long, powerful hind limbs; and a short, blunt snout (Smith 1946, Stebbins 1954,

1985). Males are larger than females, ranging in size from 87 to 120 millimeters (3.4 to 4.7 inches) snout-vent length (Tollestrup 1982). From snout to vent, females are 86 to 111 millimeters long. Adult males weigh between 31.8 and 37.4 grams, and adult females weigh between 20.6 and 29.3 grams. Males are distinguished from females by their enlarged postanal scales, femoral pores (visible pores on the underside of the thigh), temporal and mandibular muscles (muscles on the skull that close the jaws), and tail base (Montanucci 1965). Although blunt-nosed leopard lizards are darker than other leopard lizards, they exhibit tremendous variation in color and pattern on the back (Tanner and Banta 1963, Montanucci 1965, 1970). Background color ranges from yellowish or light gray-brown to dark brown depending on the surrounding soil color and vegetation association (Smith 1946, Montanucci 1965, 1970, Stebbins 1985). The color pattern on the back consists of longitudinal rows of dark spots interrupted by a series of from 7 to 10 white, cream-colored, or yellow transverse bands. Except for the throat, undersides are uniformly white to yellow in immature lizards and prenuptial females. Nuptial females have bright red-orange markings on the sides of the head and body and the undersides of the thighs and tail. This color fades to pink or light orange by late July. Males in many populations develop a nuptial color during the breeding season that spreads over the entire undersides of the body and limbs.

The blunt-nosed leopard lizard is endemic to the San Joaquin Valley of central California. Although the boundaries of its original distribution are uncertain, blunt-nosed leopard lizards probably occurred from Stanislaus County in the north, southward to the Tehachapi Mountains in Kern County. Except where their range extends into the Carrizo Plain and Cuyama Valley west of the southwestern end of the San Joaquin Valley, the foothills of the Sierra Nevada and Coast Range Mountains, respectively, define the eastern and western boundaries of its distribution. The blunt-nosed leopard lizard is not found above 792 meters (2,600 feet) in elevation.

The blunt-nosed leopard lizard was distributed historically throughout the San Joaquin Valley and adjacent interior foothills and plains, extending from central Stanislaus County south to extreme northeastern Santa Barbara County. Today its distribution is limited to scattered parcels of undeveloped land, with the greatest concentrations occurring on the west side of the valley floor and in the foothills of the Transverse Range. Blunt-nosed leopard lizards inhabit open, sparsely vegetated areas of low relief on the San Joaquin Valley floor and in the surrounding foothills (Smith 1946, Montanucci 1965). On the Valley floor, they are most commonly found in the Nonnative Grassland and Valley Sink Scrub natural communities described by Holland (1986). Valley Needlegrass Grassland, Nonnative (Annual) Grassland, and Alkali Playa (Holland 1986) also provide suitable habitat for the lizard on the Valley floor. Blunt-nosed leopard lizards also inhabit Valley Saltbush Scrub, which is a low shrubland, with an annual grassland understory, that occurs on the gently sloping alluvial fans of the foothills of the southern San Joaquin Valley and adjacent Carrizo Plain.

While the blunt-nosed leopard lizard can occupy grassland used for grazing it prefers lands with scattered shrubs and sparse grass/forb cover. Leopard lizards use small rodent burrows for shelter from predators and temperature extremes (Tollestrup 1979*b*). Burrows are usually

abandoned ground squirrel tunnels, or occupied or abandoned kangaroo rat tunnels. Each lizard uses several burrows without preference, but will avoid those occupied by predators or other leopard lizards. In areas of low mammal burrow density, lizards will construct shallow, simple tunnels in earth berms or under rocks. Potential predators are numerous and include snakes, predatory birds, and most carnivorous mammals (Montanucci 1965).

Adult lizards often seek safety in burrows, while immature lizards use rock piles, trash piles, and brush. The lizards use burrows constructed by mammals, such as kangaroo rats, for overwintering and estivation. Adult lizards hibernate during the colder months of winter, and are less active in the hotter months of late summer. Adults are active above ground from about March or April through September. Hatchlings are active until mid-October or November, depending on weather (Service 1998).

Blunt-nosed leopard lizards feed primarily on insects (mostly grasshoppers, crickets, and moths) (95.5%) and other lizards (4.5%), although some plant material is rarely eaten or, perhaps, unintentionally consumed with animal prey Kato, *et al.,* 1987a). They appear to feed opportunistically on animals, eating whatever is available in the size range they can overcome and swallow. Lizard species taken as prey include: side-blotched lizards (*Uta stansburiana*), coast horned lizards (*Phrynosoma coronatum*), California whiptails (*Cnemidophorus tigris*), and spiny lizards (*Sceloporus* spp.).

Breeding activity begins within a month of emergence from dormancy and lasts from the end of April through the beginning of June, and in some years to near the end of June. During this period, and for a month or more afterward, the adults often are seen in pairs and frequently occupy the same burrow systems. Two to six eggs averaging 15.6 by 25.8 millimeters (0.6 by 1.0 inch) are laid in June and July, and their numbers are correlated with the size of the female (Montanucci 1967). Sexual maturity is reached in from 9 to 21 months, depending on the sex and environmental conditions (USFWS 1985a).

Social behavior is more highly developed in the blunt-nosed leopard lizard than in the long-nosed leopard lizard. For example, territorial defense and related behavioral activity are completely absent in the long-nosed leopard lizard, whereas blunt-nosed leopard lizards are highly combative in establishing and maintaining territories in a typically iguanid fashion.

Seasonal above-ground activity is correlated with weather conditions, primarily temperature. Optimal activity occurs when ground temperatures are between 22 degrees and 36 degrees Celsius (72 and 97 degrees Fahrenheit) or slightly higher (USFWS 1985a,). Smaller lizards and young have a wider activity range than the adults (Montanucci 1965). This results in the smaller, subadult lizards emerging from hibernation earlier than adults, remaining active later in the year, and being active during the day earlier and later than adults (Montanucci 1965).

There are no current overall population size estimates for the species. Uptain et al. (1985) reported densities ranging from 0.3 to 10.8 lizards per hectare (0.1 to 4.2 per acre) for a

population on the Pixley National Wildlife Refuge in Tulare County. In a previous study of this population, Tollestrup (1979) estimated an average density of 3.3 lizards per hectare (1.3 per acre). In 1991, after three previous years of severe drought, two 8.1-hectare (20-acre) plots had estimated densities of 6.7 and 7.0 lizards per hectare (2.7 and 2.8 per acre) on Pixley National Wildlife Refuge (Williams and Germano, 1991). On the Elkhorn Plain, estimated population size on two 8.1-hectare plots of adult and subadult blunt-nosed leopard lizards in June (period of peak above-ground activity) varied between 0 in 1990 to more than 170 in 1993 (but see below).

Lizard habitat has been significantly reduced, degraded, and fragmented by agricultural development, urban development, petroleum and mineral extraction, livestock grazing, pesticide application, and off-road vehicle use (Service 1998). Habitat disturbance, destruction, and fragmentation continue as the greatest threats to blunt-nosed leopard lizard populations. Disturbances and modifications of habitats within areas of mineral and petroleum development pose lesser, but continuing threats as they degrade the habitat. Direct mortality occurs when animals are killed in their burrows during construction, killed by vehicle traffic, drowned in oil, or fall into excavated areas from which they are unable to escape. Displaced lizards may be unable to survive in adjacent habitat if it is already occupied or unsuitable for colonization.

Livestock grazing can result in removal of herbaceous vegetation and shrub cover and destruction of rodent burrows used by lizards for shelter. Unlike cultivation of row crops, which precludes use by leopard lizards, light or moderate grazing may be beneficial. The use of pesticides may directly and indirectly affect blunt-nosed leopard lizards. The insecticide Malathion has been used since 1969 to control the beet leafhopper, and its use may reduce insect prey populations. Fumigants such as methyl bromide are used to control ground squirrels. Because leopard lizards often inhabit ground squirrel burrows, they may be inadvertently poisoned.

By 1979, only approximately 370,000 acres out of a total of approximately 8.5 million acres on the San Joaquin Valley floor remained as non-developed land (Williams 1985, Service 1980a). Data from the California Department of Fish and Game (1985) and Service file information indicate that between 1977 and 1988, essential habitat for the blunt-nosed leopard lizard (*Gambelia sila*) declined by about 80 percent – from 311,680 acres to 63,060 acres, an average of about 22,000 acres per year (Biological Opinion for the Interim Water Contract Renewal, Ref. No. 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

The currently occupied range of the blunt-nosed leopard lizard is in scattered parcels of undeveloped land on the Valley floor, and in the foothills of the Coast Range. Surveys in the northern part of the San Joaquin Valley documented the occurrence of the blunt-nosed leopard lizard in the Firebaugh and Madera Essential Habitat areas. Essential Habitat Areas were defined in previous recovery plan editions for this species as undeveloped wildlands containing suitable habitat for the blunt-nosed leopard lizard and essential to the continued survival of the species (USFWS 1980a 1985). Within the last decade, at least 2800 acres of leopard lizard habitat in

western Madera County has been lost through agricultural conversions (P. Kelly, pers. comm.). More recently, the population in the Madera Ranch area is believed to be extirpated (P. Kelly, pers. comm.), and populations in the Lokern and Elkhorn areas are also believed to be severely depressed or extirpated (D. Germano, pers comm.).

In the southern San Joaquin Valley, extant populations are known to occur on the Pixley National Wildlife Refuge, Liberty Farms, Allensworth State Park, Kern National Wildlife Refuge, Antelope Plain, Buttonwillow, Elk Hills, and Tupman Essential Habitat areas, on the Carrizo and Elkhorn Plains, north of Bakersfield around Poso Creek, and in western Kern County in the area around the towns of Maricopa, McKittrick, and Taft (Byrne 1987, R.L. Anderson pers. comm., L.K. Spiegel pers. comm.). Remaining undeveloped lands farther north that support blunt-nosed leopard lizard populations include the Ciervo, Tumey, and Panoche Hills, Anticline Ridge, Pleasant Valley, and the Lone Tree, Sandy Mush Road, Whitesbridge, Horse Pasture, and Kettleman Hills Essential Habitat areas (CDFG 1985). The species is presumed to be present still in the upper Cuyama Valley, though no recent inventory is known for that area.

The blunt-nosed leopard lizard has been documented to inhabit the action area (CNDDB 2003; Service 1998, Biological Assessment 1). Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. Therefore, the Service believes that the blunt-nosed leopard lizard is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the project, as well as the observations of this listed species.

Hoover's Woolly-star

Hoover's woolly-star was federally listed as threatened in July 19, 1990 (55 **FR** 29361). It has not been listed by the State as either threatened or endangered. The multi-species Valley Recovery Plan issued by the Service in 1998 addresses Hoover's woolly-star.

Prior to 1986, Hoover's woolly-star was known from 19 sites in 4 counties (Service 1998). The majority of occurrences were on the San Joaquin Valley and Cuyama Valley floors. and others were from the low mountains at the west side of the San Joaquin Valley. In Kern County, Hoover's woolly-star was known from the vicinities of Lokern, Oildale, Semitrophic, Shaffter, and the Tremblor Range. In Fresno County, known occurrences were concentrated near Kerman, Mendota, and Raisin City, except for one site each in the Jacalitos and Panoche Hills. The Cuyama Valley records consisted of one collection each from Santa Barbara and San Luis Obispo counties (Taylor and Davilla 1986).

Since 1986, Hoover's woolly-star has been located in Kings and San Benito counties, and at numerous additional sites in Santa Barbara, San Luis Obispo, Kern, and Fresno counties (Service 1998). Most of the occurrences are concentrated in 4 metapopulations. In descending order by estimated number of individuals, these metapopulations are: 1) Kettleman Hills in Fresno and Kings counties, 2) Carrizo Plain-Elkhorn Plain-Tremblor Range-Caliente Mountains-Cuyama

Valley-Sierra Madre in San Luis Obispo, Santa Barbara, and extreme western Kern counties, 3) Lokern-Elk Hills-Buena Vista Hills-Coles Levee-Taft-Maricopa in Kern County, and 4) Antelope Plain-Lost Hills-Semitrophic in Kern County. Small isolated populations occur in scattered areas including the Alkalini Sink Reserve and the Guijarral, Jacalitos, Panoche, and Tumey Hills in Fresno Count; Buttonwillow, Devil's Den, Lamont, Midway Valley, and Rosedale in Kern County; and the Panoche Hills in San Benito County (Lewis 1992, 1994; California Department of Fish and Game 1995; Holmstead 1993; Danielson *et al.* 1994; EG&G Energy Measurements 1995a, 19995b). According to Skinner and Pavlik (1994), Hoover's woolly-star also occurs in Tulare County.

Hoover's woolly-star is an annual, but the seeds germinate later in the gorwing season than do those of many of the associated annual plants. Seedlings may emerge from January or February until mid-April (Taylor and Davilla 1986). The typical flowering period for Hoover's woolly-star extends from March into June (Munz and Keck 1959; Skinner and Pavlik 1994; Lewis 1992).

Populations of this plant are found in alkalini sinks, washes, on both north- and south-facing slopes, and on ridgetops. It occurs in a wide variety of plant communities. Hoover's woolly-star seems to be much more adaptable than other endemic plants in the San Joaquin Valley. Optimal habitat for this species are characterized by stabilized silty to sandy soils, and the presence of cryptogamic crusts. However, Hoover's woolly-star has been found on loamy soils, in areas of dense vegetation, and in areas lacking cryptogamic crusts. Hoover's woolly-star may recolonize disturbed soils surfaces such as well pads and dirt roads within one year after the disturbance ceases if seed sources are found in the vicinity.

o

San Joaquin Valley floor populations of Hoover's woolly-star have been destroyed primarily by farming operations and secondarily by urban development. In 1986, an estimated 92 percent of the known extant populations of Hoover's woolly-star were threatened by future conversions to agricultural use, groundwater recharge basins, and oil and gas development (Taylor and Davilla 1986). Hoover's woolly-star exists on some remnants of native habitat in western Kern County. Although some sites contain substantial populations (5,000-40,000 individuals), most of the remaining sites on the valley floor are at risk because they are isolated from one another, range in size from approximately 1 acre to less than 400 acres, and contain fewer than 1,000 individuals (55 **FR** 29361). Occurrences of the plant in the Bakersfield metropolitan area are threatened by development. Conversion of land from native habitat or grazing to row crops continues to threaten Hoover's woolly-star populations in western Kern County (Service 1998).

Hoover's woolly-star has been documented to inhabit the action area (CNDDB 2003; Service 1998, Biological Assessment 1). Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. Hoover's woolly-star was not observed by Caltrans during surveys on the west side of the project between the San Luis Obispo County/Kern County line and Interstate 5 that were conducted at unknown date(s) and time(s) and whose specific methodology also is not described in the documents they

have provided to the Service, however, they have proposed to mitigate for effects on the species resulting from the State Route 46 project (Biological Assessment 1); the listed plant was not observed during surveys for dominant plant species from Intersate 5 east to post mile 37.5 that was conducted on May 11, 1999, and on April 10, 2000, and Caltrans stated that pre-construction surveys would be conducted for the species and the Service would be contacted if it was located by them (Biological Assessment 2). Under normal circumstances, the Service would have recommended to Caltrans that additional information be provided to us, including the results of focused protocol surveys for this species, prior to initiation of formal consultation as stated in the regulations 50 CFR 402.14. However, the Service has assumed the presence of Hoover's woolly-star in the action area of the State Route 46 project given the biology and ecology of the plant, the presence of suitable habitat in and adjacent to the project, as well as the records of this listed species in the action area. and especially because of Caltrans' request for an expedited biological opinion, as described in their September 5 and 16, 2003, electronic mail messages to the Service, and their September 18, 2003, telephone message to the Service.

San Joaquin Woolly-Threads

San Joaquin woolly-threads, a member of the sunflower family (Asteraceae), was listed as an endangered species in 1990 (**FR** 55:29361-29370). It is an annual herb with tiny yellow flower heads clustered at the tips of erect to trailing stems covered with tangled hairs. It occurs on neutral to subalkaline soils that were deposited in geologic times by flowing water. On the San Joaquin Valley floor, it typically is found on sandy or sandy loam soils, whereas in the Carrizo Plain it occurs on silty soils (USFWS 1997). San Joaquin woolly-threads occupies microhabitats in non-native grassland, valley saltbush scrub, interior Coast Range saltbush scrub, and upper sonoran subshrub communities with less than 10% shrub cover but in either sparse or dense herbaceous cover. It has been reported from elevations ranging from 200 to 850 feet on the San Joaquin Valley floor, and from 2,000 to 2,600 feet in San Luis Obispo and Santa Barbara Counties (Service 1997).

The seeds of San Joaquin woolly-threads may germinate as early as November, but usually germinate in December and January. Flowering generally occurs between late February and early April, and may continue into May (Service 1997). Seed production depends on plant size and number of flower heads (Service 1997). In contrast to the more persistent skeletons of Hoover's woolly-star, all trace of San Joaquin woolly-threads plants disappears rapidly after seeds are shed in April or May. Seed dispersal agents are unknown, but may possibly include wind, water, and animals (Service 1997). Seed-dormancy mechanisms are thought to allow the formation of a substantial seed bank in the soil (Service 1997).

San Joaquin woolly-threads currently exists as four metapopulations and several small, isolated populations (Service 1997). The largest metapopulation occurs on the Carrizo Plain, where occupied habitat has been observed to vary from a high of 2,800 acres in a favorable year, to much less in years of lower rainfall (Service 1997). Much smaller metapopulations occur in Kern County near Lost Hills, in the Kettleman Hills of Fresno and Kings counties, and in the

Jacalitos Hills of Fresno County. Isolated occurrences are known from the Panoche Hills in Fresno and San Benito counties, near the city of Bakersfield, and the Cuyama Valley (Service 1997).

Potential threats to one or more sites or metapopulations of San Joaquin woolly-threads include commercial development, conversion of natural habitat to agriculture, increased petroleum production, competition from non-native plants, and either complete removal or grazing or uncontrolled grazing.

San Joaquin woolly-threads has been documented to inhabit the action area (CNDDB 2003; Service 1998, Biological Assessment 1). Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. San Joaquin woolly-threads has been documented to inhabit the action area (CNDDB 2003; Service 1998, Biological Assessment 1). Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. This listed plant was not observed by Caltrans during surveys on the west side of the project between the San Luis Obispo County/Kern County line and Interstate 5 that were conducted at unknown date(s) and time(s) and whose specific methodology also is not described in the documents they have provided to the Service, however, they have proposed to mitigate for effects on the species resulting from the State Route 46 project (Biological Assessment 1); the listed plant was not observed during surveys for dominant plant species from Interstate 5 east to post mile 37.5 that was conducted on May 11, 1999, and on April 10, 2000, and Caltrans stated that pre-construction surveys would be conducted for the species and the Service would be contacted if it was located by them (Biological Assessment 2). Under normal circumstances, the Service would have recommended to Caltrans that additional information be provided to us, including the results of focused protocol surveys for this species, prior to initiation of formal consultation as stated in the regulations at 402.14. However, the Service has assumed the presence of San Joaquin woolly-threads in the action area of the State Route 46 project given the biology and ecology of the plant, the presence of suitable habitat in and adjacent to the project, as well as the records of this listed species in the action area, and especially because of Caltrans' request for an expedited biological opinion, as described in their September 5 and 16, 2003, electronic mail messages to the Service, and their September 18, 2003, telephone message to the Service.

California Jewelflower

California jewelflower was listed as an endangered species in 1990 (**FR** 55:29361-29370). California jewelflower, an annual herb belonging to the mustard family (Brassicaceae), has flattened, sword-shaped fruits. Known populations of California jewelflower occur in non-native grassland, upper sonoran subshrub scrub, and cismontane juniper woodland and scrub communities (Service 1997). Historical records suggest that it also occurred in the valley saltbush scrub community in the past (Service 1997). Populations of California jewelflower have been reported from subalkaline, sandy loam soils at elevations of approximately 240 to 2,950 feet (Service 1997). Potential threats to one or more of the remaining populations of California

jewelflower include competition from non-native plants, pesticide effects on pollinators, and small population size, in addition to development on private land in the Santa Barbara Canyon area, and potentially cattle grazing on private land populations of California jewelflower, if grazing occurs between the rosette stage and seed set (Service 1997).

The naturally-occurring populations known to exist today are distributed in three centers of concentration: (1) Santa Barbara Canyon, (2) the Carrizo Plain, and (3) the Kreyenhagen Hills in Fresno County (Service 1997). The Santa Barbara Canyon metapopulation occurs on the terraces just west of the Cuyama River and includes approximately 30 acres of occupied habitat (Service 1997). The Carrizo Plain metapopulation is confined to the western side of the Carrizo Plain and encompasses approximately 10 acres of occupied habitat (Service 1997). The Kreyenhagen Hills metapopulation includes 4 small colonies within a small area of rolling hills (Service 1997).

Seeds of California jewelflower begin to germinate in the fall, and seedlings may continue to emerge for several months. The seedlings develop into rosettes of leaves during the winter months, after which stems elongate and flower buds appear in February or March. Flowering and seed set may continue as late as May in years of favorable rainfall and temperatures (Service 1997). It is thought that California jewelflower forms a persistent seed bank, but seeds appear to germinate only when exposed to conditions simulating prolonged weathering (Service 1997). Seed dispersal agents are unknown, but may include gravity, seed-eating animals such as giant kangaroo rats, wind, and water (Service 1997).

California jewelflower is considered to be palatable to livestock and vulnerable to direct grazing effects during active growth. Grazing prescriptions that allow successful growth, reproduction, and recovery of this species likely can be developed, but further study is needed. In the meantime, moderate livestock grazing between seed-shatter and germination, or no grazing at all, are recommended unless conducted under controlled experimental conditions.

California jewelflower has been documented to inhabit the action area (CNDDB 2003; Service 1998). Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. Suitable habitat exists within and adjacent to the project footprint from the San Luis Obispo County/Kern County line east to post mile 37.5. This listed plant was not observed by Caltrans during surveys on the west side of the project between the San Luis Obispo County/Kern County line and Interstate 5 that were conducted at unknown date(s) and time(s) and whose specific methodology also is not described in the documents they have provided to the Service, however, they have proposed to mitigate for effects on the species resulting from the State Route 46 project (Biological Assessment 1); the listed plant was not observed during surveys for dominant plant species from Interstate 5 east to post mile 37.5 that was conducted on May 11, 1999, and on April 10, 2000, and Caltrans stated that pre-construction surveys would be conducted for the species and the Service would be contacted if it was located by them (Biological Assessment 2). Under normal circumstances, the Service would have recommended to Caltrans that additional information be provided to us, including focused protocol surveys for this species, prior to initiation of formal consultation as

stated in the regulations at 402.14. However, the Service has assumed the presence of the California jewelflower in the action area of the State Route 46 project given the biology and ecology of the plant, the presence of suitable habitat in and adjacent to the project, as well as the records of this listed species in the action area, and especially because of Caltrans' request for an expedited biological opinion, as described in their September 5 and 16, 2003, electronic mail messages to the Service, and their September 18, 2003, telephone message to the Service

Effects of the Proposed Action

There will be 20.34 acres of temporary effects to listed species and their habitats and 41.8 acres of effects to listed species and permanent loss of their habitats between Interstate 5 and post mile 37.5; there will be 189.9 acres of temporary effects to listed species and their habitats and 299.9 acres of effects to listed species and permanent loss of their habitats between the Kern County/San Luis Obispo County line to Interstate 5 (Biological Assessment 1; Biological Assessment 2). and

San Joaquin kit fox

The proposed State Route 46 project likely will result in be a number of adverse effects to the San Joaquin kit fox. There is a likelihood of direct mortality to the animal from either crushing or entombment in dens due to construction activities, vehicle strikes, falling into trenches or pits, being shot, being buried after becoming trapped in pipes, injured or killed by pet cats or dogs owned by construction related personnel, poisoned by rodenticides or other pesticides, injured or killed by predators attracted to construction-related food or trash at the site, harassment from noise and vibration. San Joaquin kit foxes may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night time foraging. San Joaquin kit foxes inhabiting the project site and surrounding vicinity (for purposes of this biological opinion the surrounding vicinity is described as 300 meters [approximately 1000 feet] outside and adjacent to the project footprint) are likely to be subject to indirect effects including loss of its movement corridor caused by deaths due to vehicle strikes, loss of habitat, competitors, and a reduction in natural food sources as a result of habitat disturbance and loss.

Construction and widening of the State Route 46 project will result in the loss, fragmentation, and degradation of habitat currently utilized by the San Joaquin kit fox for foraging, breeding, and other essential behaviors. Habitat loss, fragmentation, and degradation can cause San Joaquin kit foxes to be displaced resulting in disrupted social behavior, adverse effects to feeding success, and mortality. These habitat effects also can block movement corridors and prevent dispersal and genetic exchange. Range-wide habitat loss, fragmentation, and degradation from multiple factors is the primary threat to the San Joaquin kit fox (Service 1998). Both Biological Assessment 1 and Biological Assessment 2 note that the State Route 46 project could result in adverse effects to the San Joaquin kit fox in the form of mortality, morbidity, displacement, disrupted social ecology, reduced productivity, displacement, altered space use, loss or destruction of habitat, noise

disturbance, disruption of breeding cycle, blocked movement corridors, reduced genetic exchange, genetic damage, and decreased carrying capacity.

Approximately 95% of native habitat for kit fox habitat in the San Joaquin Valley has been destroyed by agricultural, industrial, and urban development (Service 1998). Loss of natural lands continues to occur further reducing the habitat available for the animal. The amount of historical and current habitat loss directly attributable to road has not been calculated. Estimates of the area occupied by roads under the jurisdiction of Caltrans includes 239 hectares (591 acres) for Kings County,431 hectares (1065 acres) for Merced County, 817 hectares (2019 acres) for Fresno County, and 1485 hectares (3669 acres) for Kern County (Cypher 2000). These estimates are based on a standard lane width of 3.6 meters (11.8 feet), and not all of this area is in kit fox habitat. However, the estimates do not include road shoulders, medians, or associated developments (e.g. Interchanges, signs), and also do not include the area occupied by county and city roads.

The effect of habitat fragmentation on the San Joaquin kit fox is potentially significant. Fragmentation can have affect the kit fox by: (1) reduction in access to habitat as well as habitat suitability, and (2) disruption or elimination of movement corridors, dispersal, and gene flow. The construction of roads through kit fox habitat may restrict or block access to the remaining habitat patches. The likelihood of this increase with larger road size, higher traffic volume, and the presence of fences or median barriers. Knapp (1978) monitored movements of radio-collared San Joaquin kit foxes in the vicinity of Interstate 5 in Kern County. Many of the foxes used areas within 3 kilometers (2 miles) of the highway, and most exhibited movement and home range patterns that parallel the highway, but did not cross it. Only on 2 occasions were animals located on the opposite side of the highway from their primary area of use. Interstate 5 has an effect on kit fox use patterns and restricts movements by the San Joaquin kit fox between habitat blocks.

In addition to limiting access to habitat patches, roads also may reduce the suitability of habitat for San Joaquin kit foxes by fragmentation into patches too small for effective use by the animals. As a habitat patch decreases in size, the number of San Joaquin kit foxes the patch can support also decreases. This increases the probability that the animals will be extirpated from each patch. The possibility for recolonization will depend upon the nature of the factors, e.g., roads, canals, development, etc., that are causing the fragmentation. Estimates of home range size for the San Joaquin kit fox vary from from 4.3 square kilometers (1.7 square miles) to 11.6 square kilometers (4.5 square miles)(White and Ralls 1993). Typically, a mated pair will share a home range. If a habitat fragment is too small to support a home range, it may be abandoned by the animals. Whether or not the patch can be used as part of a it fox home range will depend upon the nature of the factors causing the fragmentation.

Fragmentation factors that effectively isolate patches and limit access also constitute barriers to San Joaquin kit fox movements, dispersal, and gene flow. Movements and dispersal corridors are critical to kit fox population dynamics, particularly because the animals currently persist as metapopulations with multiple disjunct population centers. Movement and dispersal corridors are

important for alleviating over-crowding and intraspecific competition during years when San Joaquin kit fox abundance is high, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects.
Roads have been documented as barriers to movements by a diversity of species, and this effect varies with road size and traffic volume. Bobcats in Wisconsin readily crossed dirt roads, but were reluctant to cross paved roads (Lovallo and Anderson 1996). Lynx also exhibit a reluctance to cross roads (Barnum 1999) as do mountain lions (*Felis concolor*)(Van Dyke *et al.* 1986). In a study in North Carolina, the number of road crossings by black bears (*Ursus americanus*) was inversely related to traffic volume, and bears almost never crossed an interstate highway (Brody and Pelton 1989). Endangered Sonoran pronghorn (*Antilocarpa americana*) in Mexico are reluctant to cross a 2-lane highway, and the planned expansion of the road could further restrict movements (Castillo-Sanchez 1999). Many rodents are reluctant to cross roads (Oxley *et al.* 974).

The inhibition of animal movements caused by roads produces a significant effect by fragmenting habitats and populations (Joly and Morand 1997). Roads were found to be significant barriers to gene flow among common frogs (*Rana temporaria*) in Germany and this has resulted in genetic differentiation among populations separated by roads (Reh and Seitz 1990). Similarly, significant genetic subdivision was detected in bank voles (*Clethrionomys glarelous*) populations separated by a 50-meter (164 foot) wide highway in Germany (Gerlach and Musolf 2000). In California, local extinctions of mountain lions has occurred when roads and other developments fragmented habitat in small patches and blocked movement corridors thereby isolating the patches and preventing recolonization (Beier 1993).

San Joaquin kit fox mortality and injury occurs when the animals attempt to cross roads and are hit by cars, trucks, or motorcycles. The majority of strikes likely occur at night when the animals are most active. Driver visibility also is lower at night increasing the potential for strikes. Such strikes are usually fatal for an animal the size of a kit fox. Thus, vehicle strikes are a direct source of mortality for the San Joaquin kit fox. If vehicle strikes are sufficiently frequent in a given locality, they could result in reduced kit fox abundance. The death of kit foxes during the November-January breeding season could result in reduced reproductive success. Death of females during gestation or prior to pup weaning could result in the loss of an entire litter of young, and therefore, reduced recruitment of new individuals into the population.

Occurrences of vehicle strikes involving San Joaquin kit foxes have been well documented, and such strikes occur throughout the range of the species. Sources of kit fox mortality were examined during 1980-1995 at the Naval Petroleum Reserves in California in western Kern County (Cypher *et al.* 2000). During this period, 341 adult San Joaquin kit foxes were monitored using radio telemetry, and 225 of these animals were recovered dead. Of these, 20 were struck by vehicles; 9% of adult kit fox mortalities were attributed to vehicles, and 6% of all monitored adults were killed by vehicles. During this same period, 184 juvenile (<1 year old) kit foxes were

monitored. Of these, 142 were recovered dead and 11 were killed by vehicles; 8% of juvenile kit fox mortalities were attributed to vehicles and 6% of all monitored juveniles were killed by vehicles. For both adults and juveniles, vehicle strikes accounted for less than 10% of all San Joaquin kit fox deaths in most years. However, in some years, vehicles accounted for about 20% of deaths. Predators, primarily coyotes and bobcats, were the primary source of mortality at the Naval Petroleum Reserves. In addition, 70 kit foxes, both radio collared and non-collared, were found dead on roads in and around the Naval Petroleum Reserves during 1980-1991 (U.S. Department of Energy 1993). Of these, 34 were hit by vehicles on the approximately 1,600 kilometers (990 miles) of roads at the Reserve, and 36 were struck on the approximately 80 kilometers (50 miles) of State and County roads (e.g., State Route 119, Elk Hills Road), where traffic volumes and average vehicle speeds were higher.

In other areas of western Kern County, 49 kit foxes were radio-collared in the highly developed Midway-Sunset oil field, and 54 kit foxes were radio-collared in the Lokern Natural Area, a nearby undeveloped area, during 1989-1993 (Spiegel and Disney 1996). Of these animals, 60 were recovered dead; 1 (2%) was killed by a vehicle, and it was found in an undeveloped area along the access road adjacent to the California aqueduct. However, 6 non-collared kit foxes were killed by vehicles on the access road. Predators, primarily coyotes, bobcats, and feral dogs were responsible for most deaths in this study. Forty-one San Joaquin kit foxes were radio-collared and monitored during 1989-1991 on the Carrizo Plain Natural Area in eastern San Luis Obispo County (Ralls and White 1995). Twenty-two were found dead; 1 (5%) were attributed to a vehicle strike. At the Camp Roberts National Guard Training Facility in Monterey and San Luis Obispo counties, 94 San Joaquin kit foxes were radio-collared during 1988-1992 (Standley *et al.* 1992). Forty-nine were found dead and 2 were attributed to vehicle strikes; 4% of the deaths were caused by vehicles and 2% of all monitored kit foxes were killed by vehicles. In western Merced County, 28 San Joaquin kit foxes were radio-collared during 1985-1987 (Briden *et al.* 1992). Seventeen were found dead and 2 (12%) of these deaths were attributed to vehicles.

In the City of Bakersfield, 113 San Joaquin kit foxes were radio-collared and monitored during 1997-2000 (Cypher 2000). Thirty-five were recovered dead (123 adults and 12 pups); 9 adults (39%) and 6 pups (50%) were attributed to vehicle strikes. At this urban site, coyotes and bobcats are rare, and vehicles are the primary source of kit fox mortality. However, survival rates are higher than rates among kit foxes in non-urban areas, and vehicles do not appear to be limiting the population size.

Vehicles constitute a consistent source of mortality for the animal, based on the frequency with which vehicle strikes occur. However, the precise effect of vehicle strikes on the San Joaquin kit fox has not been adequately investigated. According to Morrell (1970), "The automobile is by far the major cause of reported San Joaquin kit fox deaths - 128 of 152 deaths reported were caused by automobiles." Morrell acknowledged that the numbers were based on non-radio-collared kit foxes and therefore were biased because road-killed foxes are conspicuous and easily observed compared to animals dying from other causes. Predators such as coyotes, bobcats, non-native red

foxes, and domestic dogs likely constitute a higher source of mortality than vehicle strikes (Service 1998; Cypher 2000).

The local and range-wide effects of vehicle strikes on San Joaquin kit foxes have not been adequately assessed. Vehicle strikes appear to occur most frequently where roads transverse areas where kit foxes are abundant. However, the linear quantity of roads in a given area may not be directly related to the number of vehicle strikes in a given area, as exemplified by the situation at the Naval Petroleum Reserve. The type of road (e.g., number of lanes) traffic volume, and average speed of vehicles likely all influence the number of San Joaquin kit fox/vehicle strikes. The number of strikes likely increases with road size, traffic volume, and average speed (Clevenger and Waltho 1999). Another factor influencing the number of vehicles striking San Joaquin kit foxes, but for which little data is available, is the frequency with which the animals cross roads and are therefore at risk. The proportion of successful road crossings by these animals likely declines with increasing road size, traffic volume and density, and vehicle speeds. The proportion of San Joaquin kit foxes successfully crossing roads may increase in areas where they obtain more experience crossing roads, such as in and near urban areas.

Based on a study of another kit fox subspecies, Egoscue (1962) reported that 8 tagged foxes (*Vulpes macrotis nevadensis*) in Utah were killed by vehicles, and 5 of these were pups. Pups appeared to be more vulnerable to vehicle strikes. Many of the foxes killed were residents that were using dens located near roads. O'Neal *et al* (1987) examined 23 dead kit foxes in western Utah in 1983. None were killed by vehicles, possibly due to the remoteness of the study site. Swift foxes (*Vulpes velox*) are closely related to the San Joaquin kit fox, and are listed as an endangered in Canada. They show numerous ecological similarities with the San Joaquin kit fox. Hines (1980) reported that roads were a major source of swift fox mortality in Nebraska. In Alberta, where the swift fox was extirpated and recently reintroduced, vehicles were responsible for 5 of 89 (6%) of the foxes found dead (Cabyn *et al* 1994). Pups appeared to be especially vulnerable, particularly if the natal dens were located near roads (Cabyn 1998). In western Kansas, 41 adults and 24 juvenile swift foxes were radio collared and monitored during 1996-97 on 2 study sites (Sovada *et al* 1998). Among the adults, 18 were found dead, but none were killed by vehicles. Among the juveniles, 14 were found dead and 4 (29%) of these had been struck by vehicles. All 7 of the juveniles killed by vehicles were found on the same study site. This study site had 90% more roads compared to the other study site where no foxes were killed by vehicles (125 kilometers vs. 66 km; 78 miles vs. 41 mil). At a remote site in Colorado with few roads and restricted public access, swift foxes were rarely struck by vehicles (Covell 1992; Kitchen *et al.* 1999).

Vehicle-related mortality has significantly affected other listed or rare species. Vehicles caused 49% of the mortality documented among endangered Florida panthers (*Felis concolor coryi*) (Maehr *et al.* 1991). With a remaining population of 20-30 animals, the loss of any to vehicles likely constitutes a significant population effect. Similarly, at least 15% of the remaining 250-300 key deer (*Odocileus virginianus clavium*) are killed annually by vehicles (Tubak 1999), and this mortality is considered to be a limiting factor for this endangered species (U.S. Fish and Wildlife

Service 1985). Mortality from vehicles was the primary source of mortality for endangered ocelots (*Felis pardalis*) in Texas (Tubak 1999), and also contributed to the failure of a lynx (*Lynx lynx*) reintroduction project in New York (Aubrey *et al.* 1999). Rudolph *et al.* (1999) estimated that road-associated mortality may have depressed populations of Louisiana pine snakes (*Pituophis ruthveni*) and timber rattlesnakes (*Crotalus horridus*) by over 50% in eastern Texas, and this mortality may be a primary factor in local extirpations of timber rattlesnakes (Rudolph *et al.* 1998). Mortality from vehicles also is contributing to the reduction in the status of the prairie garter snake (*Thamnophis radix radix*) in Ohio (Dalrymple and Reichenbach 1984), and was a limiting factor in the recovery of the endangered American crocodile (*Crocodylus acutus*) in Florida (Kushland 1998). In Florida, threatened Florida scrub-jays (*Aphelocoma coerulescens*) suffered higher mortality in territories near roads, as well as reduced productivity due to vehicle strikes of both breeding adults and young (Mumme et al. 1999).

Construction, maintenance, and operational activities associated with roads may result in a disturbance effect on nearby San Joaquin kit foxes. Disturbance can result from noise, vibration, odors, or human activity. Disturbance may affect the kit foxes by interfering with sensory perception which could interfere with their ability to locate prey, pups, or mates, or detect approaching predators. Disturbance could induce stress which may affect physiological parameters or behavior. The resulting effects could include increase energetic requirements, decrease reproductive output, decrease immunological functions, altered space use patterns, displacement, or possibly death. Observations from a variety of sources and situations suggest that San Joaquin kit foxes may not be significantly affected by disturbance, even when the source is prolonged or continuous (Cypher 2000). However, individual animals may be more affected than others, and it is unknown whether disturbance may result in reduced local abundance.

An increase in the ambient noise level is not, in itself, likely to cause direct harm to kit foxes. No specific research has been performed on this species but a "safe, short-term level" for humans has been determined to be 75 decibels (dBA) (NIH 1990; Burglund and Lindvall 1995). The mechanisms leading to permanent hearing damage are the same for all mammals (NIH 1990). However, the enlarged pinna and reduced tragi of kit foxes indicate that hearing is more acute than in humans (Jameson and Peeters 1988). Hearing loss in humans has been correlated with cognitive dysfunction (NIH 1990). However, variation in response to intense noise has been found to vary, in humans, by as much as 30 to 50 dBA between individuals (NIH 1990). Similar variation has been found in animal studies as well (NIH 1990). Hearing loss was greater in male than in female humans; however, this may be caused by environmental factors (NIH 1990). Also, younger animals have been shown to be more susceptible to noise-induced hearing loss (NIH 1990). The ability to habituate to noise appears to vary widely between species (NPS 1990). Typical construction machinery produces noise in the range of 75 dBA (arc-welder) to 85 dBA (bulldozer) (Burglund and Lindvall 1995). Long-term noise levels of 85 dBA are recognized to cause permanent hearing damage in humans (NIH 1990). Noise at the 85 dBA level has been correlated with hypertension in Rhesus monkeys (*Macaca fasicularis*) (Cornman 2001). Increased reproductive failure in laboratory mice (*Mus musculus*) was found to occur after a level of 82-85 dBA for one week (Cornman 2001). However, measurable loss of hearing was found to

occur in chinchillas (*Chinchilla laniger*) at a sustained level of 70 dBA (Peters 1965). Hearing loss from motorcycle traffic has been documented for the kangaroo rat (*Dipodomys* species) (Bondello and Brattstrom 1979) and desert kangaroo rats (*Dipodomys deserti*) showed a significant reduction in reaction distance to the sidewinder (*Crotalus cerastes*) after exposure to 95 dBA (Cornman 2001). Other desert mammals appear to sustain the same impacts from noise (Bondello and Brattstrom 1979). Aircraft noise has produced accelerated heart-rates in pronghorn, bighorn sheep (*Ovis canadensis*), and elk (*Cervus elaphus*) (MacArthur 1976; Workman *et al.* 1992; all in U.S. National park Service (NPS) 1994).

Hearing loss is correlated with distance from the source of the noise. At a level of 110 dBA, guinea pigs (*Cavia porcellus*) suffered long-term hearing loss at distances of 25 and 50 meters, temporary loss at a distance of 100 meters, and no measurable loss at 1,500 meters (Gonzales *et al.* 1970). Over water, noise is reduced at a rate of 5 dBA for each doubling of the distance to the source (Komanoff & Shaw 2000). For instance, a noise that measured 20 dBA at 20 meters registers 10 dBA at 40 meters. This is computed as

$$(\text{noise at }) D = D_1 - 16.61 [\log (D/D_{water})],$$

where D is the distance from source, D_1 is the noise level at source, and D_{water} is the distance over water. Over clear (i.e. unobstructed) land, sound diminishes slightly more quickly at 6 dBA per doubling of distance:

$$(\text{noise at }) D = D_1 - 19.93 [\log (D/D_{land})],$$

(Komanoff & Shaw 2000). The effects of cumulative noise (α) are computed as the sum of the log of each component, multiplied by a magnitude of 10:

$$\alpha = 10 [\Sigma (\log A + \log B + \log C.....)],$$

where A, B, C, etc. are individual components of the total ambient noise. Thus, the total synergistic impact from noise will be greater than the sum of the individual components (Komanoff & Shaw 2000).

Harassment from long-term noise may cause kit foxes and kangaroo rats to eventually vacate the project site and adjacent areas. California condors (*Gymnogyps californianus*) have been shown to abandon nesting sites in response to vehicle noise (Shaw 1970). Grizzly bears (*Ursus arctos*), mountain goats (*Oreamnos canadensis*), caribou (*Rangifer* species), and bighorn sheep (*Ovis* spp.) have all been found to abandon foraging or calving areas in response to aircraft noise (Chadwick 1973; McCourt *et al.* 1974; Ballard 1975; Krausman and Hervert 1983; Gunn *et al.* 1985; Bleich 1990; all in NPS 1994).

Project effects on San Joaquin kit foxes are expected to be greater during the den selection, pregnancy, and early pup dependency periods of the breeding cycle (December through July) than

at other times of the year. San Joaquin kit foxes may exhibit increased sensitivity to disturbance during this period and therefore, ideally, surface-disturbing activities should occur between August and November. Where this is possible, it is anticipated that surface-disturbing activities and other actions likely to result in harassment will be minimized in the vicinity of San Joaquin kit fox natal dens. Habitat compensation measures are anticipated to minimize habitat impacts due to project implementation.

The presence of roads in an area could result in the introduction of chemical contaminants to the site. Contaminants could be introduced in several ways. Substances used in road building materials or to recondition roads can leach out or wash off roads adjacent habitat. Vehicle exhaust emissions can include hazardous substances which may concentrate in soils along roads. Heavy metals such as lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron are all emitted in vehicle exhaust (Trombulak and Frissell 2000). Concentrations of organic pollutants (e.. Dioxins, polychlorinated biphenyls) are higher in soils along roads (Benfenati *et al.* 1992). Ozone levels are higher in the air near roads (Trombulak and Frissell 2000). Vehicles may leak hazardous substances such as motor oil and antifreeze. Although the quantity leaked by a given vehicle may be minute, these substances can accumulate on roads and then get washed into the adjacent environment by runoff during rain storms. An immense variety of substances could be introduced during accidental spills of materials. Such spills can result from small containers falling off passing vehicles, or from accidents resulting in whole loads being spilled. Large spills may be partially or completely mitigated by clean-up efforts, depending on the substance.

San Joaquin kit foxes using areas adjacent to roads could be exposed to any contaminants that are present at the site. Exposure pathways could include inhalation, dermal contact, direct ingestion, ingestion of contaminated soil or plants, or consumption of contaminated prey. Exposure to contaminants could cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances could cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Contaminants also may have the same effect on kit fox prey species. This could result in reduced prey abundance and diminished local carrying capacity for the kit fox.

Little information is available on the effects of contaminants on the San Joaquin kit fox. The effects may be difficult to detect. Morbidity or mortality likely would occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring. However, effects have been detected on some occasions. At the Naval Petroleum Reserve, 3 kit foxes are known to have been killed by drowning in spills of crude oil (Cypher *et al.* 2000). Spiegel and Disney (1996) reported that a kit fox was found covered with crude oil at the Midway-Sunset oil field, and this individual died despite treatment. Other animals, some of which were prey species for the kit fox, were found drowned in crude oil at the Naval petroleum reserve (U.S. Department of Energy 1993). Such spills potentially can cause local reductions in the abundance of kit foxes and their prey.

Construction of roads can facilitate the invasion and establishment by species not native to the area. Disturbance and alteration of habitat adjacent to roads may create favorable conditions for non-native plants and animals. Can spread along roadsides and then into adjacent habitat. Son-native animals may use modified habitats adjacent to road to disperse into kit fox habitat. These exotic animals could compete with kit foxes for resources such as food or dens, or directly injure or kill kit foxes. Non-native plants and animals may reduce habitat quality for kit foxes or their prey, ad reduce the productivity or the local carrying capacity for the kit fox. Introductions of non-native species could cause kit foxes to alter behavioral patterns by avoiding or abandoning areas near road (Cypher 2000).

Disturbed areas adjacent to roads provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and they can alter natural communities and potentially affect habitat quality. A problematic species within the range of the San Joaquin kit fox is yellow star thistle (*Centaurea melitensis*). Dense stands of this plant can form along roadsides and then spread into adjacent habitat. This plant displaces native vegetation, compete with native plants for resources, does not appear to be used by kit fox prey, dense growth, and may be difficult for kit foxes to move through due its large size (up to 1 meter or 3.3 feet tall), and numerous sharp spines (Cypher 2000). Other species that may disperse along roads and invade adjacent habitat include mustards (*Brassica* species) and Russian thistle (*Salsola tragus*) (Tellman 1997).

Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species. Nitrogen from vehicle exhaust is deposited in habitats adjacent to roads, and the resulting enhanced nitrogen levels appear to promote growth of non-native species, particularly exotic grasses (Weiss 1999). These grasses, such as red brome create dense ground cover in the San Joaquin Valley, and this dense cover appears to reduce habitat quality for various small mammal species, such as kangaroo rats, which are an important prey for kit foxes (Goldingay *et al.* 1997; Cypher 2000).

Roads may serve as travel corridors for non-native red foxes. Red foxes can kill San Joaquin kit foxes (Ralls and White 1995; Service 1998), and likely compete with kit foxes for food and dens. Red foxes are considered a threat to the sift fox in Canada (Carbyn 1999). Red foxes are infrequently observed in large blocks of undisturbed habitat within the range of the San Joaquin kit fox, possibly due to the absence of permanent water or the presence of coyotes which prey upon red foxes. Along roads, water availability may be higher due to pooling of precipitation runoff or anthropogenic development, and coyotes may be less abundant due to the presence of humans. Roads may facilitate movements of red foxes and increase access to kit fox habitat. Non-native red foxes and feral cats are reported to use roads as movement corridors in Australia (Bennett 1991).

Negative effects to wildlife populations from roads may extend some distance from the actual road. The phenomenon can result from any of the effects already described in this biological opinion (e.g. vehicle-related mortality, habitat degradation, invasive exotic species, etc.). Forman

and Deblinger (1998) described the area affected as the "road effect" zone. Along a 4-lane road in Massachusetts, they determined that this zone extend for an average of approximately 300 meters (980 feet) to either side of the road for an average total zone width of approximately 600 meters (1970 feet). However, in places they detected an effect >1 kilometer (0.6 mile) from the road. Rudolph *et al* (1999) detected reduced snake abundance up to 850 meters (2790 feet) from roads in Texas. They estimated snake abundance out to 850 meters (2790 feet), so the effect may have been greater. Extrapolating to a landscape sale, they concluded the effect of roads on snake populations in Texas likely was significant, given that approximately 79% of the land area of the Lone Star State is within 500 meters (1640 feet) of a road. The "road-zone" effects can be subtle. Van der Zandt *et al.* (1980) reported that lapwings (*Vanellus vanellus*) and black-tailed godwits (*Limosa limosa*) feeding at 480-2000 meters (1575-6560 feet) from roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increases near roads (MacArthur *et al.* 1979). Trombulak and Frossell (2000) described another type of "road-zone' effect. Heavy metal concentrations from vehicle exhaust were greatest within 20 meters (66 feet) of roads, by elevated levels of metals in both soil and plants were detected at ≥200 meters (660 feet of roads. The "road-zone" apparently varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the effect sone along primary roads of 305 meters (1000 feet) in woodlands, 365 meters (1197 feet) in grasslands, and 810 meters (2657feet) in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 200 meters (656 feet). The "road zone" and the San Joaquin kit fox has not been adequately investigated; however, it is possible it exists given the effects of roads on the animal.

Tipton Kangaroo Rat and Giant Kangaroo Rat

The proposed State Route 46 project likely will result in be a number of adverse effects to the Tipton kangaroo rat and giant kangaroo rat. There is a likelihood of direct mortality to the animals from either crushing or entombment in burrows due to construction activities, vehicle strikes, falling into trenches or pits, being shot, being buried after becoming trapped in pipes, injured or killed by pet cats or dogs owned by construction related personnel, poisoned by rodenticides or other pesticides, injured or killed by predators attracted to construction-related food or trash at the site, harassment from noise and vibration. Giant kangaroo rats and Tipton kangaroo rats may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night time foraging. Tipton kangaroo rats and giant kangaroo rat may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night time foraging. The animals are likely to be subject to indirect effects including loss of their movement corridor caused by deaths due to vehicle strikes, loss of habitat, competitors, and a reduction in natural food sources as a result of habitat disturbance and loss. Tipton kangaroo rats and giant kangaroo rats inhabiting the project site and surrounding vicinity (for purposes of this biological opinion the surrounding vicinity is described as 300 meters [approximately 1000 feet] outside and adjacent to the project footprint) are likely to be subject to indirect effects including loss of their movement corridor caused by

deaths due to vehicle strikes, loss of habitat, exotic predators, competitors, introduced non-native plants eliminating or reducing habitat, and a reduction in natural food sources as a result of habitat disturbance and loss.

Noise and vibration generated from vehicles, construction activities, and work crews could disrupt normal behavior of the Tipton kangaroo rat and giant kangaroo rat. This includes, but is not limited to foraging, reproduction, and ability to detect or avoid predators. The net effects of the project may result in temporal impacts on fecundity and behavior. The potential for harassment will be minimized by measures such as employee training and the presence of biological monitors. However, harassment to individuals from noise and vibration is inherent in this activity and unavoidable. Project vehicles may encounter Tipton kangaroo rats and giant kangaroo rats. Vehicle movement, and construction activities may cause these mammals to become confused or disoriented, thus exposing them to harm. Considering the small size and cryptic coloration of the Tipton kangaroo rat and giant kangaroo rat, it is likely that they could be crushed by vehicles driving in their habitat. Workers may trample Tipton kangaroo rats or giant kangaroo rats. Additionally, individuals of both of these listed animals who fall into holes and trenches can be injured or killed.

Various other work activities associated with the proposed project may also adversely affect the giant kangaroo rat and the Tipton kangaroo rat. Trash left during or after project activities could attract predators to work sites, which could subsequently harass or prey on the animals. For example, coyotes and raccoons are attracted to trash and also prey opportunistically on these rodents. The temporary disturbance of habitat could result in the spread or establishment on non-native invasive plant species which could eliminate habitat and food for these listed animals. Implementation of certain types of erosion control materials, such as plastic netting, could result in the entanglement and death of Tipton kangaroo rats and giant kangaroo rats within these material (Stuart *et al.* 2001). Increased levels of vehicles and increased vehicle speeds likely will lead to increase mortality level for the giant kangaroo rat and Tipton kangaroo rat in the action area. The State Route 46 project could potentially result in habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

Blunt-nosed Leopard Lizard

The proposed State Route 46 project likely will result in be a number of adverse effects to the blunt-nosed leopard lizard. There is a likelihood of direct mortality to the animal from either crushing or entombment in burrows due to construction activities. The animals also may be adversely affected by vehicle strikes, and harassment from noise and vibration. Blunt-nosed leopard lizrads may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night

time resting. Blunt-nosed leopard lizards inhabiting the project site and surrounding vicinity (for purposes of this biological opinion the surrounding vicinity is described as 300 meters [approximately 1000 feet] outside and adjacent to the project footprint) are likely to be subject to indirect effects including loss of its movement corridor caused by deaths due to vehicle strikes, loss of habitat, exotic predators, introduced competitors, and a reduction in natural food sources as a result of habitat disturbance and loss.

Noise and vibration generated from vehicles, construction activities, and work crews could disrupt normal behavior of the blunt-nosed leopard lizard. This includes, but is not limited to foraging, reproduction, and ability to detect or avoid predators. The net effects of the project may result in temporal impacts on fecundity and behavior. The potential for harassment will be minimized by measures such as employee training and the presence of biological monitors. However, harassment to individuals from noise and vibration is inherent in this activity and unavoidable. Project vehicles may encounter blunt-nosed leopard lizards. Vehicle movement, and construction activities may cause these animals to become confused or disoriented, thus exposing them to harm. Considering the relatively small size and cryptic coloration of the blunt-nosed leopard lizard, it is likely that it could be crushed by vehicles driving in their habitat. Workers may trample torpid blunt-nosed leopard lizards. Additionally, individuals of this listed animal who fall into holes and trenches can be injured or killed.

Various other work activities associated with the proposed project may also adversely affect the blunt-nosed leopard lizard. Trash left during or after project activities could attract predators to work sites, which could subsequently harass or prey on the animals. For example, coyotes and raccoons are attracted to trash and also could prey opportunistically on these listed reptiles. The temporary disturbance of habitat could result in the spread or establishment on non-native invasive plant species, which could eliminate habitat for the animal. Implementation of certain types of erosion control materials, such as plastic netting, could result in the entanglement and death of blunt-nosed leopard lizards within these material (Stuart *et al.* 2001). Increased levels of vehicles and increased vehicle speeds likely will lead to increase mortality level for the blunt-nosed leopard lizard in the action area. The State Route 46 project could potentially result in habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

Buena Vista Lake Shrew

The proposed State Route 46 project likely will result in be a number of adverse effects to the Buena Vista Lake shrew. There is a likelihood of direct mortality to the animals from either crushing or being buried due to construction activities, vehicle strikes, falling into trenches or pits, being shot, being buried after becoming trapped in pipes, injured or killed by pet cats or dogs owned by construction related personnel, poisoned by rodenticides or other pesticides, injured or

killed by predators attracted to construction-related food or trash at the site, harassment from noise and vibration. Buena Vista Lake shrews inhabiting the West Side Kern River Canal or other wetted areas in the action area are likely to be subject to indirect effects including deaths due to vehicle strikes, loss of habitat, exotic predators, introduced competitors, introduction of non-native plants that eliminate its habitat, and a reduction in natural food sources as a result of habitat disturbance and loss. Construction activities including vegetation removal and noise and vibrations may cause the shrews to flee, thus exposing them to a greater risk of predation.

Noise and vibration generated from vehicles, construction activities, and work crews could disrupt normal essential behavior of the Buena Vista Lake shrew. This includes, but is not limited to foraging, reproduction, and ability to detect or avoid predators. The net effects of the project may result in temporal impacts on fecundity and behavior. The potential for harassment will be minimized by measures such as employee training and the presence of biological monitors. However, harassment to individuals from noise and vibration is inherent in this activity and unavoidable. Project vehicle movement, and construction activities may cause these animals to become confused or disoriented, thus exposing them to harm. Considering the small size and cryptic coloration of the Buena Vista Lake shrew, it is likely that it could be crushed by vehicles driving in their habitat. Workers may trample Buena Vista Lake shrews.

Various other work activities associated with the proposed project may also adversely affect the Buena Vista Lake shrew. Trash left during or after project activities could attract predators to work sites, which could subsequently harass or prey on the animals. For example, coyotes and raccoons are attracted to trash and also could prey opportunistically on these soricids. The temporary disturbance of habitat could result in the spread or establishment on non-native invasive plant species, which could eliminate habitat for the animal. Implementation of certain types of erosion control materials, such as plastic netting, could result in the entanglement and death of Buena Vista Lake shrews within these materials (Stuart *et al.* 2001). Increased levels of vehicles and increased vehicle speeds could lead to increase mortality levels for the Buena Vista Lake shrew in the action area. The State Route 46 project could potentially result in habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

Hoover's Woolly-star, San Joaquin wooly-threads, and California jewel-flower

Project-related vehicular traffic, grading of shoulders, excavation for culverts and utilities, and wildfires, should they inadvertently be started during project activities, could negatively affect local populations of the listed plant species addressed in this biological opinion. Except for the possibility of wildfires, these hazards will be greatest in the immediate vicinities of road shoulders, utility line corridors, and along cross-country travel routes if such routes are used. Actions related to construction, such as grading, excavation, clearing for equipment storage areas,

and other ground-disturbing activities, may cause direct loss of plants and loss of occupied and potential habitat. In addition, these activities will increase the opportunities for introduction and dominance of aggressive, non-native plant species that are competitive with the listed and proposed plants. Construction through occupied habitat fragments populations and may restrict gene flow, thereby reducing the species' ability to survive.

Potential effects to listed plants include direct mortality from earth grading or excavation or crushing by vehicles. Adverse effects also could result from soil erosion resulting in loss of the supporting substrate for plants, or from soil compaction resulting in reduced germination rates. Impacts to plants occurring after seed germination but prior to seed set could be particularly harmful as both current and future generations would be adversely affected.

Indirect effects of project activities on the listed plant species include loss of soil structure, fertility, water holding capacity, and cryptogamic crusts, which seem to be an essential microhabitat feature for some rare plant species. Fragmentation essentially isolates locations of plants from other locations so that cross-pollination between locations becomes unlikely. This isolation can result in distinct genetic populations and the ultimate decline in some species because of the lack of genetic variability within populations. Road improvements increase vehicular traffic and afford access for off-road vehicle use, which can fragment populations, and contribute to additional habitat damage

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. According to the EA, no new development besides the State Route 46 project is proposed in the project area. The EA stated that the project conforms to the San Luis Obispo County and Kern County General Plans. According to the EA, construction of the State Route 46 project is not expected to shift growth from one area to another. The EA stated that the proposed improvements would accommodate planned and existing growth in the study area; no growth inducing impacts are expected from the project. The EA claimed that due to existing constraints created by endangered species, land use policies and underlying zoning and the lack of adequate infrastructure, such as water and sewer lines to undeveloped properties, the State Route project is not expected to measurably accelerate growth in the study area.

Except for the Town of Lost Hills and the immediate vicinity, the area surrounding State Route 46 in the action area consists of ranchlands, croplands, and orchards. The planting of orchards, such as pistachio, will continue to reduce the amount of habitat for listed species, as well as the likely reduction or elimination of movement corridors for the San Joaquin kit fox.

Numerous non-Federal activities continue to eliminate habitat for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, Buena Vista Lake shrew, Hoover's woolly-star, San Joaquin woolly-threads, and California jewelflower in the action area. Loss and

degradation of habitat affecting both animals and plants continue as a result of urbanization; road and utility right-of-way management; flood control projects; overgrazing by livestock; and continuing agricultural expansion that may not be funded, permitted, or constructed by a Federal agency. Listed animal species are also affected by poisoning, shooting, increased predation associated with human development, ground squirrel reduction efforts, and reduction of food sources. Extirpation of several remaining populations of some of these species appears likely, due to chance fluctuation of small populations, unusual climatic events, or to the loss of genetic fitness commonly associated with very small population sizes. Upland, wetland, and riparian habitats used by the San Joaquin kit fox, Buena Vista Lake shrew, giant kangaroo rat, Tipton kangaroo rat, blunt-nosed leopard lizard, Hoover's woolly-star, San Joaquin woolly-threads, and California jewelflower may be degraded or destroyed by a variety of development and maintenance activities conducted by private organizations, State, or local governments. These include levee maintenance and dredging, and dumping of waste material into sensitive habitats. Increased urban development has also increased problems associated with non-native predators, freshwater urban run-off, sedimentation, contaminants, and disturbance of breeding and foraging behavior. The cumulative effects of these known actions pose a significant threat to the eventual recovery of these species.

Conclusion

After reviewing the current status of the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista shrew, California jewelflower, San Joaquin woolly-star, and the Hoover's woolly-star, the environmental baseline for the action area, the effects of the proposed State Route 46 project from the San Luis Obispo County/Kern County line to post mile 37.5, and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of these 8 listed species. Critical habitat for these listed species has not been designated or proposed; therefore none will be adversely modified or destroyed.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of

the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

Sections 7(b)(4) and 7(o)(2) of the Act, which refer to terms and conditions and exemptions on taking listed fish and wildlife species, do not apply to listed plant species. However, section 9(a)(2) of the Act prohibits removal, reduction to possession, and malicious damage or destruction of listed plant species on lands under Federal jurisdiction and the removal, cutting, digging up, or damaging or destroying such species in knowing violation of any State law or regulation, including State criminal trespass law. Actions funded, authorized or implemented by a Federal agency that could incidentally result in the damage or destruction of such species on Federal lands are not a violation of the Act, provided the Service determines in a biological opinion that the actions are not likely to jeopardize the continued existence of the species. However, the Service recommends that FHWA implement the actions listed under the *Conservation Recommendations* of this biological opinion for the State Route 46 project in order to fulfill, in part, their responsibilities under section 7(a)(1) of the Act.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the FHWA, as appropriate, in order for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If the FHWA (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service expects that incidental take of the San Joaquin kit fox, Tipton kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew will be difficult to detect or quantify for the following reasons: The nature of the organisms, and in the relatively small body sizes in the case of the Tipton kangaroo rat, giant kangaroo rat, Buena Vista Lake shrew, and blunt-nosed leopard lizard, make the finding of a dead specimen unlikely, losses may be masked by seasonal fluctuations in numbers or other causes, and the species occur in habitat that makes them difficult to detect. Due to the difficulty in quantifying the number of San Joaquin kit foxes, Tipton kangaroo rats, giant kangaroo rat, Buena Vista Lake Shrew, and blunt-nosed leopard lizards that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as all of these species inhabiting 489.8 acres (189.9 acres of temporary disturbance and 299.9 acres of permanent habitat loss) between the San Luis Obispo County/Kern County line and Interstate 5, as described in Biological Assessment 2, and the project description of this biological opinion; and 62.14 acres (20.34 acres of temporary habitat disturbance and 41.8 acres of permanent habitat loss) between Interstate 5 and post mile 37.5 as described in Biological Assessment 1, and the project description of this biological opinion. Due to the difficulty in quantifying take of the Buena Vista Lake shrews that will be taken as a result of the proposed

action, the Service is quantifying incidental take as all individuals of the Buena Vista Lake shrews inhabiting 0.176 acre at the West Side Kern River Canal (first drainage with vegetation east of Interstate 5) that will be adversely affected by the widening of the State Route 46 bridge. Upon implementation of the following reasonable and prudent measures incidental take associated with State Route 46 project in the form of harm and harassment of San Joaquin kit fox from habitat loss and construction activities will become exempt from the prohibitions described under section 9 of the Act; death, injury, and harm of the Tipton kangaroo rat, giant kangaroo rat, and Buena Vista Lake shrew from habitat loss and construction activities; and harrassment of the blunt-nosed leopard lizard.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew; no critical habitat has been proposed or designated for any of these species, therefore, none will be adversely modified or destroyed.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the State Route 46 project on the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew:

1. The FHWA and Caltrans will implement the project as described in the Biological Assessment and this biological opinion.

2. Reduce effects to the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew:

   A. Minimize the potential for harm, harassment, injury, or death through training, surveys, and specific protective measures.

   B. Minimize the potential for effects on the species due to loss of on-site habitat.

3. Ensure compliance with this biological opinion by Caltrans.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the FHWA shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure one (1):

a. The FHWA and Caltrans shall minimize the potential for harm, harassment, or killing of federally listed wildlife species resulting from project related activities by implementation of the project, including the conservation measures as described in Biological Assessment 1 and Biological Assessment 2, and appearing in the project description of this biological opinion.

b. Caltrans shall make the terms and conditions in this biological opinion a required term in all contracts for the project that are issued by Caltrans to all contractors. Caltrans shall provide the Chief of Endangered Species (Central Valley) at the Sacramento Fish and Wildlife Office with a hardcopy of the contract for this project at least ten (10) working days before Caltrans accepts or awards it.

2. The following Terms and Conditions implement Reasonable and Prudent Measure two (2):

a. To the maximum extent practicable, Caltrans shall incorporate adequately sized culverts under the road, overpasses, or other measures, to assist San Joaquin kit foxes in safely crossing the widened State Route 46. Caltrans shall provide the Service with an adequate report on which of these measures they will implement or the reasons why they will not be implemented within 60 calendar days of the issuance of the date of this biological opinion.

b. Permanent and temporary construction disturbances and other types of project-related disturbance to habitats of the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew shall be minimized to the maximum extent practicable. To minimize temporary disturbances, all project-related vehicle traffic shall be restricted to established roads, construction areas, and other designated areas. These areas also should be included in preconstruction surveys and, to the maximum extent possible, should be established in locations disturbed by previous activities to prevent further adverse effects.

c. Project-related vehicles shall observe a 20-mph speed limit within construction areas, except on County roads, and State and Federal highways; this is particularly important at night when the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, and Buena Vista Lake Shrew are most active. To the maximum extent possible, night-time construction should be minimized. Off-road traffic outside of designated project areas shall be prohibited.

d. To prevent inadvertent entrapment of San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew during the construction phase of a project, all excavated, steep-walled holes or

trenches more than 0.61 m (2 ft) deep shall be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist should immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service and/or California Department of Fish and Game shall be contacted by telephone for guidance. The Service shall be notified of the incident by telephone and electronic mail within one (1) working day.

e. San Joaquin kit foxes are attracted to den-like structures such as pipes and may enter stored pipe becoming trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 10.16 centimeters (4 inches) or greater that are stored at a construction site for one or more overnight periods must be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe shall not be moved until the Service has been consulted by telephone. If necessary, and under the direct supervision of the on-site biologist, the pipe may be moved once to remove it from the path of construction activity, until the fox has escaped.

f. To eliminate an attraction to predators of the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and/or Buena Vista Lake shrew all food-related trash items such as wrappers, cans, bottles, and food scraps must be disposed of in closed containers and removed at least once every two (2) days from the entire project site.

g. To avoid injury or death of the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and/or Buena Vista Lake shrew except for authorized security personnel, or local, State, or Federal law enforcement officials, no firearms shall be allowed on the project site.

h. To prevent harassment, injury or mortality of San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and/or the Buena Vista Lake shrew, or destruction of their dens or burrows by dogs or cats, no canine or feline pets shall be permitted on the project site.

i. Plastic mono-filament netting (erosion control matting) or similar material shall not be used at the project because Tipton kangaroo rats, giant kangaroo rats, blunt-nosed leopard lizards, or Buena Vista Lake shrews may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds

j. Use of rodenticides and herbicides at the project site shall be utilized in such a manner to prevent primary or secondary poisoning of Tipton kangaroo rats, giant kangaroo rats, Buena Vista Lake shrews, San Joaquin kit foxes, and the depletion of prey populations on which they depend. All uses of such compounds shall observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

k. A qualified biologist shall be on-site during all activities that may result in the take of the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rats, blunt-nosed leopard lizard, and/or the Buena Vista Lake shrew. The qualifications of the biologist must be presented to the Service for review and written approval prior to ground-breaking at the project site. The biologist shall be given the authority to stop any work that may result in take of these listed animal species. If the biologist(s) exercises this authority, the Service and the California Department of Fish and Game shall be notified by telephone and electronic mail within one (1) working day. The Service contact the Chief of Endangered Species Division at the Sacramento Fish and Wildlife Office at telephone 916/414-6600.

l. An employee education program on the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew must be conducted before groundbreaking for the State Route 46 project. The program should consist of a brief presentation by the on-site biologist, and legislative protection to explain endangered species concerns to all contractors, their employees, and agency personnel involved in the project. The program should include a description of the San Joaquin kit fox, Tipton kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew, and their habitat needs; an explanation of the status of these species and their protection under the Endangered Species Act; and a description of the measures being taken to reduce effects to these species during project construction and implementation. Caltrans shall submit written proof of the training to the Chief of the Endangered Species Division (Central Valley) at the Sacramento Fish and Wildlife Office within ten (1) working days of the completion of the training.

m. Upon completion of the project, all San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew habitat subject to temporary ground disturbances, including storage and staging areas, temporary roads, et cetera must be re-contoured, if appropriate, and revegetated with locally collected (e.g., within 10 miles of the project site) seeds and/or cuttings of appropriate native plant species to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance means any

area that is disturbed during the project, but that after project completion will not be subject to further disturbance and has the potential to be revegetated. Caltrans shall ensure the methods and plant species used to revegetate using locally collected seeds or cuttings of appropriate native plant species have been approved by the Service. The on-site biologist shall ensure that areas subject to temporary disturbance have been adequately restored, and this information is included under the final reports described in 3.d. of the *Terms and Conditions* of this biological opinion.

n. The Service and the California Department of Fish and Game must be notified within one (1) working day of the death or injury to a San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and/or the Buena Vista Lake shrew that occurs due to project related activities or is observed at the project site. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are the Chief of the Division of Endangered Species (Central Valley) at the Sacramento Fish and Wildlife Office, and the Resident Agent-in-Charge (Law Enforcement Division) at 916/414-6660. The California Department of Fish and Game contact is Mr. Ron Schlorff at 1416 9th Street, Sacramento, California 95814, (916) 654-4262.

o. As described in Biological Assessment 2, fee title or conservation easements for 1108.59 acres of habitat for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, and blunt-nosed leopard lizard for the portion of the project located between Interstate 5 and the Kern County/San Luis Obispo County line and Interstate Highway 5 within 4.5 miles of the centerline of State Route 46 shall be acquired in a location that would be reasonably be expected to maintain a north-south corridor for these species, especially the San Joaquin kit fox, as delineated as Figure 1 of this biological opinion. Caltrans shall obtain the written approval of the Service that the parcel(s) are suitable for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, and blunt-nosed leopard lizard prior to acquiring interest in those lands. The fee title or conservation easements for the 1108.59 acres shall be obtained by Caltrans at least sixty (60) calendar days prior to the date of initial groundbreaking at the State Route 46 project.

p. As described in Biological Assessment 1, fee title or conservation easements for 147.79 acres of habitat for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake Shrew for the portion of the project located between post mile 32.8 and post mile 37.5 on State Route 46 on the east side of Interstate 5 shall be acquired along State Route 46. The parcels shall be located between post mile 32.8 and post mile 37.5 on State Route 46, and within 4.5 miles of the centerline of State Route 46 as delineated as

Figure 2 of this biological opinion. The parcels shall contain undisturbed natural habitat for these species. Caltrans shall obtain the written approval of the Service that the parcel(s) are suitable for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake Shrew prior to acquiring interest in those lands. The fee title or conservation easements shall be obtained by Caltrans at least sixty (60) calendar days prior to the date of the initial ground breaking at the State Route 46 project.

q. If conservation easements are used by Caltrans, they shall include, but not be limited to, provisions and responsibilities of the project proponent and the land trust organization approved by the Service for the protection of all habitats set aside including any future transfers of the easements or fee interest that may be anticipated. The easements shall specify the purposes for which it is established (*i.e.*, measures to minimize impacts to the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew associated with the State Route 46 project). Caltrans shall provide the Service with a true copy of the recorded conservation easements within thirty (30) calendar days of its recordation. The conservation easements shall be held by a third party approved by the Service. The conservation easement shall include a list of prohibited activities that are inconsistent with the maintenance of the preserve for the listed species including, but not limited to:

i. leveling, grading, landscaping, cultivation, or any other alterations of existing topography for any purposes, including the exploration for, or development of, mineral resources;
ii. placement of any new structures on the preserve, including buildings and billboards;
iii. discharge, dumping, burning, or storing of rubbish, garbage, grass clippings, dredge material, household chemicals, or any other wastes or fill materials within the preserve;
iv. building of any roads or trails within the preserve areas;
v. killing, removal, alteration, or replacement of any existing native vegetation except in Service-approved prescribed burning situations, or as otherwise authorized in writing by the Service;
vi. activities that may alter the hydrology of the preserve and the associated watersheds, including but not limited to: excessive pumping of groundwater, manipulation or blockage of natural drainages, inappropriate water application or placement of storm water drains, etc. unless authorized in writing by the Service;
vii. incompatible fire protection activities;
viii. use of pesticides, herbicides, or rodenticides on the preserve or within the watershed that can contaminate the preserve except as authorized in writing by the Service; and

ix. introduction of any exotic species or species not native to the area, including aquatic species, except as approved by the Service.

r. In the event Caltrans seeks to obtain a conservation easement in lieu of fee title acquisitions for the purposes of satisfying the requirements of the terms and conditions of this biological opinion, Caltrans shall provide the language of the proposed conservation easements to the Service for prior review and approval. The conservation easements shall include language establishing a right of entry by the Service to determine compliance with the terms and conditions of this biological opinion and the terms of the conservation easements, as well as identifying the Service as a third party beneficiary with the standing to take whatever legal action is necessary to enforce the terms of this conservation easement. Should Caltrans make fee title acquisition of lands to satisfy the terms and conditions of this biological opinion, Caltrans shall encumber such lands with restrictive covenants that provide the same rights to the Service as would be established under the conservation easement described above. Such restrictive covenants shall be provided to the Service for prior review and approval before they are recorded against the conservation lands.

s. At least sixty (60) calendar days prior to the date of initial ground breaking at the proposed State Route 46 project, Caltrans shall endow a Service-approved fund for monitoring and perpetual management and maintenance of the 1256.38 acres that have been protected by Caltrans under fee title and/or conservation easements. The principal in the endowment must generate sufficient revenue to fully cover the costs of ongoing operations and management actions as described in the Service-approved management plan and this biological opinion, without the need to make use of the principal to adequately fund such expenditures. Specific actions funded by the endowment shall be addressed in the Service-approved management plan. Caltrans shall utilize an appropriate third party who has been approved by the Service to determine what amount of money is necessary for an endowment fund to adequately finance the monitoring and perpetual management and maintenance of the preserve for the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew. Caltrans shall empower the Service to access and expend such funds to implement Service-approved remedial measures in the event the responsible preserve managers fail to adequately implement the Service-approved management plan. The final determination of success or failure of the management plan shall be made solely by the Service. Prior to the date of initial groundbreaking at the State Route 46 project, Caltrans shall provide the Service with documentation that: (1) funds for the perpetual management and maintenance of the 1256.38 acres have been transferred to the appropriate third party approved by the Service; (2) the third party has accepted the funds and considers them adequate; and (3) that these funds have been deposited in an account (*i.e.*, endowment) that will provide

adequate financing for the monitoring and perpetual management and maintenance of the 1256.38 acres.

3. The following Terms and Conditions implement Reasonable and Prudent Measure three (3):

a. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans shall allow access by Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew, and their habitats.

b. Because of the potential for significant changes to the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, Buena Vista Lake shrew, and blunt-nosed leopard lizard and their habitats, compensation guidelines, and the species baseline prior to the start of ground breaking for this project, FHWA and Caltrans shall reinitiate formal consultation if the initial ground breaking for the project is greater than two (2) calendar years from the date of issuance of this biological opinion.

c. FHWA shall ensure Caltrans provides the Service with adequate annual written reports that describe the progress of implementation of all of the *Terms and Conditions* of this biological opinion. The first report is due December 31, the first year of groundbreaking, and annually thereafter on December 31 until all of the terms and conditions are completed, as stated in writing by the Service. The reports shall be addressed to the Chief of the Endangered Species Division (Central Valley) , Sacramento Fish and Wildlife Office.

d. Caltrans shall submit a post-construction compliance report prepared by the on-site biologist to the Sacramento Fish and Wildlife Office within 60 calendar days of the completion of construction activity or within 60 calendar days of any break in construction activity lasting more than 60 calendar days. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Shrew, if any; (v) occurrences of incidental take of any of these four species; and (vi) other pertinent information. The reports shall be addressed to the Chief of the Endangered Species Division (Central Valley) , Sacramento Fish and Wildlife Office.

e. The FHWA shall require Caltrans to report to the Service any information about take or suspected take of listed wildlife species not authorized in this biological

opinion. Caltrans must notify the Service via electronic mail and telephone within 24 hours of receiving such information. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. The individual animal shall be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are the Chief of the Endangered Species Division (Central Valley) , Sacramento Fish and Wildlife Office at 916/414-6600, and the Service's Law Enforcement Division at 916/414-6660.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases. We have the following conservation recommendations:

1. For the San Joaquin kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and Buena Vista Lake shrew:

   a. Caltrans should participate in the planning for regional habitat conservation plans for the kit fox, Tipton kangaroo rat, giant kangaroo rat, blunt-nosed leopard lizard, and the Buena Vista Lake shrew.

   b. The FHWA and Caltrans should continue to conduct or fund road mortality studies for these five listed species.

   c. The FHWA and Caltrans should incorporate wildlife overpasses and underpasses in highway/road design and construction in order to reduce vehicle-related injuries and deaths of San Joaquin kit foxes and other animals who are attempting to cross the roadways.

2. For the endangered California jewelflower, endangered San Joaquin woolly-threads, and the threatened Hoover's woolly-star:

   a. To minimize the introduction of exotic weeds, only certified weed-free straw/hay bales, if bales are used, should be used for erosion control or other purposes at the project.

   b. A worker awareness training program on the California jewelflower, San Joaquin woolly-threads, and the Hoover's woolly-star for construction personnel should be

conducted before groundbreaking at the project. The program should provide workers with information on their responsibilities with regard to the California jewelflower, San Joaquin woolly-threads, and the Hoover's woolly-star, an overview of the life-history of these three listed species, and a description of the measures being taken to reduce effects to the species during project construction. Caltrans should submit proof of the training to the Chief of the Endangered Species Division (Central Valley) at the Sacramento Fish and Wildlife Office.

c. Lands acquired as compensation for adverse effects to listed animal species, as described in Biological Assessment 1, Biological Assessment 2, and the project description and the terms and conditions of this biological opinion, should contain populations of the California jewelflower, San Joaquin woolly-threads, and Hoover's woolly-star. Caltrans should obtain the written concurrence of the Service that these lands are adequate for the conservation of the listed plants prior to the acquisition of fee-title or conservation easement.

d. If conservation easements for the conservation of Hoover's woolly-star, San Joaquin woolly-threads, and the California used by Caltrans, they should include, but not be limited to, provisions and responsibilities of the project proponent and the land trust organization approved by the Service for the protection of all habitats set aside including any future transfers of the easements or fee interest that may be anticipated. The easements should specify the purposes for which it is established (*i.e.*, measures to minimize effects to these three listed plants associated with the State Route 46 project). Caltrans should provide the Service with a true copy of the recorded conservation easements within thirty (30) calendar days of its recordation. The conservation easements should be held by a third party approved by the Service. The conservation easement should include a list of prohibited activities that are inconsistent with the maintenance of the preserve for the listed species including, but not limited to:

i. leveling, grading, landscaping, cultivation, or any other alterations of existing topography for any purposes, including the exploration for, or development of, mineral resources;
ii. placement of any new structures on the preserve, including buildings and billboards;
iii. discharge, dumping, burning, or storing of rubbish, garbage, grass clippings, dredge material, household chemicals, or any other wastes or fill materials within the preserve;
iv. building of any roads or trails within the preserve areas;
v. killing, removal, alteration, or replacement of any existing native vegetation except in Service-approved prescribed burning situations, or as otherwise authorized in writing by the Service;

vi. activities that may alter the hydrology of the preserve and the associated watersheds, including but not limited to: excessive pumping of groundwater, manipulation or blockage of natural drainages, inappropriate water application or placement of storm water drains, etc. unless authorized in writing by the Service;
vii. incompatible fire protection activities;
viii. use of pesticides, herbicides, or rodenticides on the preserve or within the watershed that can contaminate the preserve except as authorized in writing by the Service; and
ix. introduction of any exotic species or species not native to the area, including aquatic species, except as approved by the Service.

e. In the event Caltrans seeks to obtain a conservation easement in lieu of fee title acquisitions for the purposes of conserving the San Joaquin woolly-threads, Hoover's woolly-star, and the California jewelflower, Caltrans should provide the language of the proposed conservation easements to the Service for prior review and approval. The conservation easements should include language establishing a right of entry by the Service to determine the status of the listed plants, and the terms of the conservation easements, as well as identifying the Service as a third party beneficiary with the standing to take whatever legal action is necessary to enforce the terms of the conservation easement. Should Caltrans make fee title acquisition of lands to protect the Hoover's woolly-star, San Joaquin woolly-threads, and the California jewlflower, Caltrans should encumber such lands with restrictive covenants that provide the same rights to the Service as would be established under the conservation easement described above. Such restrictive covenants should be provided to the Service for prior review and approval before they are recorded against the conservation lands.

f. At least sixty (60) calendar days prior to the date of initial ground breaking at the proposed State Route 46 project, Caltrans should endow a Service-approved fund for monitoring and perpetual management and maintenance of the Hoover's woolly-star, San Joaquin woolly-threads, and California jewelflower on the lands that have been protected by Caltrans under fee title and/or conservation easements. The principal in the endowment should generate sufficient revenue to fully cover the costs of ongoing operations and management actions for the listed plants as described in the Service-approved management plan without the need to make use of the principal to adequately fund such expenditures. Specific actions funded by the endowment should be addressed in the Service-approved management plan. Caltrans should utilize an appropriate third party who has been approved by the Service to determine what amount of money is necessary for an endowment fund to adequately finance the monitoring and perpetual management and maintenance of the preserve(s) for the San Joaquin woolly-threads, Hoover's woolly-star, and the California jewelflower. Caltrans should empower the Service

to access and expend such funds to implement Service-approved remedial measures in the event the responsible preserve managers fail to adequately implement the Service-approved management plan. The final determination of success or failure of the management plan for the three listed plants should be made solely by the Service. Prior to the date of initial groundbreaking at the State Route 46 project, Caltrans should provide the Service with documentation that: (1) funds for the perpetual management and maintenance of the lands that have been protected for the three listed plants have been transferred to the appropriate third party approved by the Service; (2) the third party has accepted the funds and considers them adequate; and (3) that these funds have been deposited in an account (*i.e.*, endowment) that will provide adequate financing for the monitoring and perpetual management and maintenance of the three listed plants and their habitats.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of this recommendation.

REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the proposed State Route 46 from the Kern County/San Luis Obispo County line to post mile 37.5 project. As provided in 50 CFR §402.16 and in the terms and conditions of this biological opinion, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the actual date that the initiation of the initial ground breaking is two (2) calendar years or more from the date of issuance of this biological opinion, (3) the amount or extent of incidental take is exceeded; (4) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (5) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (6) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Please contact Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species), of this Field Office at the letterhead address or at 916/414-6600, if you have questions concerning this biological opinion on the State Route 46 Project.

Sincerely,

Cay C. Goude
Acting Field Supervisor

cc:

California Department of Fish and Game, Fresno, California (Attn: Donna Daniels)
California Department of Fish and Game, Sacramento, California (Attn: Dee Warenycia)
California Department of Fish and Game, Sacramento, California (Attn: Ron Schlorff)
California Department of Transportation, Sacramento, California (Attn: Gary Winters)
California Department of Transportation, Sacramento, California (Attn: Katrina Pearce)
California Department of Transportation, Fresno, California (Attn: David Armes)
USFWS, Clovis, California (Attn: S.A. B. Dickerson)

Literature Cited

Aitchison, C. W. 1987. Review of winter trophic relations of soricine shrews. Mamm. Rev. 17:1-23.

Aubrey, K.B., G.M. Koehler, and J. R. Squires. 1999. Ecology of Canada lynx in southern boreal forests *in* L.F. Ruggiero, K.B. Aubrey, S.W. Buskirk, G. Koehler, C. Krebs, K. McKelvey, and J. Squires (eds.). The scientific basis for lynx conservation. General Technical Report RMRS-GTR-30, U.S.D.A. Forest Service, Ogden, Utah.

Barbour, M.G. and Major, J. 1988. Terrestrial vegetation of California. California Native Plant Society, Sacramento, California.

Barnum, S. 1999. A programmatic agreement to minimize highway project impacts on Canada lynx (*Lynx canadensis*) in Colorado. Pages 67-74 *in* G.L.Evink, P. Garrett, and D. Ziegler (eds.). Proceedings of the third international conference on wildlife ecology and transportation. FL-ER-73-99. Florida Department of Transportation, Tallahassee, Florida.

Barclay, W. R. and A. W. Knight. 1984. Physiochemical processes affecting production in a turbid vernal pond. Pages 126-142 *in* S. Jain and P. Moyle (eds.). Vernal pools and Intermittent Streams. Institute of Ecology, University of California, Davis, California.

Barrett, L. 1990. Annual review of animal rabies in California. 1989. California Vet. 44:52-54.

Bedell, C. 2000. Kern cows may soon double (or more?). Bakersfield Californian. November 20, 2000 (villagenews.weblogger.com).

Beedy, E. C., V. K. Getz, and D. A. Airola. 1992. Status of the San Joaquin Kit Fox *Vulpes macrotis mutica* in the urban Kern River Parkway, Bakersfield, California. Pages 47-53 *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.) Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission, Sacramento, California.

Beier, P. 1993. Determining minimum habitat areas and habitat corridors for cougars. Conservation Biology 7:940-108.

Bell, H. M. 1994. Analysis of habitat characteristics of the San Joaquin kit fox in its northern range. Master of Arts thesis, California State University, Hayward, California. 90 pp.

Benfenati, E., S. Valzacchi, G. Maniani, L. Airoldi, and R. farnelli. 1992. PCDD, PCDF, PCB, PAH, cadmium, and lead in roadside soil: relationship between road distance and concentration. Chemosphere 24:1077-1083.

Bennett, A.F. 1991. Roads, roadsides, and wildlife conservation: a review. Pages 99-108 *in* D. A. Saunders and R. J. Hobbs (eds.). Nature conservation: the role of corridors. Surrey Beatty and Sons, Melbourne, Australia.

Berry, W. H., W. G. Standley, T. P. O'Farrell, and T. T. Kato. 1992. Effects of military-authorized activities on the San Joaquin kit fox (*Vulpes velox macrotis*) at Camp Roberts Army National Guard Training Site, California. U. S. Department of Energy Topical Report No. EGG 10617-2159, EG&G/EM Santa Barbara Operations, National Technical Information Service, Springfield, Virginia.

Best, T.L. 1993. Patterns of morphologic and morphometric variation in heteromyid rodents. Pp. 197-237 in H.H. Genoways and J.H. Brown (eds.). Biology of the Heromyidae. Amer. Soc. Mammal. Spec. Pub. 10: 1-719.

Birkner, J. H. 1978. Selenium in aquatic organisms from seleniferous habitats. Ph.D. Thesis, Colorado State University, Fort Collins, Colorado.

Bondello, M. and B. Brattstrom. 1979. The experimental effects of off-road vehicle sounds on three species of vertebrates. Report to the Bureau of Land Management.

Boolootian, R.A. 1954. An analysis of subspecific variations in *Dipodomys nitratoides*. J. Mammal. 35:570-577.

Bradford, D. F. 1992. Biogeography and endemism in the Central Valley of California. Pages 65-80 *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission, Sacramento, California.

Braun, S.E. 1985. Home range and activity patterns of the giant kangaroo rat, *Dipodomys ingens*. Master of Science these, University of Minnesota, Minneapolis, Minnesota.

Briden L.E., M. Archon, and D.L. Chesemore. 1987. Ecology of the San Joaquin kit fox in western Merced County. California State University, Fresno, California. 16 pp.

Briden, L.E., M. Archon, and D.L. Chesemore. 1992. Ecology of the San Joaquin kit fox (*Vulpes macrotis mutica*) in western Merced County, California. Pages 81-87 *in* D.F. Williams, S. Byrne, and T.A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission. Sacramento, California.

Byrne, S. 1987. Rare and endangered wildlife species of the Ultragpower-Ogle 115kV transmission line project area. Unpubl. Rep., Pacific Gas and Electric Company, San Ramon, California. 19 pp.

Burglund, B. and T. Lindvall. 1995. Effects of Community Noise. Archives of the Center for Sensory Research 2(1): 1-195.

Burt, W. H. and R. P. Grossenheider. 1964. A field guide to the mammals. Houghton Mifflin Company, Boston, Massachusetts. 284 pp

Bury, R.B., and J.A. Whelan. 1984. Ecology and management of the bullfrog. U.S. Fish and Wildlife Service Resource Publication 155.

California Department of Fish and Game. 1991. Annual report on the status of California state listed threatened and endangered animals and plants. Sacramento, California. 192 pp.

_____ 1995. Data on the locations of listed species from the Natural Hertitage Division, Sacramento, California.

_____ 1998. Data on the locations of listed species from the Natural Heritage Division, Sacramento, California.

_____ 2000. Data on the locations of listed species from the Natural Heritage Division, Sacramento, California.

_____ 2001a. Data on the locations of listed species in the Natural Heritage Division, Sacramento, California.

_____ 2001b. The Status of Rare, Threatened and Endangered animals and Plants of California. Annual Report for 2000. Sacramento, California. 225 pp.

_____ 2002. Data on the locations of listed species in the Natural Heritage Division, Sacramento, California.

_____ 2003. Data on the locations of listed species in the Natural Heritage Division, Sacramento, California.

California Department of Food and Agriculture. 2001. California Dairy Statistics 2000. Dairy Marketing Branch, Sacramento, California.

California Department of Pesticide Regulation, (CDPR). 2000. Summary of Pesticide Use Report Data 1999, Indexed by Commodity, Preliminary Data. September 2000. Available on CDPR's Web site <www.cdpr.ca.gov>

California Department of Water Resources. 1997. Tulare Basin Resource Assessment--Preliminary Report. Memorandum Report. San Joaquin District, Fresno, California.

_____ 1998. Draft California Water Plan Update Bulletin 160-98, Vol.1 California Department of Transportation's Internet website, January 2, 2003

Carbine, L.N. 1998. Update, COSEWIC status report on swift fox (*Vulpes velox*). Committee of the status of endangered wildlife in Canada. Ottawa, Ontario, Canada.

Carbyn, L.N., H.J. Armbuster, and C. Mamo. 1994. The swift fox reintroduction program in Canada from 1983 to 1992. Pages 247-270 *in* M.L. Bowles and C.J. Whelan (eds.). Restoration of endangered species: conceptual issues, planning and implemenation. Cambridge University Press, Cambridge, Great Britain

Carraway, L. N. 1990. A morphologic and morphometric analysis of the "*Sorex vagrans* species complex" in the Pacific Coast region. Special Publications, The Museum, Texas Tech University 32:1-78.

Carraway, L. N. 1995. A key to recent Soricidae of western United States and Canada based primarily on dentaries. Occ. Papers Mus. Nat. Hist. Univ. Kansas 175:1-49.

Castillo-Sanchez, C. 1999. Highways and wildlife conservation in Mexico: the Sonoran pronghorn at El Pinacate y Gran Desierto de Altar Biosphere Reserve on the Mexico-USA border. Pages 289-292 *in* G.L. Evink, P. Garrett, and D. Ziegler (eds.). Proceedings of the third international conference on wildlife ecology and transportation. FL-ER-73-99. Florida Department of Transporation. Tallahassee, Florida.

Caughley, G., and Gunn, A. 1993. Dynamics of large herbivores in deserts: kangaroos and caribou. Oikos, 67: 47-55.

Chesemore, D. 1980. Impact of oil and gas development on blunt-nosed leopard lizards. U.S. Bureau of Land Management, Bakersfield, California, Final Rep., Contract No. YA-512-CT9-118. 83 pp.

Churchfield, S. 1990. The Natural History of Shrews. Christopher Helm, A & C Black Pub. London. 178 pp.

Churchfield, S. 1991. Niche dynamics, food resources, and feeding strategies in multi-species communities of shrews. Pages 23-34, *in*: J. S. Findley and T.L. Yates (eds.). The Biology of the Soricidae. Special Publication, Museum of Southwestern Biology, University of New Mexico. Albuquerque, New Mexico.

Clark, W. A., S. M. Juarez, and D. L. Chesemore. 1982. Nature Conservancy small mammal inventory on the Paine Wildflower Preserve and the Voice of America in Kern County, California. The Nature Conservancy, San Francisco, California. Unpubl. rept., 47 pp.

Clark, D. R., Jr. 1987. Selenium accumulation in mammals exposed to contaminated California irrigation drainwater. Sci. Total Environ. 66:147-168.

Clark, D. R., Jr., P. A. Ogasawara, G. J. Smith, and H. M. Ohlendorf. 1989. Selenium accumulation by raccoons exposed to irrigation drainwater at Kesterson National Wildlife Refuge, California, 1986. Arch. Environ. Contam. Toxicol. 18:787-794.

Clevenger, A. P., M. McIvor, D. McIvor, B. Chruszcz, K. Gunson 2001. Tiger Salamander, *Ambystoma tigrinum,* Movements and Mortality on the Trans-Canada Highway in Southwestern Alberta. Canadian Field Naturalist 115: 199-204.

Clevenger, A.P. and N. Waltho. 1999. Dry culvert use and design considerations for small- and medium-sized mammal movement across a major transportation corridor. Pages 263-178 *in* G. L. Evink, P. Garrett, and D. Zeigler (eds.). Proceedings of the third international conference on wildlife ecology and transportaion. FL-ER-73-99, Florida Department of Transportation. Tallahassee, Florida.

Coe, T. (1988). The Application of Section 404 of the Clean Water Act to Vernal Pools. Urban Wetlands. National Wetlands Society, Sacramento, California.

Collins, J. 1990. Standard common and current scientific names for North American amphibians and reptiles. Soc. Stud. Amphib. Reptiles. Herpetol. Circ. 19: 1-41.

Cope, E. 1900. The crocodilians, lizards, and snakes of North America. Ann. Rep., Board of Regents, Smithsonian Institution, year ending June 30, 1898. U.S. Nat. Mus. 2:151-1294

Corbet, G. B., and J. E. Hill. 1980. A World List of Mammalian Species. British Museum, Comstock Pub. Asso., Cornell Univ. Press, Ithaca, New York.

Cornman, David. 2001. Effects of Noise on Wildlife. Nature Sound Society. San Francisco State University, San Francisco, California

Cott, H. 1966. Adaptive Coloration in Animals. Methuen & Co. Ltd. London, Great Britain. 508 pp.

Council for Agricultural Science and Technology (CAST). 1994. Risks and benefits of selenium in agriculture. Issue Paper No. 3 Supplement. Ames, Iowa. 35 pp.

Covell, D.F. 1992. Ecology of the swift fox (*Vulpes velox*) in southeastern Colorado. Master of Science thesis, University of Wisconsin, Madison, Wisconsin.

Crampton, B. 1959. The grass genera *Orcuttia* and *Neostapfia*: A study in habitat and morphological speciation. Madrono 12(8): 225-256.

Culbertson, A. E. 1946. Observations on the natural history of the Fresno kangaroo rat. J. Mammal. 27: 189-203.

Cypher, B. L. 2000. Effects of roads on San Joaquin kit foxes: a review and synthesis of existing data. Endangered Species Recovery Program, California State University, Fresno, California.

Cypher, B. L., and Scrivner, J. H. 1992. Coyote control to protect endangered San Joaquin kit foxes at the Naval Petroleum Reserves, California. Pages 42-47 *in* J.E. Borrecco and R. E. Marsh (eds.). Proceedings of the 15th Vertebrate Pest Conference, March 1992, Newport Beach, Calif. University of California, Davis, California.

Cypher, B. L., and Spencer, K. A. 1998. Competitive interactions between coyotes and San Joaquin kit foxes. Journal of Mammalogy 79: 204-214

Cypher, B.L., G.D. Warrick, M.R.M. Otten, T.P.O'Farrell, W.H. Berry, E.C. Harris, T.T. Kato, P.M. McCue, J.H. Scrivner, and B.W. Zoellick. 2000. Population dynamics of San Joaquin kit foxes at the Naval Petroleum Reserve in California. Wildlife Monographs 145.

Cypher, E. A. 1994. Demography of *Caulanthus californicus*, *Lembertia congdonii*, and *Eriastrium hooveri,* and vegetation characteristics of endangered species populations in the southern San Joaquin Valley, and the Carriso Plain Natural Area in 1993. California Department of Fish and Game, Sacramento, California.

Dalrymple, G.H., and N.G. Reichenbach. 1984. Management of an endangered species of snake in Ohio, USA. Biological Conservation 30:195-200.

Danielsen, K. C., T. M. Austin, and C. Lee-Wong. 1994. Field inventory of *Caulanthus californicus* (California jewelflower) in Los Padres National Forest. U. S. Forest Service, Goleta, California.

Dannelid, E. 1994. Comparison of pigment and other dental characters of eastern Palearctic *Sorex* (Mammalia: Soricidae). Pages 217-231 *in* Merritt, J. F., G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 18:1-458.

Dell'Omo, G., Turk, A., and R. F. Shore. 1999. Secondary poisoning in the common shrew (*Sorex araneus*) fed earthworms exposed to an organophosphate pesticide. Environ. Tox. Chem. 18:237-240.

Disney, M., and Spiegel, L. K. 1992. Sources and rates of San Joaquin kit fox mortality in western Kern County, California. Trans. West. Sec. Wildl. Soc. 28: 73-82.

Dolgov, V. A. 1994. The evolution of the Soricidae as shown by the variability of cranial morphology. Pages. 325-333 *in* Merritt, J. F., G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 8:18:1-45.

EG&G Energy Measurements. 1995a. Endangered species program Naval Petroleum Reserves in California - annual report FY93. U. S. Department of Energy Rept. No. EGG 11265-2047, EG&G Energy Measurements, Las Vegas, Nevada.

_____ 1995b. Endangered species program Naval Petroleum Reserves in California - annual report FY94. EGG11265-1162, EG&G Energy Measurements, Las Vegas, Nevada.

Egoscue, H.J. 1956. Preliminary studies of the kit fox in Utah. Journal of Mammalogy 37:351-357.

_____ 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 43:481-497.

_____ 1975. Population dynamics of the kit fox in western Utah. Bulletin of the Southern California Academy of Sciences 74:122-127.

Eisler, R. 1985. Selenium hazards to fish, wildlife, and invertebrates: a synoptic review. Contaminant Hazard Reviews Report no.5. Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, Laurel, Maryland.

Endangered Species Recovery Program (Endangered Species Recovery Program). 1999a. Buena Vista Lake shrew Summary Report for the Kern National Wildlife Refuge. California State University, Stanislaus, California. 5pp.

_____ 1999b. Buena Vista Lake shrew. Summary Report for the Coles Levee Nature Center. California State University, Stanislaus, California. 4pp.

_____ 1999c. Buena Vista Lake shrew Summary Report for Lake Woollmes. California State University, Stanislaus, California. 4pp.

Endangered Species Recovery Program and United States Bureau of Reclamation. 2001. Land retirement demonstration project report: Year two. Stanislaus, California. 124 Pp.

Engler, J. 1994. Status of the Buena Vista Lake shrew at the Kern National Wildlife Refuge. 1994 report of activities, U. S. Fish and Wildlife Service, Kern National Wildlife Refuge, Delano, California. 2 pp.

Environmental Protection Agency (EPA). 1988. Clean Water Act Section 404 Program Definitions and Permit Exemptions; Section 404 State Program Regulations; Final Rule. **Federal Register** 53: 20764.

_____ 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. **Federal Register** 65: 31681-31719.

Fahrig, L. 1997. Relative Effects of Habitat Loss and Fragmentation on Population Extinction. Journal of Wildlife Management 61:603-610.

Floit, S. B., and Barnthouse, L. W. 1991. Demographic analyses of a San Joaquin kit fox population. Environmental Sciences Division Publication Number 3590, Oak Ridge National Laboratory, National Technical Information Service, Springfield, Virginia.

Forman, R. T., L.E. Alexander. 1998. Roads and their major ecological effects. Annual review of Ecology and Systematics 29:207-231.

Food and Drug Administration (FDA), U. S. Department of Agriculture. 1993. Food additives permitted in feed and drinking water of animals; selenium; stay of the 1987 amendments; final rule. **Federal Register** 58:47961-47973.

Frank, K. W. 1934. A new toxicant occurring naturally in certain samples of plant foodstuffs. J. Nutrition 8:597-608.

Frankenberger, W. T. Jr. and R. A. Engberg (eds). 1998. Environmental Chemistry of Selenium. Marcel Dekker, Inc. New York, New York. 713 Pp.

Freas, K. 1989. Center for Conservation Biology rediscovers endangered Buena Vista shrew. Center for Conservation Biology Update. Stanford University, Stanford, California. Spring/Summer Vol.3, No.1.

Freas, K. 1990. An investigation of the distribution and abundance of the Buena Vista Lake shrew, *Sorex ornatus relictus,* at the Kern Lake Preserve. Unpublished report to The Nature Conservancy. Center for Conservation Biology, Stanford University, Stanford, California. 6 pp.

Frankham, R., and K. Ralls. 1998. Inbreeding leads to extinction. Nature 241:441-442.

Frost, D. and J. Collins. 1988. Nomenclatural notes on reptiles of the United States. Herpetol. Rev. 19:73-74

Genoud, M. 1988. Energetic strategies of shrews: ecological constraints and evolutionary implications. Mamm. Rev. 18:173-193.

George, S. 1986. Evolution and historical biogeography of Soricine shrews. Syst. Zool. 35:153-162.

George, S. 1988. Systematics, historical biogeography, and evolution of the genus *Sorex*. J. Mamm. 69:442-461.

Gerlach, G., and K. Musolf. 2000. Fragmentation of landscapes as a cause for genetic subdivision in bank voles. Conservation Biology 14:1066-1074.

Germano, D.J. 2000. Translocation of Tipton kangaroo rats (*Dipomys nitratoides nitratoides*) in Kern County. Prepared for Wolfe and Associates.

_____ 2002. Radiotracking study of translocated Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*) in Kern County, California.

Germano, D. J. and S. P. Tabor. 1993. Survey of protected animals in the area of the semitropic ground water banking project in Kern County, Ca. Prepared for the Metropolitan Water District of Southern California. 49 Pp.

Germano, D. and D. Williams. 1992. *Gambelia sila (*Blunt-nosed leopard). Reproduction. Herpet. Rev.23:117.

_____. 1993. Recovery of the blunt-nosed leopard lizard: past efforts, present knowledge, and future opportunities. Trans. West. Sec. Wildl. Soc. 28:38-47.

_____. 1994a. *Gambelia sila* (Blunt-nosed leopard lizard). Cannibalism. Herpet. Rev.25:26-27

_____. 1994b. Population ecology of blunt-nosed leopard lizards in 1994 on the Elkhorn Plain, San Luis Obispo County, California.. U.S. Bureau of Land Management, Bakersfield, California. 32 pp.

Germano, D., D. Williams, and W. Tordoff III. 1994. Effect of drought on blunt-nosed leopard lizards (*Gambelia sila*). Northwest. Nat. 75:11-19.

Gierman, E. 1995. Letter from Edward C. Gierman. Vice President, General Council, J. G. Boswell Company, to the U.S. Fish and Wildlife Service.

Gilliom, Robert, J. 1999. Pesticides in the Nation's Water Resources. U.S. Geological Survey. Water Environment Federation Briefing Series Presentation. Capitol Building, Washington D.C. March 19, 1999.

Gilpin, M. E. 1987. Spatial structure and population vulnerability. Pages 125-139 *in* M. E. Soule (ed.). Viable populations for conservation. Cambridge University Press, New York, New York.

Gilpin, M. E. and M. E. Soule. 1986. Minimum viable populations: processes of species extinction. Pages 19-34 *in* M. E. Soule, (ed.). Conservation biology : the science of scarcity and diversity. Sinauer Associates. Sunderland, Massachusetts.

_____ 1988. Minimum viable populations: processes of species extinction. Pages 18-34 *in* E.E. Soule, (ed.). Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Sunderland, Massachusetts.

Goldingay, R.L., P.A. Kelly, and D.F. Williams. 1997. The kangaroo rats of California: endemism and conservation of keystone species. Pacific Conservation Biology 3:47-60.

Goodman, D. 1987a. The demography of chance extinction. Pages 11-19 *in* M. E. Soule (ed.). Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Sunderland, Massachusetts.

_____. 1987b. How do any species persist? Lessons for conservation biology. Conservation Biology 1:59-62.

Griggs, F.T. 1992. The remaining biological diversity of the San Joaquin Valley, California. Pages 11-15 *in* E D. F. Williams, S. Byrne, and T. A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission. Sacramento, California.

Griggs, F. T., Z. M. Zaninovich, and Werschkull, G. D. 1992. Historic native vegetation map of the Tulare Basin, California. Pages 111-118 *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission. Sacramento, California.

Grinnell, J. 1922. A geographical study of the kangaroo rats of California. Univ. Calif. Pub. Zoo. 24: 1-124.

_____ 1932a. A relic shrew from central California. Univ. California Publ. Zool. 38:389-390.

_____ 1932b. Habitat relations of the giant kangaroo rat. J. Mammology 13:305-320.

_____ 1933. Review of the recent mammal fauna of California. Univ. California Publ. Zool. 40:71-234.

Grinnell, J., J.S. Dixon, and J.M. Linsdale. 1937. Fur-bearing mammals of California. Volume 2. University of California Press. Berkeley, California.

Hafner, M. S. 1979. Density, distribution, and taxonomic status of *Dipodomys nitratoides nitratoides* Merriam, 1894 (Rodentia - Heteromyidae). California Department of Fish and Game, Sacramento, California.

Hall, E. R. 1981. The mammals of North America. 2nd ed. John Wiley and Sons, New York, New York.

Hall, H. M. 1983. Status of the kit fox at the Bethany wind turbine generating (WTC) project site, Alameda County, California. California Department of Fish and Game, Sacramento, California.

Halverson, A. W., Ding-tsair Tsay, K. C. Triebwasser, and E. I. Whithead. 1970. Development of hemolytic anemia in rats fed selenite. Toxicol. Appl. Pharmacol. 17:151-159.

Hanski, I. 1994. Population biological consequences of body size in *Sorex*. Pages 15-26 *in* J. F. Merritt, G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 18:1-458.

Harker, M.B. G.B. Rathbun, and C.A. Langtimm. 1999. Beaded-chain collars: a new method to radiotag kangaroo rats for short-term studies. Wildlife Society Bulletin. 27(2):314-317.

Harris, J. H. 1990. Ornate Shrew, *Sorex ornatus*. Pages 12-13 *in* D. C. Zeiner, W. F. Laudenslayer, Jr., K. E. Mayer, and M. White (eds.). California's wildlife, Volume III Mammals. California Dept. Fish and Game, Sacramento, California. 407 pp.

Haukisalmi, V., Henttonen, H., and T. Mikkonen. 1994. Pages 97-102 *in* J. F. Merritt, G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ.18:1-458.

Hawbecker, A. C. 1944. The giant kangaroo rat and sheep forage. J. Wildl. Manage. 8:161-165.

_____ 1951. Small mammal relationships in an Ephedra community. J. Mammal. 32:50-60.

Hawes, M. 1977. Home range, territoriality, and ecological separation in sympatric shrews, *Sorex vagrans* and *Sorex obscurus*. J. Mamm. 58:354-366.

Hays, W. S. 1990. Population ecology of ornate shrews, *Sorex ornatus*. Master of Science. Thesis. University of California, Berkeley, California. 39 pp.

Hoffmann, W. M. 1974. The Fresno kangaroo rat study. California Department of Fish and Game, Sacramento, California.

Holling, C. S. 1959. The components of predation by a study of small-mammal predation of the European pine sawfly. Can. Entomol. 91:293-320.

Holmstead, G. 1993. Distribution, ecology, and management of Hoover's woolly-star (*Eriastrum hooveri*) on the Naval Petroleum Reserve in California. EG&G Energy Measurements, Las Vegas, Nevada.

Holmstead, G. L. and D. C. Anderson. 1993. Reestablishment of Hoover's woolly-star (*Eriastrum hooveri*) following disturbance. EG&G Energy Measurements, Las Vegas, Nevada.

Holt, D. W. and S. M. Leasure. 1993. Short-eared Owl (*Asio flammeus*). The brds of North America No. 62. The American Ornithologists' Union. The Academy of Natural Sciences; Philadelphia, Pennsylvania.

Houston, C. S., D. G. Smith, and C. Rohner. 1998. Great Horned Owl (*Bubo virginianus*). The Birds of North America No. 372. The American Ornithologists' Union. Academy of Natural Sciences. Philadelphia, Pennsylvania.

Hansen, R. W., and R. L. Tremper. 1993. Amphibians and reptiles of central California. California Natural History Guides. University of California Press, Berkeley, California.

Hersteinsson, P., and D.W. MacDnald. 1982. Interspecific competition and the geographical distribution of red and arctic foxes (*Vulpes vulpes* and *Alopex lagopus*). Oikos 64:505-515.

Hines, T.D. 1980. An ecology study of *Vulpes velox* in Nebraska. Master of Science thesis, University of Nebraska, Lincoln, Nebraska.

Ingles, L. G. 1961. Home range and habitats of the wandering shrew. J. Mamm. 42:455-462.

Ingles, L. G. 1965. Mammals of the Pacific States: California, Oregon, Washington. Stanford University Press, Stanford, California. 506 pp.

Ivanitskaya, E. Y. 1994. Comparative cytogenetics and systematics of *Sorex*: A cladistic approach. Pages 313-323 *in* J. F. Merritt, G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 18:1-458.

Ivanter, E. V. 1994. The structure and adaptive peculiarities of pelage in Soricine shrews. Pages 441-454 *in* J. F. Merritt, G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 18:1-458.

Jackson, H. H. T. 1928. A review of the American long-tailed shrews (genus *Sorex* and *Microsorex*). N. Amer. Fauna 51:1-238.

Jamerson, E. W. Jr., and H. J. Peeters. 1988. California Mammals. California Natural History Guides, University of California Press, Berkeley, California. 403 pp.

Jennings, M. 1987. Annotated checklist of the amphibians and reptiles of California. Southwest. Herpt. Soc. Spec. Pub. 3: 1-48..

Joly, P. and A. Morand. 1997. Amphibian diversity and land-water ecotones. Pages 161-182 *in* J.P. Bravard and R. Juge (eds.). Biodiversity in land-water ecotones. Man and Biosphere

series volume 18. United Nations Educational, Scientific, and Cultural Organization, Paris, France.

Junge, J. A., and R. S. Hoffmann. 1981. An annotated key to the long-tailed shrews (Genus *Sorex*) of the United States and Canada, with notes on Middle American *Sorex*. Univ. Kansas. Occas. Papers Mus. Nat. Hist. 94:1-48.

Kato, T., and T. O"Farrell. 1986. Biological assessment of the effects of petroleum production at maximum rate, Naval Petroleum Reserve (Elk Hills), Kern County, California on the endangered blunt-nosed leopard lizard, *Gambelia silus*. U.S. Dep. Tropical Rep. No. EGG 10282-2124, Santa Barbara Operations, EG&G Energy Measurements, Goleta, California 44 pp.

Kato, T., B. Rose, and T. O'Farrell. 1987a. Diet of the blunt-nosed leopard lizard, *Gambelia silus*, on Naval Petroleum Reserves #1 and #2, Kern County, CA. U.S. Dep. Of Energy Final Rep. No EGG 10282-2185, Santa Barbara Operations, EG&G Energy Measurements, Goleta, California. 16 pp.

_____ 1987b. Distribution, abundance, and habitat use of the endangered blunt-nosed leopard lizard on the Naval Petroleum Reserves, Kern County, CA. U.S. Dep. Of Energy Final Rep. No EGG 10282-2182, Santa Barbara Operations, EG&G Energy Measurements, Goleta, California. 44 pp.

Kirkland, G. L. Jr. 1991. Competition and coexistence in shrews (Insectivora: Soricidae). Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico. Special Publication 1:15-22.

Kitchen, A.M. E.M. Gese, and E.R. Schauster. 1999. Resource partitioning between coyotes and swift foxes: space, time, and diet. Canadian Journal of Zoology 77:1645-1656.

Knapp, D.K. 1978. Effects of agricultural development in Kern County, California, on the San Joaquin kit fox in 1977. California Department of Fish and Game. Non-Game Wildlife Investigations Final Report Project E-1-1, Nov V-1.21.

Komanoff, C. and H. Shaw. 2000. Drowning in Noise: Noise costs of jet skis in America. The Noise Pollution Clearinghouse. Montpelier, Vermont.

Koos, K. A. 1979. Food relationships of an alkali sink rodent community. Master of Science thesis, California State University, Fresno, California.

Koopman, M.E. 1995. Food habits, space use, and movements of the San Joaquin kit fox on the Elk Hills Naval Petroleum Reserves in California. Master of Science thesis, University of California, Berkeley, California. 41 pp.

Koopman, M.E., J.H. Scrivner, and T.T. Kato. 1998. Patterns of den use by San Joaquin kit foxes. Journal of Wildlife Management 62:373-379.

Kushlan, J.A. 1988. Conservation and management of the American crocodile. Environmental Management 12:777-790.

Lande, R. 1988. Genetics and Demography in Biological Conservation. Science 241:1455-1460.

_____ 1999. Extinction risks from anthropogenic, ecological, and genetic factors. Pages 1-22 *in* L. Landweber and A. Dobson (eds.). Genetics and the Extinction of Species: Cambridge Univ. Press. Cambridge, England.

Laughrin, L. 1970. San Joaquin kit fox, its distribution and abundance. Wildlife Management Branch Administrative Report 70-2. California Department of Fish and Game, Sacramento, California.

Lesica, P. and F. W. Allendorf. 1995. When are peripheral populations valuable for conservation? Conservation Biology 9:753-760.

Lewis, R. 1992. *Eriastrum hooveri* field inventory. U. S. Bureau of Land Management, Bakersfield, California.

_____ 1994. *Eriastrum hooveri* U. S. Bureau of Land Management, Bakersfield, California.

Lewis, J.C., K.L. Sallee, and R.T. Golightly, Jr. 1993. Introduced red fox in California. California Dept. Fish and Game, Sacramento, Nongame Bird and Mammal Sec., Rep. 93-10:1-70, 70 pp.

Lillebo, H. P., S. Shaner, D. Carlson, N. Richard, and P. DuBowy. 1988. Water quality criteria for selenium and other trace elements for protection of aquatic life and its uses in the San Joaquin Valley. California State Water Resources Control Board, Sacramento, California. SWRCB Order No. W. Q. 85-1. Technical Committee Report, Appendix D.

Lovallo, M.J., and E.M. Anderson. 1996. Bobcat movements and home ranges relative to roads in Wisconsin. Wildlife Society Bulletin 24:71-76.

Ma, Wei-Chun and S. Talmage. 2001. Insectivora. Pages 123-158. *in* R. F. Shre and B. A. Rattner (eds). Ecotoxicology of Wild Mammals. John Wiley & Sons, Ltd. Chichester, Great Britain.

MacArthur, R.A., R.H. Johnston, and V. Geist. 1979. Factors influencing heart rate in free ranging bighorn sheep: a physiological approprach to the study of wildlife harrassment, Canadian Journal of Zoology 57:2010-2021.

MacDonald, D.W., and D.R. Voigt. 1985. The biological basis of rabies models. Pages 71-108 *in* P.J. Beacon (ed.). Population dynamics of rabies in wildlife. Academic Press, London, Great Britain.

McCue, P.M., and T.P. O'Farrell. 1988. Serological survey for selected diseases in the endangered San Joaquin kit fox (*Vulpes macrotis mutica*). J. Wildl. Dis. 24(2)274-281.

Maehr, D.S., E.D. Land, and M.E. Roelke. 1991. Mortality patterns of panthers in southwest Florida. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 45:201-207.

Maldonado, J. 1992. A review of the population status of the Buena Vista Lake shrew (*Sorex ornatus relictus*) in the Tule Elk Reserve. University of California, Los Angeles, California. 28 pp.

_____ 1998. The population status of the Buena Vista Lake shrew (*Sorex ornatus relictus*). University of California, Los Angeles, California. 15 pp.

_____ In press. Discordant patterns of morphological variation in genetically divergent populations of ornate shrews (*Sorex ornatus*).

Maldonado, J., M. L. Castellanos, and F. Hertel. 1998. Surveys for the Buena Vista Lake shrew at the Kern National Wildlife Refuge. University of California, Los Angles, California. 12 pp.

Maldonado, J., C. Vila, and R. K. Wayne. 2001. Tripartite genetic subdivisions in the ornate shrew (*Sorex ornatus*). Molecular Ecol. 10:127-147.

Marks, J. S., D. L. Evans, and D. W. Holt. 1994. Long-eared Owl (*Asio otus*). The Birds of North America, No. 133 . American Ornithologists' Union. Academy of Natural Sciences, Philadelphia, Pennsylvania.

Marti, C. O. 1992. Barn Owl (*Tyto alba*). The birds of North America. American Ornithologists' Union. The Academy of Natural Sciences, Philadelphia, Pennsylvania.

Mason, H. L. 1945. The genus *Eriastrum* and the influence of Bentham and Hooker upon the problem of genetic confusion in the Polemoniaceae. Madrono 8:65-91.

Mayr, E., E. G. Linsley, and R. L. Usinger. 1953. Methods and Principals of Systematic Zoology. McGraw-Hill Book Co. New York, New York

McGrew, J. C. 1979. *Vulpes macrotis*. Mammal Species 123:1-6.

McNab, B. K. 1991. The energy expenditure of shrews. Pages 35-45 *in* J. S. Findley and T. L. Yates (eds.). The Biology of the Soricidae. The Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico. Special Pub. No. 1.

Menges, E.S. 1991. The application of minimum viable population theory to plants. Pages 45-61 *in* D.A. Falk and K.E. Holsinger (eds.). Genetics and conservation of rare plants. Oxford University Press, New York, New York.

Mercer, L. J. and W. D. Morgan. 1991. Irrigation, drainage, and agricultural development in the San Joaquin Valley. Pages 9-27 *in* A. Dinar and D. Zilberman (eds.), The Economics and Management of Water and Drainage in Agriculture. Kluwer Acad. Pub., Boston, Massachusetts.

Metcalf, A.E. 1998. The mtDNA genetics of southern California kangaroo rats: Evolution and Conservation. Dissertation submitted to the iology Program. University of California, Riverside, California.

Montanucci, R. 1965. Observations on the San Joaquin leopard lizard, *Crotophytus wislizenii Silus* Stejneger. Herpetologica 21:270-283.

_____. 1967. Further studies on leopard lizards, *Crotophytus wislizenii.* Herpetologica 23:119-126.

_____. 1970. Analysis of hybridization between *Crotophytus wislizenii* and *Crotophytus silus* (Sauria:Iguanidae) in California. Copeia 1970:104-123.

Montanucci, R, R. Axtell, and H. Dessauer. 1975. Evolutionary divergence among collared lizards (*Crotophytus*) with comments on the status of *Gambelia*. Herpetologica 31:336-347.

Moore, S. B., S. T. Detwiler, J. Winckel, and M. D. Weegar. 1989. Biological residue data for evaporation ponds in the San Joaquin Valley, California. San Joaquin Valley Drainage Program, U. S. Fish and Wildlife Service, Sacramento, California

Morrell, S. H. 1970. Life history study of the San Joaquin kit fox. California Department of Fish and Game, Federal Aid in Wildlife Restoration project W-54R-2. Sacramento, California.

____ 1972. Life History of the San Joaquin kit fox. California Fish and Game 58:162-174.

____ 1975. San Joaquin kit fox distribution and abundance in 1975. California Dept. Fish and Game, Sacramento, California. Wildl. Manage. Branch, Admin. Rep. No. 75-3, 28 pp.

Mumme, R.L., S.J. Schoech, G.E. Woolfenden, and J.W. Fitzpatrick. 1999. Life and death in the fast lane: demographic consequences of road mortality in the Florida scrub jay. Conservation Biology 14:501-512.

Nagel, A. 1994. Metabolic rates and regulation of cardiac and respiratory function in European shrews. Pages 421-434 *in* Merritt, J. F., G. L. Kirkland, Jr., and R. K. Rose (eds.). Advances in the Biology of Shrews. Carnegie Mus. Nat. Hist. Spec. Publ. 18:1-458.

National Institute of Health (NIH). 1990. Noise and hearing loss. NIH Consensus Statement, 8(1):1-24.

National Park Service (NPS). 1994. Report on effects of aircraft overflights on the National Park System. Report to Congress. Technical Report No. NPSD1062. Washington, D.C.

Natural Resources Conservation Service. 2000. Summary Report 1997 National Resources Inventory. Iowa State University. United States Department of Agriculture.

Newman, J. R. 1970. Energy flow of a secondary consumer (*Sorex sinuosus*) in a salt marsh community. Ph.D. Thesis. University of California, Davis, California. 100 pp.

Newman J. R. 1976. Population dynamics of the wandering shrew *Sorex vagrans*. Wasmann J. Biol. 34:235-250.

Newman J. R. and R. L. Rudd. 1978. Minimum and maximum metabolic rates of *Sorex sinuosus*. Acta theriol. 23:371-380.

Nikiforoff, C. C. 1941. Hardpan and microrelief in certain soil complexes of California. Washington, D.C. United States Department of Agriculture: 45.

O'Farrell, T.P. , P. McCue, and T. Kato. 1987. Distribution of the giant kangaroo rat, *Dipodomys ingens*, on the Naval Petroleum Reserves, Kern County, California. EG&G report 10282-2173. Santa Barbara Operations, EG&G, Goleta, California.

Olson, O. E. 1986. Selenium toxicity in animals with emphasis on man. J. Am. College Toxicol., 5:45-70.

O'Neal, G.T., J.T. Flinders, and W.P. Clary. 1987. Beavioral ecology of the Nevada kit fox (*Vulpes macrotis nevadensis*) on a managed desert rangeland. Pages 443-481 *in* H.H. Genoways (ed.). Current Mammalogy volume I. Plenum Press, New York, New York.

O'Toole, D. and M. F. Raisbeck. 1998. Magic numbers, elusive lesions: Comparative pathology and toxicology of selenosis in waterfowl and mammalian species. Pages 355-395 *in* A. Dinar and D. Zilberman (eds.), The Economic and Management of Water and Drainage in Agriculture. Kluwer Acad. Pub. Boston, Massachusetts.

Owen, J. G., and R. S. Hoffmann. 1983. *Sorex ornatus*. Mamm. Spec., 212:1-5.

Oxley, D.J., M.B. Fenton, and G.R. Carmody. 1974. The effects of roads on populations of small mammals. Journal of Applied Ecology 11:51-59.

Patton, J. L. and P. V. Brylski. 1987. Pocket gophers in alfalfa fields: Causes and consequences of habitat-related body size variation. Amer. Nat. 130:493-506.

Paveglio, F. L. and S. D. Clifton. 1988. Selenium accumulation by San Joaquin kit foxes and coyotes in the Kesterson National Wildlife Refuge Area-draft. U.S. Fish and Wildlife Service. Los Banos, Calfornia. Unpubl. Rep. 59 pp.

Pearson, O. P. 1959. A traffic survey of *Microtus-Reithrodontomys* runways. J. Mamm. 40:169-180.

Ralls, K. and P.J. White. 1995. Predation on San Joaquin kit foxes by larger canids. Journal of Mammalogy 76:723-729.

Randall, J.A. 1997. Social organization and communication in *Dipodomys ingens*. Report for research during 1995-1996 on the giant kangaroo rat, *Dipodomys ingens*. U. S. Fish and Wildlife Service, Sacramento, California.

_____ 1999. Report to U.S. Fish and Wildlife Service on research on endangered giant kangaroo rat, *Dipodomys ingens*: spacing and neighbor recognition. Annual Report submitted for permit TE-799486. Sacramento Fish and Wildlife Office, Sacramento, California.

Regional Water Quality Control Board (RWQCB), State of California, Central Valley Region. 2001. Fact Sheet No. 2 for Dairies, Dairy Waste Management for Protection of Water Quality. 2 pp.

Reh, W., and A. Seitz. 1990. The influences of land use on the genetic structure of populations of the common frog *Rana temporaria*. Biological Conservation 54:239-249.

Reilly, K., and D. Mangiamele. 1992. California rabies surveillance. 1991. California Vet. 46:47-51.

Repenning, C. A. 1967. Subfamilies and genera of the Soricidae. Geol. Surv. Prof. Paper 565:1-74.

Ritter, J. 2000. Valley of Plenty Fights to Survive the Irrigated Marvel, That Is the World's Richest Farmland Is Losing Ground to Economics and Urban Sprawl. USA Today.

Rose,R. K., R. K. Everton, and T. M. Padgett. 1987. Distribution and current status of the threatened Dismal Swamp southeastern shrew, *Sorex longirostris fisheri*. Vir. J. Sci. 38:358-363.

_____ 1955a. Population variation and hybridization in some California shrews. Syst. Zool. 4:21-34.

Rudd, R. L. 1955b. Age, sex, and weight comparisons in three species of shrews. J. Mamm. 36:323-339.

Rudolph,D.C., S.J. Burgdorf, R.N.Conner, and J.. Dickson. 1998. The impact of roads on the timber rattlesnake (*Crotalus horridus*) in eastern Texas. Pages 236-240 *in* G.L. Evink, P. Garrett, D. Ziegler, and J. Berry (eds.). Proceedings of the international conference on wildlife ecolog and transportation. FL-ER-69-98. Florida Department of Transportation, Tallahassee, Florida.

Rudolph, D.C., S.J. Burgdorf, R.N. Conner, and R.R. Schaefer. 1999. Preliminary evaluation of the impact of roads and associated vehicular traffic on snake populations in eastern Texas. Pages 129-136 *in* G.L. Evink, P. Garrett, and D. Zeigler (eds.). Proceedings of the third international conference on wildlife ecology and transportation. FL-ER-73-99. Florida Department of Transportation, Tallahassee, Florida.

Saccheri, I., M. Kuussaari, M. Kankare, P. Vikman, W. Fortelius, and I. Hanski. 1998. Inbreeding and extinction in a butterfly population. Nature 392:491-494.

Saiki, M. K. and T. P. Lowe. 1987. Selenium in aquatic organisms from subsurface agricultural drainage water, San Joaquin Valley, California. Arch. Environ. Contam. Toxicol. 16:657-670.

Schauber, E. M., W. D. Edge, and J. O. Wolff. 1997. Insecticide effects on small mammals: Influence of vegetation structure and diet. Ecological Applications 7:143-157

Schultz, L.J., and L.R. Barrett. 1991. Controlling rabies in California 1990. California Vet. 45:36-40.

Schwartz, M.K., K. Ralls, D.F. Williams, and R.C. Fleischer. 2000. Genetic variation and substructure of San Joaquin kit fox population. Unpublished report.

Scrivner, J. H., and T. P. O'Farrell, T. T. Kato, and M. K. Johnson. 1987*a*. Diet of the San Joaquin kit fox, *Vulpes macrotis mutica*, on Naval Petroleum Reserve #1, Kern County, California. Rep. No. EGG 10282-2168, EG&G Energy Measurements. Goleta, California. 26 pp.

Scrivner, J. H., and T. P. O'Farrell, T. T. Kato, 1987*b*. Dispersal of San Joaquin kit fox, *Vulpes macrotis mutica*, on Naval Petroleum Reserve #1, Kern County, California. Rep. No. EGG 10282-2190, EG&G Energy Measurements, Goleta, California. 32 pp.

Seiler, R. L., J.P. Skorupa, and L. A. Peltz. 1999. Areas susceptible to irrigation-indiced selenium contamination of water and biota in the western United States. U. S. Geological Survey Circular 1180. 36 pp.

Shaffer, M. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86 *in* M. E. Soule (ed.). Viable populations for conservation. Cambridge University Press, New York, New York

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.

Sheffield, S. R. and R. L. Lochmiller. 2001. Effects of field exposure to diazinon on small mammals inhabiting a semienclosed prairie grassland ecosystem. I. Ecological and reproductive effects. Envir. Toxicol. Chem. 20:284-296.

Shaw, E.W. 1970. B. M. Pavlik. 1994. California Native Plant Society invetory of rare and endangered vascular plants of California. 5th edition. Spec. Pub. 1, California Native Plant Society, Sacramento, California.

Skorupa, J. W. 1998. Selenium. Pages 139-184 *in* P.L. Martin and D.E. Larsen (eds.). Guidelines for interpretation of biological effects of selected constituents in biota, water, and sediment. Information Report No. 3, National Irrigation Water Quality Program, U. S. Department of Interior, Denver, Colorado. 198 pp.

Skorupa, J. W., Morman, S. P., and J. S. Sefchick-Edwards. 1996. Guidelines for interpreting Selenium exposures of biota associated with non-marine aquatic habitats. Technical Report. U.S. Fish and Wildlife Service, Sacramento, California.

Smith, H. 1946. Handbook of lizards: Lizards of the United States and Canada. Comstock Publishing Co., Ithaca, New York. 557 pp.

Soule, M. 1990. The onslaught of alien species and other challenges in the coming decades. Conservation Biology 4:233-239

Sovada, M.A.., C.C. Roy, J.B. Bright, and J.R. Gillis. 1998. Causes and rates of mortality of swift foxes in western Kansas. Journal of Wildlife Management 62:1300-1306.

Spencer, K.A., W.H. Berry, W.G. Standley, and T.P.O'Farrell. 1992. Reproduction of the San Joaquin kit fox on Camp Roberts Army National Guard Training site, California. U.S. Department of Energy Topical Report EGG 10617-2154.

Spiegel, L.K. 1996. Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California Energy Commission Pub. No. P700-96-003. California Energy Commission Publication Unit, Sacramento, California.

Spiegel, L. K. and R. L. Anderson. 1992. Southern San Joaquin Valley ecosystem protection program: natural lands inventory. Pages 249-261 *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission, Sacramento, California

Spiegel, L.K. and M. Disney. 1996. Mortality sources and survival rates of San Joaquin kit foxes in oil-developed and undeveloped lands of southwestern Kern County, California. Pages 71-92 *in* L.K. Spiegel, ed. Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California Energy Commission, Sacramento, California.

Spiegel, L.K. and J. Tom. 1996. Reproduction of San Joaquin kit fox undeveloped and oil-developed habitats of Kern County, California. Pages 53-69 *in* L.K. Spiegel (ed.). Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California Energy Commission, Sacramento, California.

Standley, W. G., W. H. Berry, T. P. O'Farrell, and T. T. Kato. 1992. Mortality of San Joaquin kit fox (*Vulpes velox macrotis*) at Camp Roberts Army National Guard Training Site, California. U. S. Department of Energy Topical Report No. EGG 10617-2157, EG&G/EM Santa Barbara Operations, National Technical Information Service, Springfield, Virginia.

Stebbins, J. C., T. E. Mallory, W. O. Traylor, and G. W. Moise. 1992. Botanical resources report: California Aqueduct - San Joaquin Field Division. California Department of Water Resources, Sacramento, California.

Stebbins, J.C., W. Trayler, and R. Kokx. 1995. Habitat characterization study of San Joaquin Valley vernal pools. Unpublished report to the California Department of Fish and Game and the U.S. Fish and Wildlife Service, Sacramento, California.

Stebbins, R.C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston, Massachusetts.

Stejneger, L. 1890. Annotated list of reptiles and batrachians, with descriptions of new species. North Amer. Fauna. 3:103-118

Stehn, R. A., J. A. Stone, and M. E. Richmond. 1976. Feeding response of small mammal scavengers to pesticide-killed arthropod prey. Amer. Mid. Nat. 95:253-256.

Stephens, D. W., B. Waddell, L.A. Peltz, and J.B. Miller. 1992. Detailed study of selenium and selected elements in water, bottom sediment, and biota associated with irrigation drainage in the Middle Green River Basin, Utah, 1988-90. Water-Resources Investigations Report 92-4084. U.S. Geological Survey, Salt Lake City, Utah. 164 pp.

Stuart, J.M., M.L. Watson, T.L. Brown, and C. Eustice. 2001. Plastic netting: an entanglement hazard to snakes and other wildlife. Herp. Rev. 32(3):162-164.

Tanner, W. and B. Banta. 1963. The systematics of *Crotaphytus wislizenii wislizenii* Baird and Girard, and a description of a new species from the Upper Colorado River Basin. Great Basin Nat. 23:129-148

Tappe, D. T. 1941. Natural history of the Tulare kangaroo rat. J. Mammal. 22:117-148.

Taylor, D. W. and R. E. Buck. 1993. Duistribution of San Joaquin woolly-threads (*Lembertia congdonii*) in the vicinity of Los Hills, Kern County, California. Lost Hills Utility District, Lost Hills, California.

Taylor, D. W., and W. B. Davilla. 1986. Status survey of three plants endemic to the San Joaquin Valley and adjacent areas, California. U. S. Fish and Wildlife Service, Sacramento, California.

Tellman, B. 1997. Exotic pest plant introduction in the American southwest. Desert Plants 13:3-10.

Terbough, J. and B. Winter. 1980. Some causes of extinction. Pages 119-133 *in* M. Soule and B. A. Wilcox (eds.) Conservation biology: an evolutionary-ecological perspective. Sinauer Associates. Sunderland, Massachusetts.

Thomas, C.D. 1990. What do real population dynamics tell us about minimum viable population sizes? Conservation Biology 4:324-327.

Tollestrup, K. 1976. A standardized method of obtaining an index of densities of blunt-nosed leopard lizards, *Crotaphytus silus*. U. S. Fish and Wildlife Service, Sacramento, California. 11pp.

_____ 1979a. Distribution of *Gambelia silus* (blunt-nosed leopard lizard) in the western foothills of the San Joaquin Valley. U.S. Bureau of Land management, Sacramento, California. 18 pp.

_____ 1979b. The ecology, social structure, and foraging behavior of two closely related species of leopard lizards, *Gambelia silus* and *Gambelia wislizenii*. Ph. D. Dissertation, Univ. California, Berkeley, California.

_____ 1982. Growth and reproduction in two closely related species of leopard lizards, *Gambelia silus* and *Gambelia wislizenii*. Amer. Midl. Nat. 108:1-20.

_____ 1983. The social behavior of two closely related leopard lizards, *Gambelia silus* and *Gambelia wislizenii*. J. Tierpsychol. 62:307-320.

Trombulak, S.C., and C.A. Frissell. 2000. The ecological effects of roads on terrestrial and aquatic communities: a review. Conservation Biology 14:18-30.

Turbak, G. 1999. Can American motorists yield the right-of-way to wild creatures? National Wildlife 37(6):66-68.

U. S. Bureau of Reclamation. 2000. Draft biological assessment for the Central Valley Project Improvement Act (CVPIA) Long-term Refuge water supply water service agreement for the Kern National Wildlife Refuge complex. Sacramento, California. 41 pp. + maps & append.

U.S. Department of Agriculture. 1994. Ecological units of California: subsections. Forest Service and Natural Resources Conservation Service. U.S. Government Printing Office, Washington, D.C. (1994-586-792).

U. S. Department of Energy. 1993. Petroleum production at maximum efficiency rate, Naval Petroleum Reserve number 1 (Elk Hills), Kern County, California: supplement to the 1979 final environmental impact statement. Naval Petroleum Reserve, Tupman, California.

U. S. Fish & Wildlife Service. 1980. Blunt-nosed leopard lizard recovery plan. Portland, Oregon.

_____ 1983. San Joaquin Kit Fox Recovery Plan. Sacramento, California
_____ 1985a. Revised blunt-nosed leopard lizard recovery plan. Portland, Oregon
_____ 1985b. Florida key deer recovery plan. Atlanta, Georgia.
_____ 1986. Kern National Wildlife Refuge Master Plan. Portland, Oregon.
_____ 1994. Endangered and threatened wildlife and plants: 12-month petition finding for the California tiger salamander. **Federal Register** 59: 18353.
_____ 1998. Final Recovery Plan for upland species of the San Joaquin Valley, California. Portland, Oregon.
_____ 1999. Technical review of the draft report "Ecological Risk Assessment for Kesterson Reservoir" prepared by CH2M HILL for the Bureau of Reclamation, Sacramento, California.

U. S. Fish and Wildlife Service (USFWS) and U. S. Bureau of Reclamation (USBR) 2001. Water Acquisition Program for the Central Valley Improvement Act (CVPIA) Sections 3406(b)(3) and (g). Workplan for Fiscal Year 2002. 12pp + attachment I.

Uptain, C., W. Clark, and S. Juarez. 1985. Mark-recapture estimates and visitation indices for the blunt-nosed leopard lizard, *Gambelia silus*, at the Pixley National Wildlife Service. U.S. Fish and Wildlife Service, Delano, California. Contract Nos. 10181-9810-3(js) and 10181-4672-4. 34 pp.

Uptain, C., P. Kelly, G. Moise, F. Vang, and D. Williams. 2000. Biological assessement for sensitive species along Highway 41, Kings County. Prepared for: California Dept. of Transportation, Fresno, California.

Van der Zande, A.N., W.J. ter Keurs, and W.J. Van der Weijden. 1980. The impact of roads on the densities of four bird species in an open field habitat - evidence of a long-distance effect. Biological Conservation 18: 299-321.

Van Dyke, G.D., R.H. Brocke, and H.G. Shaw. 1986. Use of road track counts as indices of mountain lion presence. Journal of Wildlife Management 50:102-109.

Vaughan, T. 1978. Mammalogy. W. B. Saunders Co. Philadelphia, Pennsylvania. 522 pp.

Warrick, G.D. and B.L. Cypher. 1999. Variation in the body mass of San Joaquin kit foxes. Journal of Mammalogy 80:972-979.

Wayland, R. H. III. 1996. Memorandum from Director, Office of Wetlands, Oceans, and Watersheds, U. S. Environmental Protection Agency (EPA), to Wetlands Program Division Directors, EPA Regions I-IX

Weiss, S.B. 1999. Cars, cows, and checkerspot butterflies: nitrogen deposition and management of nutrient-poor grasslands for a threatened species. Conservation Biology 13:1476-1486.

Werschkull, G. D., F. T. Griggs, and J. M. Zaninovich. 1992. Tulare Basin protection plan. Pages 87-294. *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.): Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission, Sacramento, California.

Whitaker, J. O., Jr. 1976. Food habits of five western Oregon shrews. Northwest Sci. 50:102-107.

Whitaker, J. O., Jr., and R. E. Russell 1972. Food and ectoparasite of Indiana shrews. J. Mamm. 53:329-335.

White, P.J., and R.A. Garrott. 1999. Population dynamics of kit foxes. Can. J. Zool. 77:486-493.

White, P.J., W.H. Berry, J.J. Eliason, and M.T. Hanson. 2000. Catastrophic decrease in an isolated population of kit foxes. Southwest. Nat. 45(2):204-211.

White, P.J., and K. Ralls. 1993. Reproduction and spacing patterns of kit foxes relative to changing prey availability. Journal of Wildlife Management 57:861-867.

White, P.J., C.A. Vanderbilt-White, and K. Ralls. 1996. Functional and numerical responses of kit foxes to a short-term decline in mammalian prey. J. Mammal. 77(2):370-376.

White, P.J., C.A. Vanderbilt-White, and K. Ralls. 1996. Functional and numerical responses of kit foxes to a short-term decline in mammalian prey. J. Mammal. 77(2):370-376.

Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. Bioscience 48 (8): 607-615.

Wilber, C. G. 1980. Toxicology of selenium: A review. Clinical Toxicol. 17:171-230.

Williams, D. 1991. Habitats of shrews (Genus *Sorex*) in forest communities of the western Sierra Nevada, California. Pages 1-14. *in* J.S. Findley and T.L. Yates (eds.). The Biology of the Soricidae. . The Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico. Special Publication No. 1.

Williams, D.F. 1980. Distribution and population status of the San Joaquin antelope squirrel and giant kangaroo rat. California Department of Fish and Game, Sacramento, California.

_____ 1985. A review of the population status of the Tipton kangaroo rat, *Dipodomys nitratoides nitratoides.* U. S. Fish and Wildlife Service, Sacramento, California.

_____ 1986. Mammalian Species of Special Concern in California. California Dept. of Fish and Game, Wildlife Management Division Administrative Report 86-1:1-112.

_____ 1992. Geographic distribution and population status of the giant kangaroo rat, (Rodentia: Heteromyidae). Pp. 301-328 *in* D. F. Williams, S. Byrne, and T. Rado (eds.). Endangered and sensitive species in the San Joaquin Valley, California. California Energy Commission. Sacramento, California.

Williams, D. F., M. K. . Tordoff, III. 1993. Population studies of endangered kangaroo rats and blunt-nosed leopard lizards in the Carrizo Plain Natural Area, California. California Department of Fish and Game, Sacramento, California.

Williams, D. F. and A. C. Harpster. 2001a. Status of the Buena Vista Lake shrew (*Sorex ornatus relictus*). Endangered Species Recovery Program, California State University, Stanislaus, California. 22 pp.

Williams, D. and K. S. Kilburn. 1992. The conservation status of the endemic mammals of the San Joaquin faunal region, California. Pages 329-345 *in* D. F. Williams, S. Byrne, and T. A. Rado (eds.). Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation. California Energy Commission, Sacramento, California.

Wilson, D. E., and D. M. Reeder. 1993. Mammal species of the world. A taxonomic and geographic reference. Second Edition. Smithsonian Institution Press, Washington D.C., 1206 pp.

Zoellick, B. W., T.P. O'Farrell, P.M. McCue, C.E. Harris, and T.T. Kato. 1987. Reproduction of the San Joaquin kit fox on Naval Petroleum Reserve #1, Elk Hills, California 1980-1985. U.S. Department of Energy Topical report EGG 10282-2144.

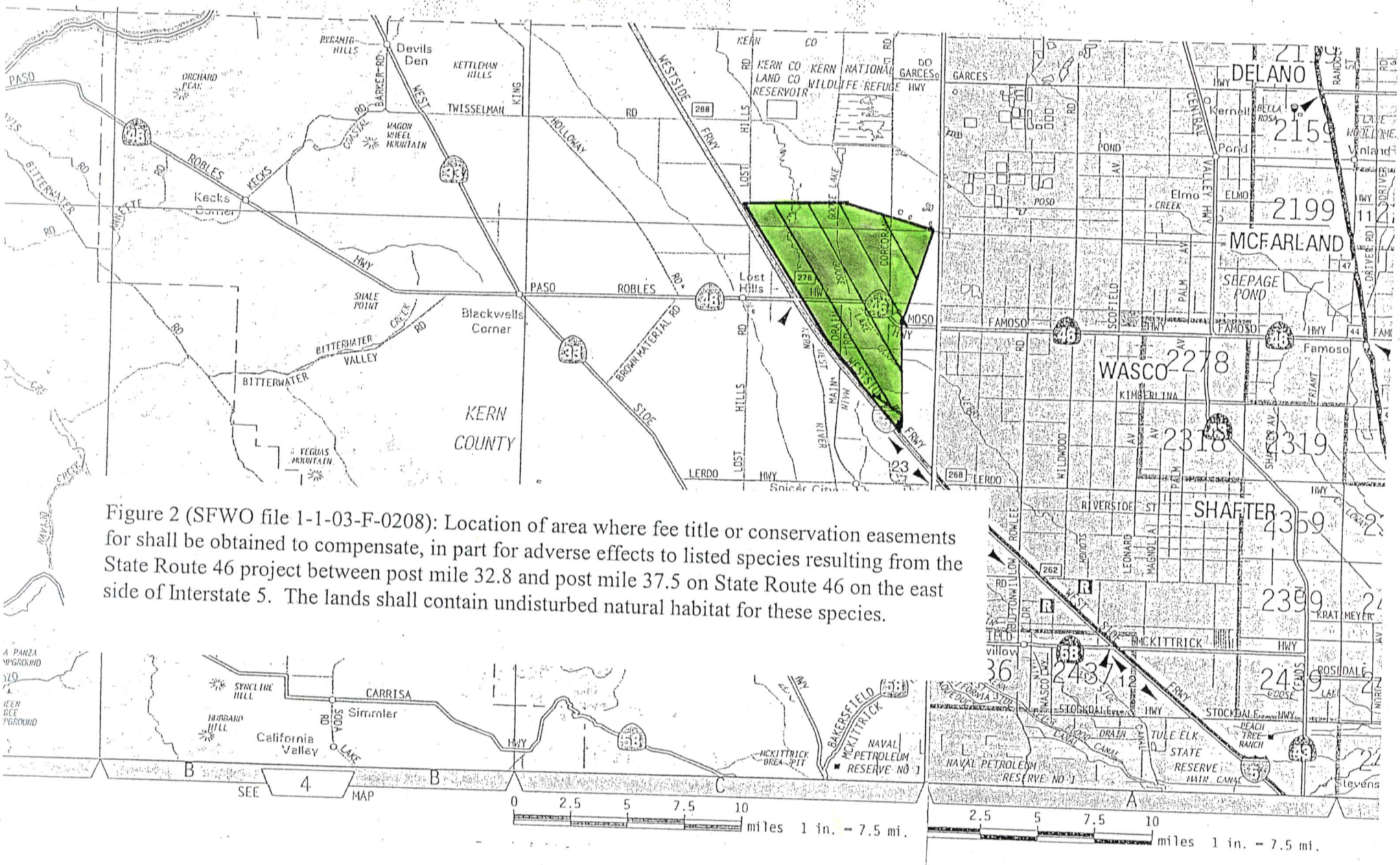


Figure 2 (SFWO file 1-1-03-F-0208): Location of area where fee title or conservation easements for shall be obtained to compensate, in part for adverse effects to listed species resulting from the State Route 46 project between post mile 32.8 and post mile 37.5 on State Route 46 on the east side of Interstate 5. The lands shall contain undisturbed natural habitat for these species.

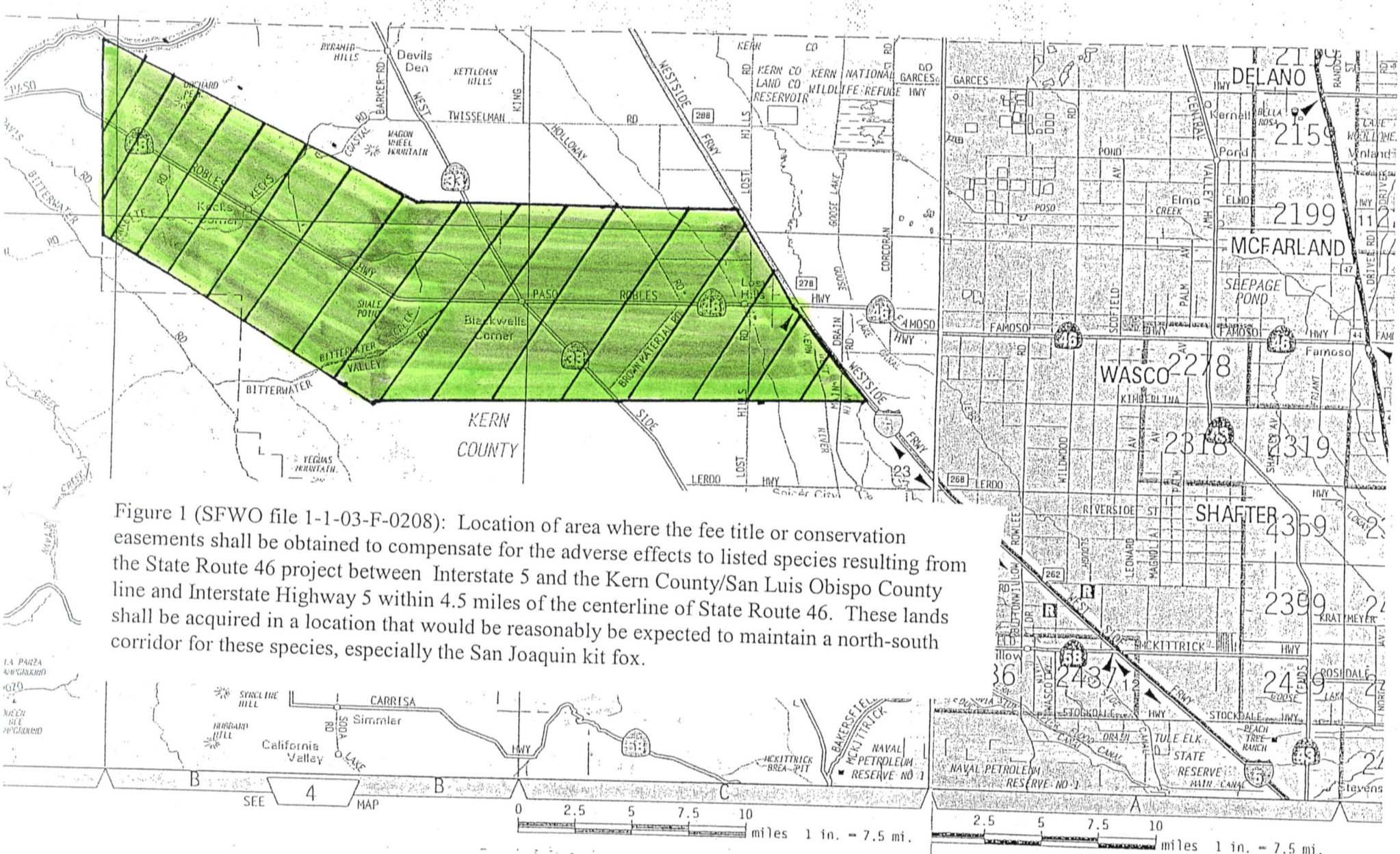


Figure 1 (SFWO file 1-1-03-F-0208): Location of area where the fee title or conservation easements shall be obtained to compensate for the adverse effects to listed species resulting from the State Route 46 project between Interstate 5 and the Kern County/San Luis Obispo County line and Interstate Highway 5 within 4.5 miles of the centerline of State Route 46. These lands shall be acquired in a location that would be reasonably be expected to maintain a north-south corridor for these species, especially the San Joaquin kit fox.

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. FRITZ HOFFMAN, CHIEF
Bridge Design Branch 6
Bridge Design Services
Office of Structure Design
Division of Engineering Services MS #9-4/8I

Attention: Mr. Richard Melko

Date: February 8, 2010

File: 06-KER-46 PM 7.3/19.8
EA# 06-442520
Bitterwater Creek Br.
Br. No. 50-0506 R/L
Replacement

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services – MS 5
Office of Geotechnical Design – North

Subject: Revised Seismic Design Recommendations

Introduction

This report presents the Revised Seismic Recommendations for the replacement of Bitterwater Creek Bridge located on Route 46 in Kern County and supersedes the Seismic Report Recommendations dated July 30, 2008 and October 7, 2008. The Office of Geotechnical Design North, Branch C completed a Seismic Design Recommendations following the March 26, 2008 request by the Office of Bridge Design Branch 6, Structure Design. The Office of Structure Design intends to develop a Project Report for the proposed conversion of a segment of State Route (SR) 46 with existing two-lane roadway to a four-lane expressway with a standard width median. The segment of SR 46 involved in this project extends from Kecks Road (PM 7.3) to just east of Interstate 5 (PM 33.49). The current proposal is to replace the existing structure with two separate structures to convey east-west traffic aimed at accommodating the proposed new expressway. The revised memorandum dated October 7, 2008 presented the correct dimensions of the proposed structures. This revised memorandum presents the correct bridge number for the proposed structures.

Project Description

According to the as-built plans and reports, the existing culvert was built in 1971 on SR 46 to convey east-west vehicular traffic over Bitterwater Creek. The existing structure consists is of a two 10 foot by 8 foot reinforced concrete box culvert with reinforced concrete wing walls that are parallel to the highway. The width of the culvert is 54 feet.

The existing concrete box culvert will be replaced by two one-span, cast-in-place, prestressed slab bridges. Both left and right bridges are 50.83 feet long and 41.96 feet wide. The new left bridge will be built in the same location while the right bridge will be built immediately south of the existing structure.

The March 26, 2008 foundation request proposes that fourteen piles Class 140 Pipe piles at each of the abutments will be utilized.

Subsurface Exploration and Subsurface Conditions

This Office performed a subsurface exploration from May 5 to May 8, 2008, and consisted of four 127-mm (5-inch) diameter exploratory mud rotary sample borings (R-08-01, R-08-02, R-08-03, and R-08-04) The mud rotary borings were advanced using a self-casing wireline drilling method to a maximum depth of 86.5 and 91.5 feet or elevations 857.1 feet, 856.8 feet, 859.8 feet, and 859.7 feet respectively. Equipment used for the subsurface investigation consisted of a CME 75 and Acker drill rig, both equipped with an automatic hammer. Sampling was achieved by utilizing the Standard Penetration Test (SPT) sampler at 5 feet intervals. Sampling between SPT samples was performed. Selected soil samples were bagged for laboratory testing.

Based on the 2008 subsurface exploration, the proposed abutment 1 and 2 locations are underlain by loose silty sand and sandy silt to depths of 5 feet to 10 feet underlain by poorly and well graded sand, sand with silt and silty sand to depths of 32 feet to 35 feet . Underlying the granular material is very stiff elastic silt to depth of 43 feet. Beneath the elastic silt is poorly and well graded sand with intercalated layers of silty sand and sandy silt to depths of 69 to 71 feet. In boring R-08-01 the poorly and well graded sand are encountered at a depth of 55 feet. Beneath the sand is very stiff elastic silt to depths of 61 feet (boring R-08-1) and 75 feet to 79 feet. Underlying the silt is medium dense to dense poorly and well graded sand and very dense silty sand to maximum depths explored of 86.5 and 91.5 feet.

Ground Water

Ground water was not encountered during the May 2008 drilling investigation. A piezometer was installed in boring R-08-01 to a maximum depth explored of 86.5 feet and measurements during the month of June resulted in no water present.

Ground water surface elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at the time of construction. For more details, please refer to the LOTB and As-Built LOTB sheets.

Seismic Data and Evaluation

The study site is potentially subject to strong ground motions from nearby earthquake sources during the design life of the structure. According to Caltrans' 1996 California Seismic Hazard Map (CHSM), the project site is located between the following faults:

1) San Andreas/C Fault (SAC) is classified as a strike-slip fault and Caltrans has assigned a Maximum Credible Earthquake (MCE) of Moment Magnitude (M_w) of 8.0. This fault is located approximately 9.7 miles southwest of the project site.

2) Coast-Ranges-Sierran Block Boundary Zone (CSB) is classified as reverse thrust fault, and Caltrans has assigned a Maximum Credible Earthquake (MCE) of Moment Magnitude (M_w) of 7.0. This fault is located approximately 12 miles northeast of the project site.

Approximate locations of the faults are shown in Figure 1, California Seismic Hazard Index Map 1996. The controlling seismic source for design is the San Andreas/C fault. Using the attenuation relationship by Sadigh et al (1997), it is estimated that the site is likely to experience a Peak Bedrock Acceleraton (PBA) of 0.4g in the event of a 7.0 magnitude earthquake associated with the SAC fault.

Based on the results of the 2007 subsurface exploration the soil profile may be classified as Type D as defined in the Department's Seismic Design Criteria (SDC, 2006, Version 1.4). The recommended design Acceleration Response Spectrum (ARS) curve was obtained from Figure B.9 of the SDC corresponding to a MCE= 8.0 and PBA of 0.4g. (See Figure 2, Acceleration Response Spectrum Curve). The ARS curve for this site includes 5% damping.

Liquefaction and Lateral Spreading Evaluation

Liquefaction can occur when saturated, loose to medium dense granular soils, or specifically defined cohesive soils, are subjected to ground shaking. The absence of ground water and the presence of medium to very dense granular soils indicate that the site is not susceptible to soil liquefaction during earthquake shaking and lateral spreading.

Fault Rupture

The site does not lie within or adjacent to an Alquist-Priolo Earthquake Fault Zone for fault rupture hazard, and no known active faults cross the Bitterwater Creek Bridge. The

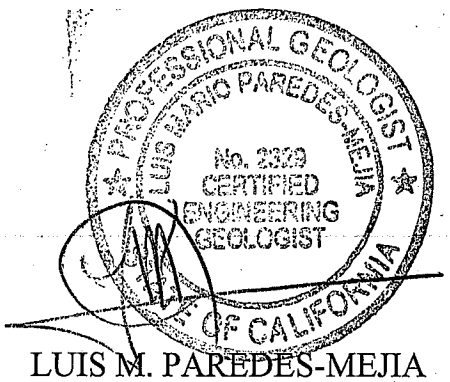
referenced mapping by Dibblee shows that no fault or splay from the San Andreas Fault cross the study area. Therefore, the potential for fault rupture and ground displacement to adversely affect the proposed structure is non-existent.

Seismic Settlement

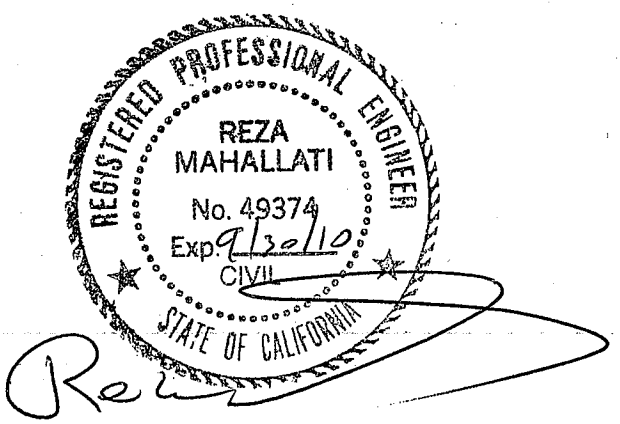
During a seismic event, ground shaking can cause densification of relatively loose granular soil above the water table that can result in settlement of ground surface. Because most of the soils in the study area are considered dense to very dense, the potential for seismic settlement is insignificant.

Any questions regarding the above recommendations should be directed to Luis Paredes-Mejia at (916) 227-1047 or Reza Mahallati at (916) 227-1033 of the Office of Geotechnical Design North.

Prepared by:



LUIS M. PAREDES-MEJIA
Engineering Geologist, CEG 2329
Geotechnical Design – North, Branch C



REZA MAHALLATI
Senior Materials & Research Engineer
Office of Geotechnical Design-North

cc: OGD N File Room
Douglas Brittsan
R.E. Pending
Structure OE (E-Copy)
PCE (E-Copy)
DME (E-Copy)
GDN File
GS File Room

REFERENCES

Norris, Robert M., and Webb, Robert M., 1990, Geology of California, Second Edition, John Wiley & Sons, Inc., 324-327 pp.

Seismic Design Criteria (2006), California Department of Transportation, Version 1.4.

Youd, T.L. et al. (2001), "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of soils." *Journal of Geotechnical and Geoenvironmental Engineering*, 817 – 833.

Dibblee, T.W. (1992), Geologic Maps of Fourteen 15-Minute Quadrangle along The San Andreas Fault in the Vecinity of Paso Robles and Chulame Southward to Maricopa and Cuyama, California.: U.S. Geological Survey, Open-File Report oF-72-89, Scale 1:62500

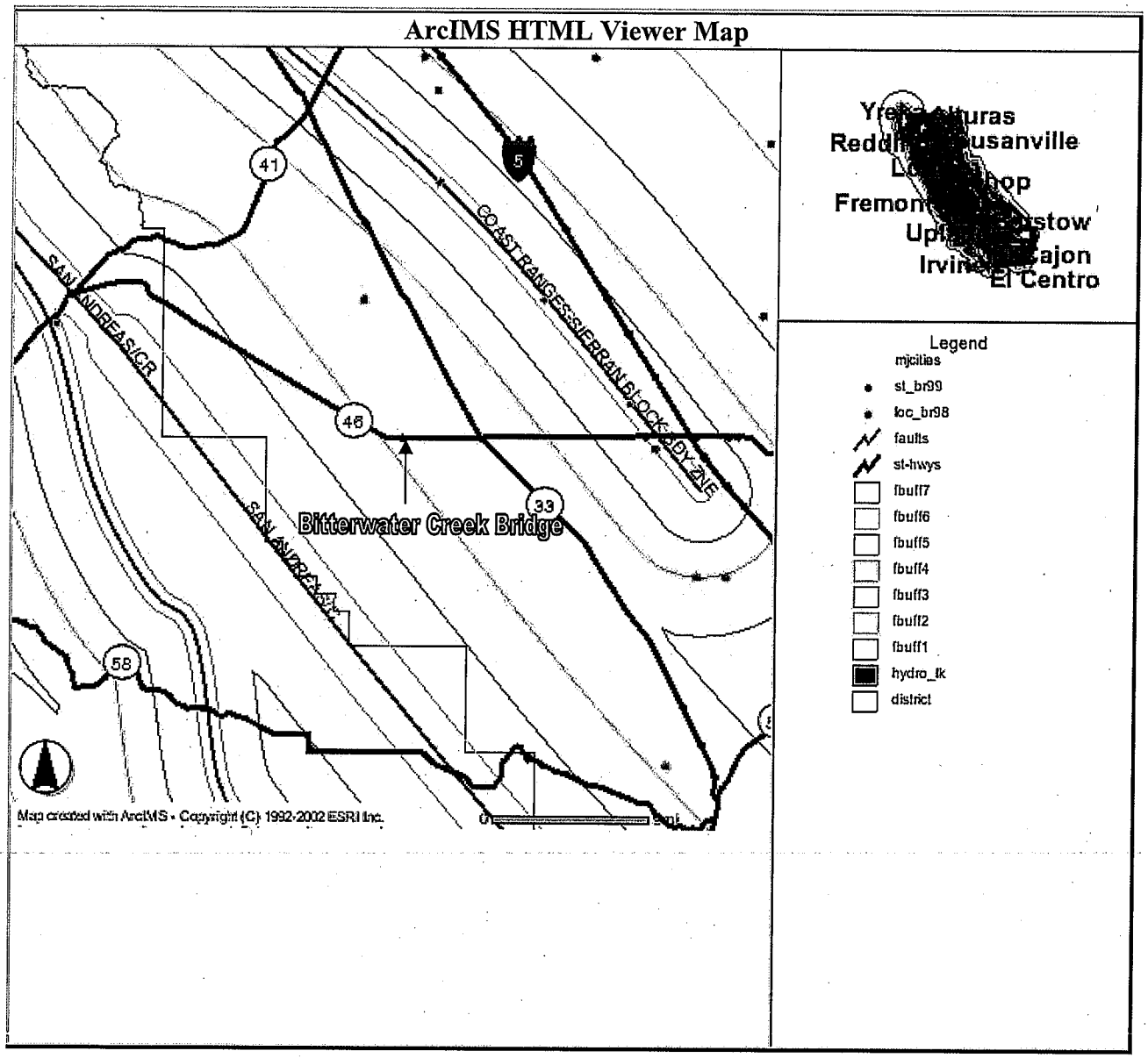


Figure 1: California Seismic Hazard Index Map 1996

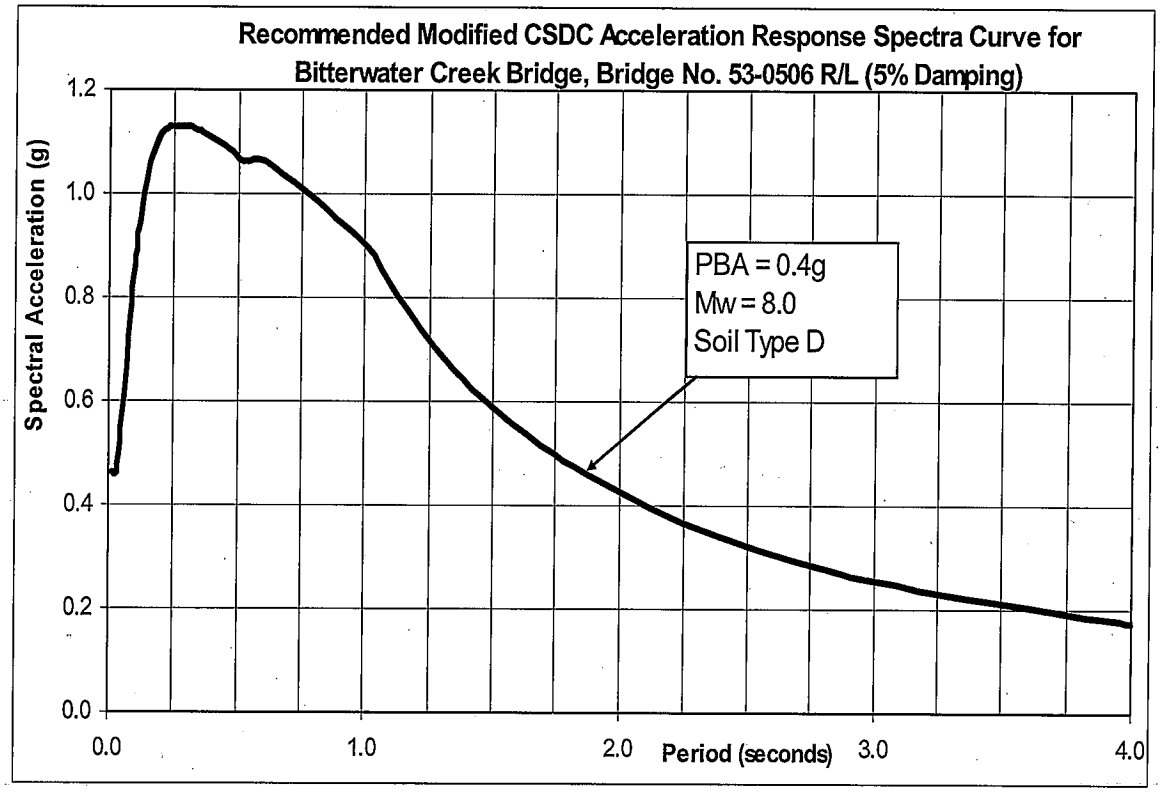


Figure 2: Acceleration Response Spectrum Curve.

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**
1. Preliminary Report
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services
1. GS (Sacramento)
2. GS

District Project Development
District Project Engineer

Date: 7/13/09

Bitterwater Creek Br.
Structure Name

06 - Ker - 046 - 15.88
District County Route Post ~~Km~~ M.

06-442521 50-0506 R/L
E.A. Number Structure Number

Foundation Report By: L. Paredes-Mejia Dated: 3/5/09

Reviewed By: R. Malko (OSD) R. Price (GS)

General Plan Dated: 6/30/09 Foundation Plan Dated: 6/30/09

☒ No changes. ☐ The following changes are necessary.

FOUNDATION CHECKLIST

- ✓ Pile Types and Design Loads
- ✓ Pile Lengths
- ✓ Predrilling
- ✓ Pile Load Test
- ✓ Substitution of H Piles For Concrete Piles ☐ Yes ☐ No
- ✓ Footing Elevations, Design Loads, and Locations
- ✓ Seismic Data
- ✓ Location of Adjacent Structures and Utilities
- ✓ Stability of Cuts or Fills
- ✓ Fill Time Delay
- ✓ Effect of Fills on Abutments and Bents
- ✓ LOTB's
- ✓ Fill Surcharge
- ✓ Approach Paving Slabs
- ✓ Scour
- → Ground Water
- ✓ Tremie Seals/Type D Excavation

Office of Structure Design 6 Branch No. Geotechnical Services

Rev. 10/02

State of California | Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. FRITZ HOFFMAN, CHIEF
Bridge Design Branch 6
Bridge Design Services
Office of Structure Design
Division of Engineering Services MS #9-4/8I

Attention: Mr. Richard Melko

Date: February 8, 2010

File: 06-KER-46 PM 7.3/19.8
06-442521
Bitterwater Creek Br.
Br. No. 50-0506 R/L
Replacement

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES- MS5
OFFICE OF GEOTECHNICAL DESIGN- NORTH

Subject: Revised Foundation Recommendations

Introduction

This report presents the Revised Foundation Recommendations for the replacement of Bitterwater Creek Bridge located on Route 46 in Kern County and supersedes the Revised Foundation Recommendations dated October 7, 2008, the Foundation Recommendations dated September 2, 2008 and the Foundation Recommendations dated March 5, 2009. The Office of Geotechnical Design North had prepared these Foundation Recommendations for of Bitterwater Creek Bridge following the March 26, 2008, request by the Office of Bridge Design Branch 6, Structure Design. The Office of Structure Design intends to develop Plans and Specs for the proposed conversion of a segment of State Route (SR) 46 with existing two-lane roadway to a four-lane expressway with a standard width median. The segment of SR 46 involved in this project extends from Kecks Road (PM 7.3) to just east of Interstate 5 (PM 33.49). The current proposal is to replace the existing structure with two separate structures to convey east-west traffic aimed at accommodating the proposed new expressway.

The original foundation dated March 26, 2008, request proposed that fourteen Class 140 Pipe piles at each of the abutments be utilized at all support locations; however, the original foundation report recommended that 100 ton H-piles will be utilized instead due to the presence of relatively clean, dense sand and gravel. The revised memorandum dated October 7, 2008, presented the correct dimensions of the proposed structures as well as the appropriate terminology for the proposed foundation piles.

The revised memorandum dated March 5, 2009 reflected the both Designer's proposed changes in the foundation design loads and changes in elevations for finished grade and cut-off, as well as pile cap size and number of piles as directed in his e-mail dated January 21, 2009. This revised memorandum presents the correct bridge number for the proposed structures.

Pertinent Reports and Investigations

The following foundation recommendations are based on the subsurface information gathered during the recent foundation investigation (May 2008) along with the review of the previous foundation reports, As-Built records and As-Built records of the California Aqueduct Bridge (Br. 50-0197) and on relevant geological records.

Resources used for the Foundation Recommendations are based on the following references:

- Division of Structures Final Hydraulic Report, Bitterwater Creek, Bridge No. 50-0437, dated June 12, 2008.
- Bridge Report for the Bitterwater Creek Bridge, Bridge No. 50-0437, dated May 11, 1972.
- Hydraulic Evaluation for the Bitterwater Creek Bridge, Bridge No. 50-0437, dated August 7, 1998.
- Scour Protection Plan for Bitterwater Creek Bridge, Bridge No. 50-0437, dated June 18, 2002.
- As-Built General Plan, LOTB, and Foundation Plan for California Aqueduct, Bridge No. 50-0197, dated January 10 and 18, 1966, and September 28, 1999 respectively.
- Geologic Map of California, San Luis Obispo Sheet, Scale 1:250,000, Published by California Geological Survey, 1959.
- Geologic Map of California, Bakersfield Sheet, Scale 1:250,000, Published by California Geological Survey, 1965.

Project Description

Bitterwater Creek Bridge is located in western section of Kern County, California. (See Vicinity Map as Figure 1 at the end of this report). The existing concrete box culvert will be replaced by two one-span, cast-in-place, prestressed slab bridges. The left and right bridges are 50.83 feet long and 41.96 feet wide, respectively. The new left bridge will be built in the same location while the right bridge will be built immediately south of the existing structure.

Regional Setting and Area Geology

The project site is located in the southern section of the San Joaquin Valley, which forms the southern segment of the Great Valley. The Great Valley is elongated lowland of about 400 miles long and 50 miles wide flanked to the west by the Coast Ranges and to the east by the Sierra Nevada. It is divided in two segments, the southern, where the project is located, the San Joaquin Valley and the northern, the Sacramento Valley. The former occupies about two thirds of the Great Valley, whereas the latter makes up one third of the province. The south-flowing Sacramento River drains the northern Valley and the north-flowing San Joaquin River the southern portion of the Great Valley.

Unconsolidated Recent and Pleistocene Sediments from eroded sediments mainly from the Sierra Nevada, forms the surface of the Great Valley (See Figures 2 and 3, Geologic Map and Geologic Map Legend). Underlying the recent alluvium is a 65,000 feet thick sedimentary basin filled with a sequence of sedimentary rocks deposited from the Mesozoic (Jurassic and Cretaceous) to Cenozoic. This sequence of sedimentary rocks, also called the Great Valley Sequence, consists of marine and terrestrial sediments that reflect the geologic history of the Great Valley. Mesozoic sediments, consisting of sandstone, shale, and conglomerate, were deposited in an ocean basin that lay west of the Mesozoic North American Margin. The ocean basin formed part of a forearc basin located between the Sierran arc and the Mesozoic subduction zone. Cenozoic rocks deposited in increasingly shallow marine environments reflect the rapid uplift of the Sierra Nevada and gradual filling up of the sedimentary basin. However, a deep marine environment persisted much longer in the San Joaquin Valley as marine shale and sandstone were deposited during early and middle Cenozoic time. Sediments from the Sierra Nevada and the newly formed Coast Ranges were deposited until the late Pliocene. Three million years ago, during the Pliocene time, much of the southern portion of the San Joaquin Valley was open to the sea and formed a large embayment in the coastline. By the end of the Pliocene time, about 2 million years ago, the San Joaquin Valley emerged above sea level, and about one million years ago, during the Pleistocene time, the valley was completely cut off from the Pacific Ocean leaving an extensive lake that occupied the southern section of the Sacramento Valley and most of the San Joaquin Valley. The evidence of the existence of this lake is a 30 to 50 feet thick clay layer with Pleistocene fossils, known as the Corcoran Clay.

The Great Valley sequence was deposited on a sedimentary breccia containing angular clasts of mafic and ultramafic rocks. The valley sediments and the breccia are separated by an unconformity meaning that that was a period of erosion before the first sediments of the Great Valley sequence were deposited. The breccia is overlying the ultramafic rocks of the Coast Range ophiolite. The composition of the Coast Range ophiolite ranges from spilite and basalt to gabbro and peridotite, including rocks rich in serpentine, chlorite,

epidote and albite. The age of this ophiolite has been determined from intrusions of igneous rocks and fossils derived from the oldest rocks of the Great Valley sequence. It is calculated that the age of this ophiolite is between 155 and 150 million years old. It is about the same age as the Josephine ophiolite of the Klamath province.

Subsurface Exploration and Subsurface Conditions

This Office performed a subsurface exploration from May 5 to May 8, 2008, and consisted of four 127-mm (5-inch) diameter exploratory mud rotary sample borings (R-08-01, R-08-02, R-08-03, and R-08-05) (See Figure 4, Boring Location Plan). The mud rotary borings were advanced using a self-casing wireline drilling method to a maximum depth of 86.5 (Borings R-08-01) and 91.5 feet (Boring R-08-02, 03, and 04) or elevations 770.6 feet, 765.3 feet, 768.3 feet, and 768.2 feet respectively. Equipment used for the subsurface investigation consisted of a CME 75 and Acker drill rig, both equipped with an automatic hammer. Continuous sampling was achieved by utilizing the Standard Penetration Test (SPT) sampler at 5 feet intervals and "punch core" sampling in between SPT samples. Selected soil samples were bagged for laboratory testing.

The drilling method used for the subsurface investigation was Rotary Wash Boring Method. This method is the most appropriate method for use in soil formations below the groundwater level, and allows the use of the "punch core" sampler for continuous soil sampling. In rotary wash borings, the sides of the borehole are supported either with casing or with the use of a drilling fluid. Drill casing and drilling fluid were utilized in all the borings for this project. Borings were advanced sequentially by placing the casing to the desired sample depth, cleaning out the hole to the bottom of the casing and inserting the sampling device and obtaining the sample from below the bottom of the casing.

Based on the 2008 subsurface exploration, the proposed abutment 1 and 2 locations are underlain by loose silty sand and sandy silt to depths of 5 feet to 10 feet underlain by poorly and well graded sand, sand with silt and silty sand to depths of 32 feet to 35 feet. Underlying the granular material is very stiff silt that grades into lean clay (Boring R-08-01) to depth of 43 feet. Beneath the silt is poorly and well graded sand with intercalated layers of silty sand and sandy silt to depth of 69 to 71 feet. In boring R-08-01 the poorly and well graded sand are encountered to a depth of 55 feet. Beneath the sand is very stiff elastic silt to depths of 61 feet (boring R-08-1) and 75 feet to 79 feet. Underlying the silt is medium dense to dense poorly and well graded sand and very dense silty sand to maximum depths explored of 86.5 and 91.5 feet.

Test boring information, including exploration numbers, stations, offsets, top of borehole elevations, depths, and groundwater level measurements are summarized in Table 1. For subsurface data and boring locations, site-specific information and conditions please refer

to both the Log of Test Borings. These sheets will be forwarded to your office upon completion.

Table 1: Summary of the Geotechnical Exploration Information

Boring Number[(1)]	Station (ft)	Offset from "A1" Line (ft)	Top of Borehole Elevation (ft)	Exploration Depth (ft)	Ground Water Elevation (ft)
R-08-01	839+60.6	78.31 Lt. CL	857.1	86.5	Not encountered
R-08-02	841+39.8	77.73 Lt. CL	856.8	91.5	N/A
R-08-03	840+18.4	54.32 Rt. CL	859.8	91.5	N/A
R-08-04	841+23.4	55.28 Rt. CL	859.7	91.5	NA

Notes: 1) Borings R-08-01, R-08-02, R-08-03 and R-08-04 used mud rotary wash method.

Groundwater

Groundwater was not encountered during the May 2008, drilling investigation. A piezometer was installed in boring R-08-01 to maximum depth explored of 86.5 feet and measurements during the month of June resulted in no water present.

Groundwater surface elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at the time of construction. For more details, please refer to the LOTB sheets.

Scour Potential

The channel had shown signs of long term degradation on the downstream side of the structure since its construction. Mitigation measures such as placement of concreted rock in the downstream channel and rock slope protection were adopted. However, scour of the downstream channel continued and more permanent hydraulic countermeasures were recommended in the Hydraulic Evaluation Report dated August 7, 1998. The recommended scour mitigation measures consisted of rock slope protection at both downstream embankments along with an adequately designed check dam and biannual monitoring. These countermeasures were completed in March 26, 2003. The check dam consists of steel sheet pile constructed 6 feet downstream of the box culvert outlet invert. The check dam runs the entire length of the box culvert. Additionally, quarter ton rock on Type B fabric lining was placed between the box culvert invert and the check dam. And, half ton rock along on Type B fabric lining was place in the downstream area of the check dam.

According to the March 30, 1978, Supplementary Bridge Report, the bridge was overtopped from storm runoff in February, 1978. Major scour was observed at the embankments and immediately downstream of the box culvert. The report addressed the inadequacy of the waterway and recommended rock slope protection at the abutments and in the downstream channel. The 1998 Hydraulic Evaluation recommended replacing the box culvert with a new single span bridge to increase waterway capacity and biannual monitoring to determine if the bridge overtopping is a chronic problem.

The Final Hydraulics Report dated June 12, 2008, indicates that the existing structure is not considered to be scour critical. However, the new bridge can not convey the 100 year storm flow and the channel itself can only convey flows approximately equivalent to the 25 year storm. Consequently, when this 25-year storm event occurs runoff water overtops the creek bed into the surrounding flood plain. This report points out the existence of a channel bend of approximately 30° in the median between the two proposed bridges, and it recommends that rock slope protection along the western embankment between the two structures.

Corrosion Evaluation

Five composite soil samples were collected from Borings R-08-01, R-08-2, R-08-03, and R-08-04 during the 2008 subsurface investigation. The Office of Testing and Technology Services, Corrosive Technology Branch tested the composite samples for corrosive potential. The site is considered corrosive if one or more of the following conditions exist for the representative soil: chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less. The minimum resistivity serves only as an indicator parameter for the possible presence of soluble salts and is not included to define a corrosive site. It is the practice of the Corrosion Technology Branch that if the minimum resistivity of the sample is greater than 1000 ohm-cm, the sample is considered to be non-corrosive and testing to determine the sulfate and chloride content is not performed.

The results of the laboratory tests determined that the composite samples were considered to be corrosive at this site. Refer to Table 2 below for specific test results.

Table 2: Corrosion Test Summary-Composite Samples for Bitterwater Creek Bridge (Br. No. 50-0506 R/L)

Approx. Support Location/ SIC* Corrosion Number	Boring Number	Sample Depth (ft)	PH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (PPM)*	Chloride Content (PPM)*
C644082	R-08-01	0.0-2.5	8.0	808	3800	18
C644083	R-08-02	31.5-35.0	8.19	1150		
C644084	R-08-03	36.5-40.0	8.17	1168		
C644085	R-08-03	71.5-75	8.24	589	300	50
C644086	R-08-04	26.5-30.0	8.46	2378		

*SIC means Sample Identification Card

Should steel piling be used for bridge support, then corrosion mitigation measures are to be followed. Corrosion protection mitigation may include the need of sacrificial metal or corrosion allowance, or the use of protective coatings, and/or cathodic protection. Sacrificial metal or corrosion allowance is the thickness of metal (above what is structurally required for the pile) needed to compensate for the loss of metal that will occur as the pile corrodes. This extra metal thickness is added to all the surfaces of the pile exposed to the corrosive soil or water.

For steel piling, used in corrosive soil or water, sacrificial corrosion allowance is required per Department's Corrosion Guidelines, Section 10.1, "Corrosion Mitigation Measures for Steel Piles", available at http://www.dot.ca.gov/hq/esc/ttsb/corrosion/Index.htm.

The Department currently uses the following corrosion rates for steel piling exposed to the corrosive soil and/or water: For the soil embedded zone (from bottom to below 3 feet below water table) the corrosion rate is 0.001 inches per year; for the immerse zone (below water table) 0.004 inches per year; and for scour zone is 0.005 inches per year.

Laboratory Testing

Laboratory testing was performed on selected samples of the subsurface materials obtained from the 2008 field investigation. Tests were performed to determine the corrosivity and engineering properties of the subsurface materials for use in the foundation analysis. The tests performed included:

- Moisture Content (ASTM D 2216-05)
- Unit Weight (ASTM D 4767-04)
- Particle-Size Analysis (ASTM D 422-63)
- Liquid Limit, Plastic Limit and Plasticity Index (AASHTO T 89-02 & 90-00)

- Soil Corrosivity (CTM 643)
- Sulfates (CTM 417)
- Chlorides (CTM 422)

All tests were performed in general accordance with American Society for Testing and Materials (ASTM) standards or California Test Methods (CTM). Laboratory test results will be available upon request.

Seismic Data and Evaluation

The study site is potentially subject to strong ground motions from nearby earthquake sources during the design life of the structure. According to Caltrans' 1996 California Seismic Hazard Map (CHSM), the project site is located between the following faults:

1) San Andreas/C Fault (SAC) is classified as a strike-slip fault and has been assigned a Maximum Credible Earthquake Magnitude (MCE) of 8.0. This fault is located approximately 9.7 miles southwest of the project site.

2) Coast-Ranges-Sierran Block Boundary Zone (CSB) is classified as reverse thrust fault, and has been assigned a Maximum Credible Earthquake Magnitude (MCE) of 7.0. This fault is located approximately 12.0 miles northwest of the project site.

Approximate locations of the faults are shown in Figure 5, California Seismic Hazard Index Map 1996. The controlling seismic source for design is the San Andreas/C fault. Using the attenuation relationship by Sadigh et al (1997), it is estimated that the site is likely to experience a Peak Horizontal Bedrock Acceleration (PBA) of 0.4g in the event of a 7.0 magnitude earthquake associated with the SAC fault.

Based on the results of the 2007 subsurface exploration the soil profile may be classified as Type D as defined in the Department's Seismic Design Criteria (SDC, 2006, Version 1.4). Based on the above information (PBA = 0.4g, MCE = 8.0, and Soil Type D) and the proximity of the fault, 9.7 miles, an Acceleration Response Spectra curve (ARS) is presented in Figure 6. Due to the proximity of the site to the controlling fault, the SDC ARS curve has been modified for directivity. This modification is such that there is no increase in spectral acceleration for periods less than 0.5 seconds and a 20% increase for periods greater than 1.0 second. The ARS curve was also modified by using linear interpolation for periods between 0.5 and 1.0 second.

Liquefaction and Lateral Spreading Evaluation

Liquefaction can occur when saturated, loose to medium dense granular soils, or specifically defined cohesive soils, are subjected to ground shaking. The absence of

ground water and the presence of medium to very dense granular soils indicate that the site is not susceptible to soil liquefaction during earthquake shaking and lateral spreading.

Fault Rupture

The site does not lay within or adjacent to an Alquist-Priolo Earthquake Fault Zone for fault rupture hazard, and no known active faults cross the Bitterwater Creek Bridge. The referenced mapping by Dibblee shows that no fault or splay from the San Andreas Fault crosses the study area. Therefore, the potential for fault rupture and ground displacement to adversely affect the proposed structure is non-existent.

Seismic Settlement

During a seismic event, ground shaking can cause densification of relatively loose granular soil above the water table that can result in settlement of ground surface. Because most of soils in the study area are considered dense to very dense, the potential for seismic settlement is insignificant.

As-Built Foundation Information

According to the as-built plans and reports, the existing culvert was built in 1971 on SR 46 to convey east-west vehicular traffic over Bitterwater Creek. The existing structure consists of a two 10 foot by 8 foot reinforced concrete box culvert with reinforced concrete wing walls that are parallel to the highway. The width of the culvert is 54 feet.

Foundation Recommendations

The following foundation recommendations are for the proposed Abutments of Bitterwater Creek Bridge (Bridge No. 50-0506). These recommendations are based on the subsurface conditions encountered in the exploratory borings performed in May 2008. The site is conducive to H-piles due to the presence of relatively clean, dense sand and gravel. However, the structural designer requested that Class 140 pipe piles in the Request for Foundation Recommendations dated March 26, 2008. The presence of dense to very dense layers may preclude the construction of the requested piles. Our Office recommends that 100 ton HP 14x89 Steel H-piles be used to build all proposed support locations to comply with lateral load demand and the corrosion allowance (sacrificial metal loss).

Sacrificial metal or corrosion allowance is the thickness of metal needed to compensate for the loss of metal that will occur as the pile corrodes. This extra metal thickness is added to all surfaces of the pile exposed to the corrosive soil. According to the Corrosion Guidelines, Version 1.0, dated September 2003, the corrosion rates for steel pile in the soil embedded zone is 0.001 in per year. This corrosion rate should be doubled for steel H-

Piling since there are two surfaces on either side of the web and flanges that are exposed to the corrosive soil. Assuming that the recommended steel H-piles have a 75-year design life, and then its corrosion allowance is 0.15 in (.001in/yr x 75 years x 2 exposed sides).

The Designer provided the following foundation information in table 3 and 4.

Table 3: Revised Foundation Design Data Provided by the Designer for the Left Bridge

Foundation Design Data								
Support No.	Design Method	Pile Type	Finished Grade Elev. (ft)	Cut-Off Elev. (ft)	Pile Size Cap (ft)		Permissible Settlement under Service Load (in)*	Number of Piles per Support
					B	L		
Abut 1	WSD	CL-140	862.0	840.0	10	43	2	17
Abut 2	WSD	CL-140	862.0	840.0	10	43	2	17

* Based on CALTRANS' current practice, the total permissible settlement is one inch for structures with continuous spans or multi-column bents, and two inches for simple span structures.

Table 4: Revised Foundation Design Data Provided by the Designer for the Right Bridge

Foundation Design Data								
Support No.	Design Method	Pile Type	Finished Grade Elev. (ft)	Cut-Off Elev. (ft)	Pile Size Cap (ft)		Permissible Settlement under Service Load (in)*	Number of Piles per Support
					B	L		
Abut 1	WSD	CL-140	862.0	841.5	10	45.25	2	17
Abut 2	WSD	CL-140	862.0	841.5	10	45.25	2	17

* Based on CALTRANS' current practice, the total permissible settlement is one inch for structures with continuous spans or multi-column bents, and two inches for simple span structures.

Table 5: Foundation Design Loads Provided by Designer for the Left Bridge

Foundation Design Loads (LRFD)											
Support No.	Service-1 Limit State (kips)			Strength Limit State (Controlling Group) (kips)				Extreme Event Limit State (Controlling Group) (kips)			
	Total Load*		Permanent Load**	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	1830	133	1646	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 2	1830	133	1646	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Total Load = Permanent Loads + Transient Loads

**Permanent Loads = See Section 3 of AASHTO 3rd Edition and CA Amendments.

Table 6: Foundation Design Loads Provided by Designer for the Right Bridge

Foundation Design Loads (LRFD)												
Support No.	**Service-1 Limit State (kips)**			**Strength Limit State (Controlling Group) (kips)**				**Extreme Event Limit State (Controlling Group) (kips)**			
	Total Load*		**Permanent Load****	**Compression**		**Tension**		**Compression**		**Tension**	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	1827	133	1643	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 2	1827	133	1643	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Total Load = Permanent Loads + Transient Loads

**Permanent Loads = See Section 3 of AASHTO 3rd Edition and CA Amendments.

Our Office used the above foundation design data and loading conditions to evaluate abutments using Caltrans November 2003 Bridge Design Specifications for foundations using Working Stress Design methods. Foundation recommendations are shown in the following tables.

Table 7: Foundation Recommendations for Abutments for the Left Abutment

Abutment Foundation Design Recommendations										
Supp. No.	**Pile Type**	**Cut-Off Elev. (ft)**	**Service Limit State Load (kips)**			**Required Nominal Resistance (kips)**		**Design Tip Elev. (ft)**	**Specified Tip Elev. (ft)**	**Nominal Driving Resistance (kips)**
			Per Support		**Per Pile**	**Compr.**	**Tension**			
			Total	**Perm.**						
Abut 1	Steel H-Pile HP 14x89	840.0	1830	1646	133	260	N/A	N/A	795.0	260.0
Abut 2	Steel H-Pile HP 14x89	840.0	1830	1646	133	260	N/A	N/A	795.0	260.0

Table 8: Foundation Recommendations for Abutments for the Right Abutment

Abutment Foundation Design Recommendations										
Supp. No.	Pile Type	Cut-Off Elev. (ft)	Service Limit State Load (kips)			Required Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance (kips)
			Per Support		Per Pile	Compr.	Tension			
			Total	Perm.						
Abut 1	Steel H-Pile HP 14x89	841.5	1827	1643	133	260	N/A	N/A	795.0	260.0
Abut 2	Steel H-Pile HP 14x89	841.5	1827	1643	133	260	N/A	N/A	795.0	260.0

Table 9: Pile Data Table for the Left Bridge

Pile Data Table						
Support No.	Pile Type	Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance (kips)
		Compr.	Tension			
Abut 1	Steel H-Pile HP 14x89	260.0	0	795.0	795.0	260.0
Abut 2	Steel H-Pile HP 14x89	260.0	0	795.0	795.0	260.0

Table 10: Pile Data Table for the Right Bridge

Pile Data Table						
Support No.	Pile Type	Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance (kips)
		Compr.	Tension			
Abut 1	Steel H-Pile HP 14x89	260.0	0	795.0	795.0	260.0
Abut 2	Steel H-Pile HP 14x89	260.0	0	795.0	795.0	260.0

The capacities of the 100-ton 14x89 Steel H-Piles were calculated using Nordlund method (1963) and the Tomlinson's α-Method (1980) shown in the FHWA manual titled *Design and Construction of Driven Pile Foundations* (Pub. No. FHWA HI 97-013) revised November 1998.

The tips of the 100-ton Steel H-Piles will bear in dense sand between 60 and 65 feet below the existing ground surface elevation at the abutment locations. The compressive

resistance was determined using the Federal Highway Administration's Driven 1.2 (March 20, 2001) computer program developed by Blue-Six Software, Inc.

We neglected skin friction of native soil to a depth of 15 feet and all the abutment locations because the cut-off elevation is approximately 15 feet below the existing ground surface.

Lateral Capacity

Lateral capacity of the recommended piles was not evaluated because data required data for the lateral load analysis has not been provided at this time. Lateral design tip shall be incorporated to the Abutment Foundation Design Recommendations table and shall be placed on the Contract Plans.

Group Settlement

The immediate pile group settlement is approximately 0.4 inches for Abutments 1 and 2. The calculation of the settlement was obtained by using the LRFD Service-I Limit State Load and the Method base on SPT test data outlined in Section 9.8.2.2 of FHWA Publication No. FHWA-HI-97-013 titled "Design and Construction of Driven Pile Foundations". Volume 1, November 1998.

The calculated group settlement is less than the permissible settlement of 1 inch specified for the structure foundation. It is not anticipated a significant long-term settlement due to the competent soil conditions at the abutment locations.

Construction Considerations

Jetting and drilling to assist driving in conformance to section 49-1.05 of the Standard Specifications (May 2006) "Driving Equipment" is not allowed for the recommended steel H-piles.

100-ton Steel H-Piles, type 14x89, were selected due to potential of hard driving conditions at the proposed site, and corrosion allowance due to corrosive environment at the site.

Due to the presence of caving clean sand with gravel and cobbles, Cast-In-Drilled-Hole (CIDH) piles are not recommended.

Due to the granular nature of the soils, primary settlement is expected to occur immediately and concurrent with new fill placement; therefore, no waiting period is required prior to installing abutment piles.

Cobbles and occasional boulders will be encountering during the pile driving. The existence of these rocks and very dense intermittent layers will make pile driving erratic and difficult at times.

The calculated geotechnical capacity of the abutment piles is based on a combination of skin friction and end-bearing.

Pre-drilling through embankment fill shall conform to Section 49-1.06 of the State of California Department of Transportation, Standard Specifications. Pre-drilling is allowed to a depth of 12 feet below ground surface.

Piles at abutments 1 and 2 locations shall be driven in predrilled holes in conformance with the provisions in Section 49-1.06, "Predrilled Holes", of the Standard Specifications

Difficult pile installation is anticipated due to the presence of soils containing dense to very dense sand, gravel and cobbles.

Pile bearing at the abutment locations is to be addressed as per section 49-1.08 of the Standard Specifications (May 2006). Any driven piles achieving refusal within 5 feet of Specified Tip Elevation may be considered good and cut off with a written approval from the Engineer. Refusal is defined as a pile achieving two times (2x) the required nominal driving resistance as shown in the Contract Plans.

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads. If any conceptual changes are made during final project design, the Office of Geotechnical Design - North should review those changes to determine if these foundation recommendations are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

1. Log of Test Boring for Bitterwater Creek Bridge, Bridge No. 50-0506 R/L.

Data and Information included in the Information Handout provided to the bidders and Contractors are:

1. Revised Foundation Report for Bitterwater Creek Bridge, Bridge No. 50-0506 R/L, dated February 8, 2010.

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by Structure Design, Office of Bridge Design, and Branch 6. If any conceptual changes are made during final project design, the Office of Geotechnical North, Branch C should review those changes to determine if these foundation recommendations are still applicable.

Any questions regarding the above recommendations should be directed to Luis Paredes-Mejia at (916) 227-1047 or Douglas Brittsan at (916) 227-1079 of the Office of Geotechnical Design North, Branch C.

Prepared by:

PROFESSIONAL GEOLOGIST
LUIS MARIO PAREDES-MEJIA
No. 2329
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

LUIS M. PAREDES-MEJIA
Engineering Geologist, CEG 2329
Geotechnical Design – North, Branch C

REGISTERED PROFESSIONAL ENGINEER
REZA MAHALLATI
No. 49374
Exp 9/30/12
CIVIL
STATE OF CALIFORNIA

REZA MAHALLATI
Senior Materials & Research Engineer
Office of Geotechnical Design-North

cc: OGD N File Room
Douglas Brittsan
R.E. Pending
Structure OE (E-Copy)
PCE (E-Copy)
DME (E-Copy)
GDN File
GS File Room

REFERENCES

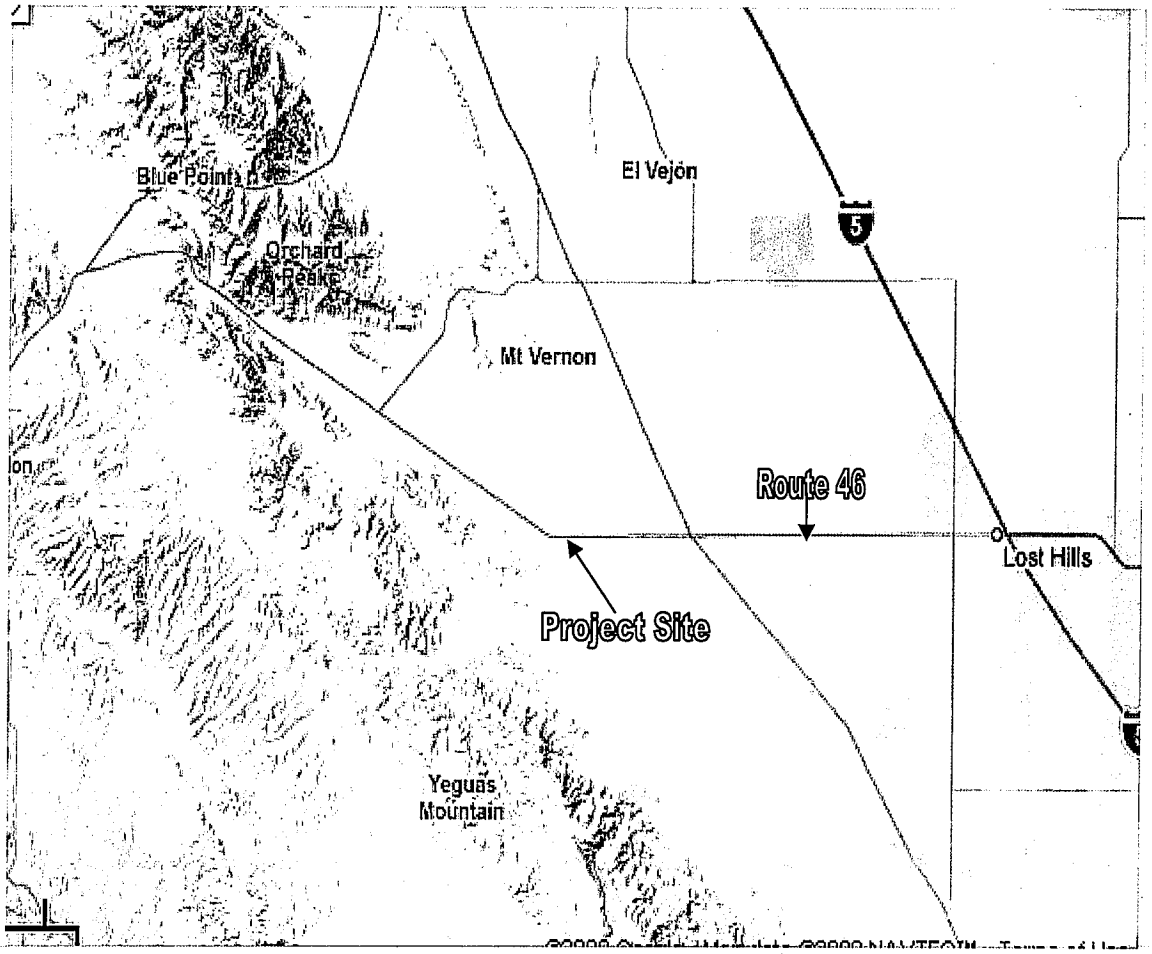
Federal Highway Administration (FHWA), Design and Construction of Driven Pile Foundations, (Pub. No. FHWA HI-97-013) published November 1998.

Norris, Robert M., and Webb, Robert M., 1990, Geology of California, Second Edition, John Wiley & Sons, Inc., 324-327 pp.

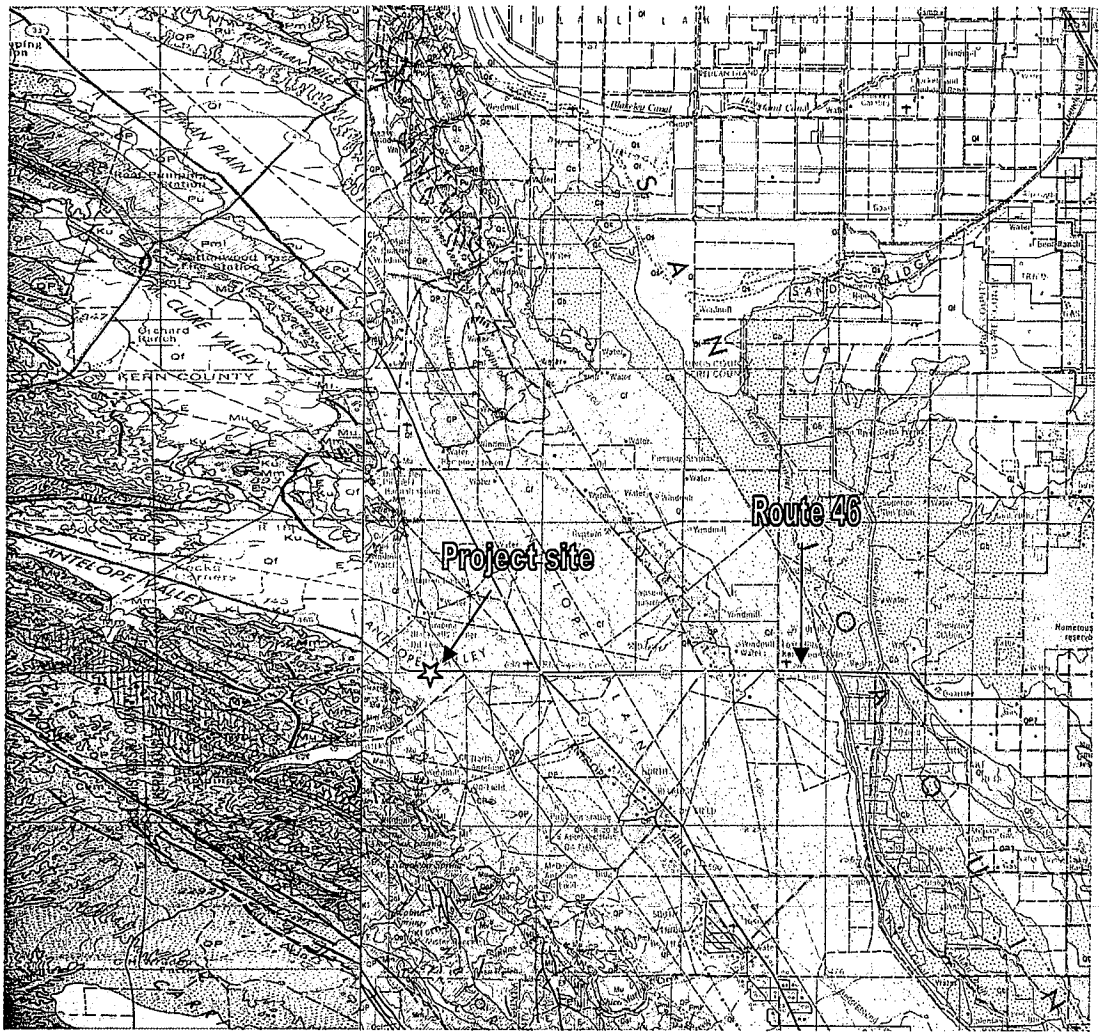
Seismic Design Criteria (2004), California Department of Transportation, Version 1.3.

Youd, T.L. et al. (2001), "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of soils." *Journal of Geotechnical and Geoenvironmental Engineering*, 817 – 833.

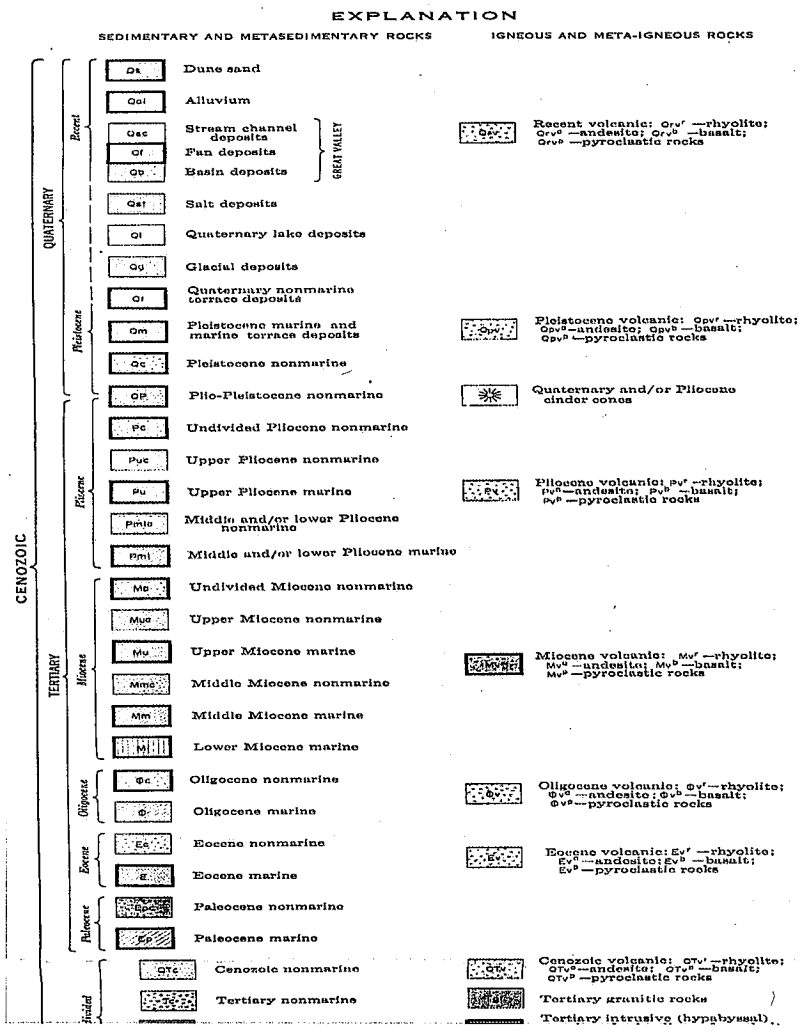
Dibblee, T.W. (1992), Geologic Maps of Fourteen 15-Minute Quadrangle along The San Andreas Fault in the Vicinity of Paso Robles and Chulame Southward to Maricopa and Cuyama, California: U.S. Geological Survey, Open-File Report oF-72-89, Scale 1:62500



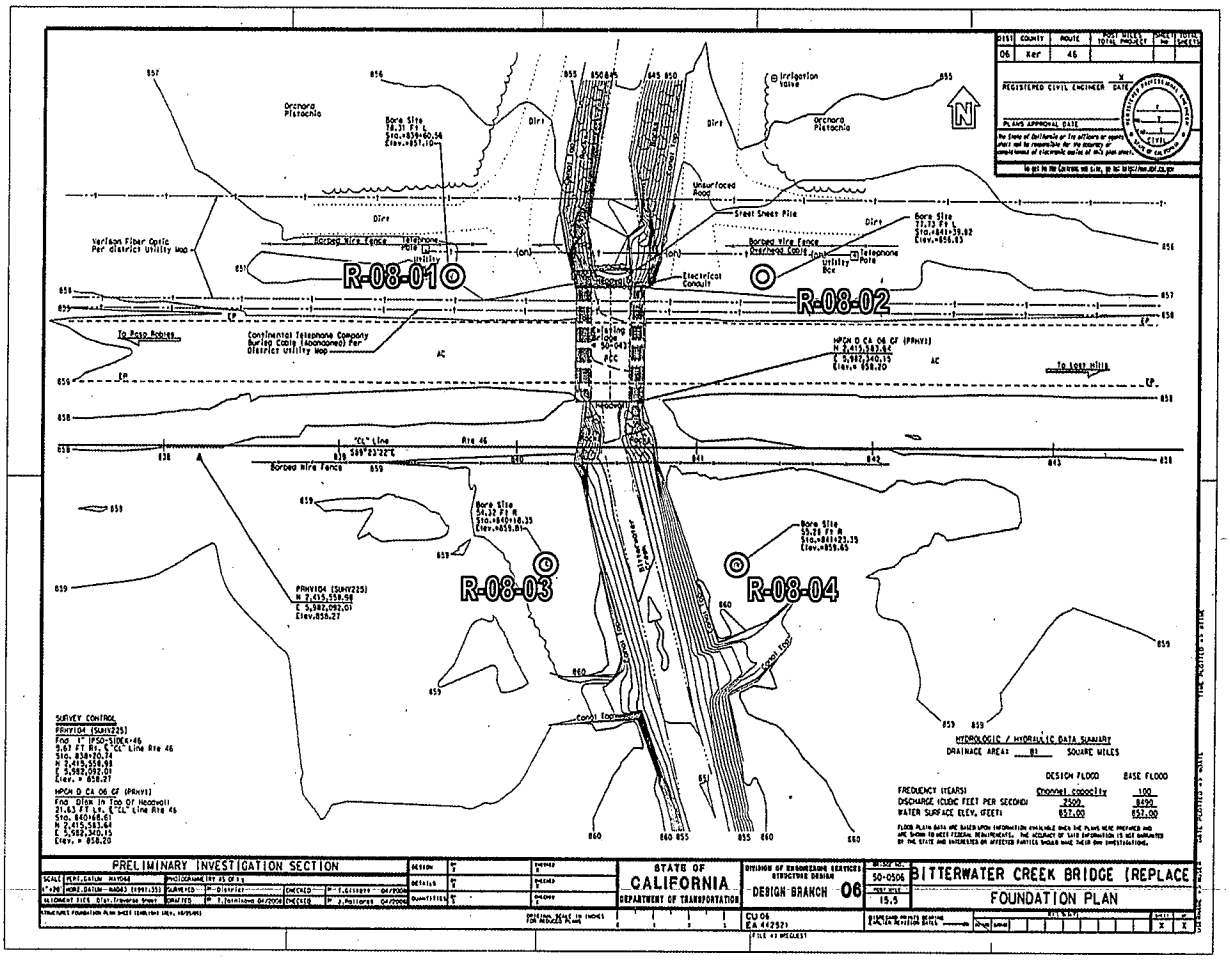
CALTRANS Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 06-442520 Br. No. 50-0506 R/L	**Vicinity Map**
	06-Ker-46-PM 7.3/19.8 Bitterwater Creek Bridge (Replace)	Figure 1



CALTRANS Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 06-442520 Br. No. 50-0506 R/L	**Geologic Map**	
	06-Ker-46-PM 7.3/19.8 **Bitterwater Creek Bridge (Replace)**		Figure 2

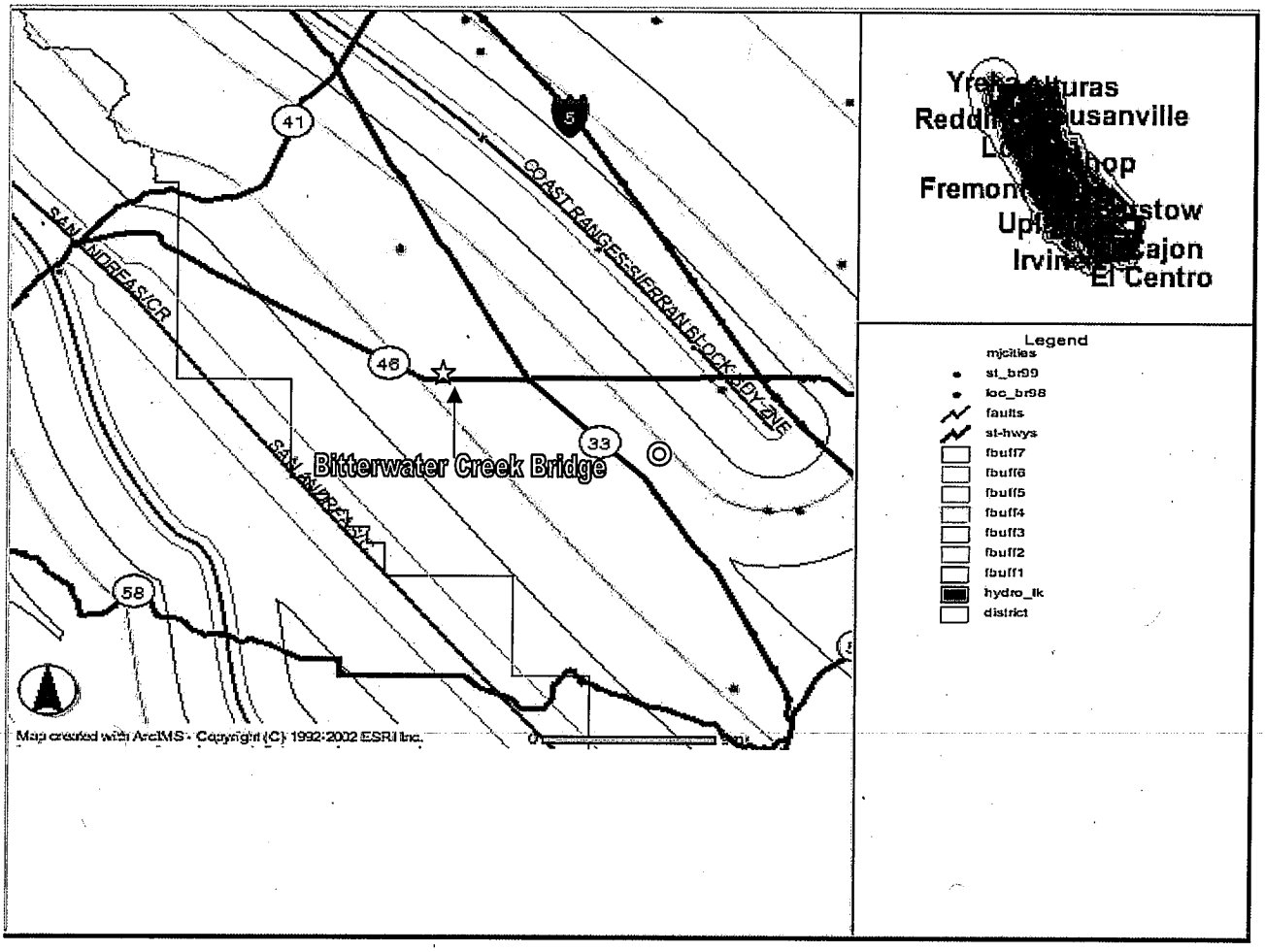


CALTRANS Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 06-442520 Br. No. 50-0506 R/L	**Geologic Map Legend**
	06-Ker-46-PM 7.3/19.8 **Bitterwater Creek Bridge (Replace)**	Figure 3

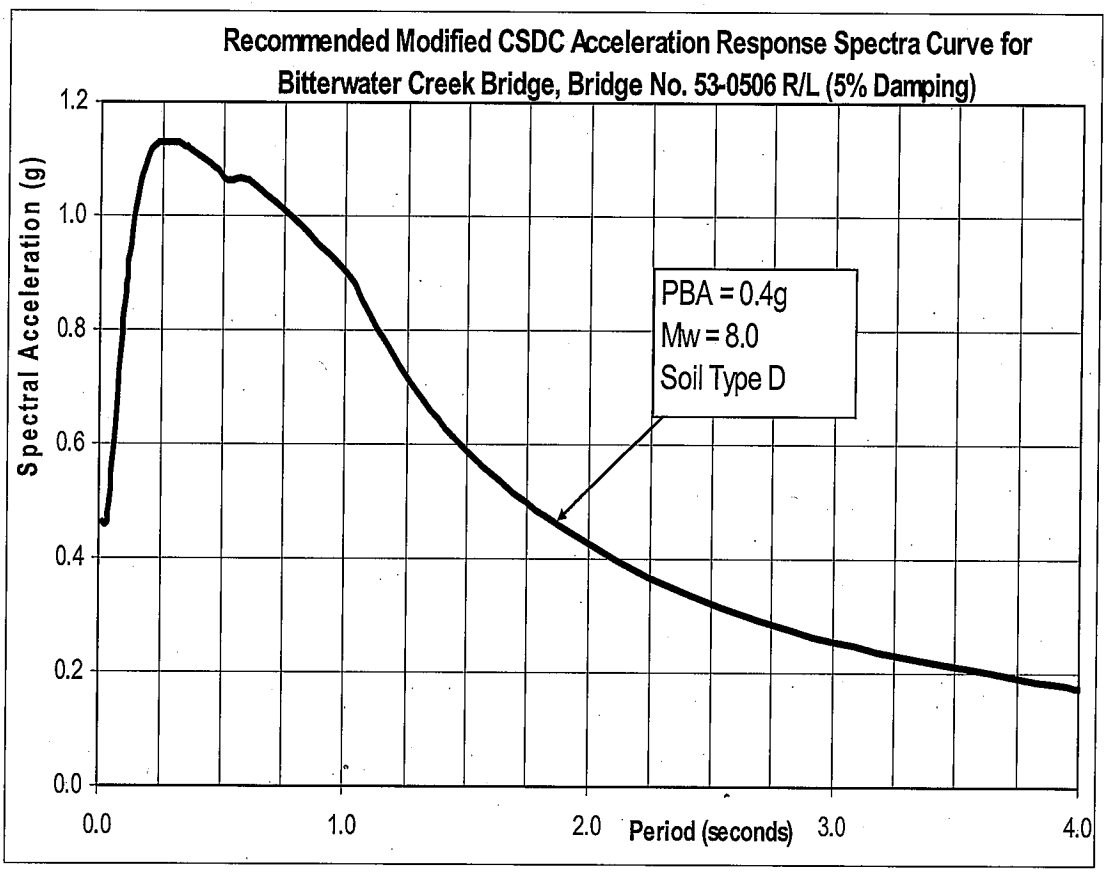


CALTRANS
Division of Engineering Services
Geotechnical Services
Geotechnical Design – North

EA: 06-442520	Boring Location Map
Br. No. 50-0506 R/L	
06-Ker-46-PM 7.3/19.8 Bitterwater Creek Bridge (Replace)	Figure 4



CALTRANS Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 06-442520 Br. No. 50-0506 R/L	California Seismic Hazard Index Map 1996
	06-Ker-46-PM 7.3/19.8 Bitterwater Creek Bridge (Replace)	Figure 5



Caltrans	CALTRANS Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 06-442520 Br. No. 50-0506 R/L	Acceleration Response Spectrum Curve
		06-Ker-46-PM 7.3/19.8 Bitterwater Creek Bridge (Replace)	Figure 6

State of California Department of Transportation

Structure Hydraulics

DIVISION OF STRUCTURES FINAL HYDRAULIC REPORT

Bitterwater Creek

Located about 4 miles west of State Route 33 on State Route 46 over Bitterwater Creek in Kern County

---

JOB:

Bitterwater Creek, EA 06-442521

LOCATION:

New Bridge No. 50-0506 L/R (Existing Br. No. 50-0437); 06-KER-46-PM 15.88

WRITTEN BY:

Tony Nedwick

DATE:

Original: June 12, 2008

Revised: February 9, 2010

REVIEWED BY:

Sharon Ropp

Hydrology/Hydraulics Report

General:

The Report has been revised from the original June 12, 2008 report; the information from the September 8, 2008 Addendum has been included and the bridge numbers have been revised to match the assigned bridge numbers for both structures.

It is proposed to replace the existing reinforced concrete double box culvert at Bitterwater Creek on State Route 46 within Kern County. The new structures will cross Bitterwater Creek, with the left structure constructed along the approximate alignment of the existing structure and the right structure on a parallel alignment. There will be a median separation of approximately 48 feet between the structures. The existing structure is Bridge Number 50-0437. The new structures will be 50-0506L and 50-0506R. For the purposes of this report, the left structure is the westbound, downstream bridge constructed at the location of the existing culvert. The right structure is the eastbound structure, constructed upstream of the existing culvert.

Rich Melko and Sherman Stake, of Structure Design, provided the Planning Study and other proposed preliminary design data used in this analysis. Preliminary Investigations-North provided the Caice file based on survey data provided by the District. The Planning Study indicates that the structures will both be single span bridges with overall length of 49.2 feet, a total width of 42.0 feet and a structural depth of 1.5 feet. Preliminary designs indicate a bridge skew of approximately 15° for the right structure, with no bridge skew noted for the left structure. Hydraulic skew will vary, with the abutment walls aligned with the channel for both structures, but there is a channel bend of approximately 30° that occurs in the median between the two proposed structures. Based on the analysis, the structures can accommodate the 50-year flows. The structures cannot convey the 100-year flow, but can convey the flows at channel capacity, estimated to be 2,500 cfs.

Due to a downstream head cut threatening to undermine the existing structure, Caltrans Division of Maintenance, Structure Maintenance Design, designed and constructed a steel sheet pile check dam protected with ½-ton RSP and filter fabric immediately downstream of the existing structure. All elevations in this report are based on the survey data provided by Preliminary Investigations-North and the preliminary design information provided by Structure Design. The Vertical Datum is NAVD 88, with a vertical

transformation of approximately 2.86 feet above the NGVD 1929 elevations used for the existing structure. The data provided by Structure Design indicates elevations of 849.00 feet and 847.96 feet for the upstream and downstream inverts of existing culvert, respectively.

Basin:

At the bridge, Bitterwater Creek drains approximately 81 square miles. The watershed is located in the arid region along the west side of the southern San Joaquin Valley in the extreme western portion of Kern County and the eastern portion of San Luis Obispo County. Daily temperatures vary from 30° F to 115° F. This watershed is considered to be mostly in the South Lahontan-Colorado Desert Region, per USGS Publication 77-21.

Discharge:

Several basins were utilized to estimate the flow rates for the project watershed. FEMA published flow rates were found for a nearby stream at Blackwells Corner, just to the east of the project site as well as USGS stream gage data for station #11197370 on Bitterwater Creek upstream from the project site. Both of these sources were adjusted utilizing the Basin Transfer method to account for differences in basin area, as indicated in USGS publication 77-21. At the project site the estimated 50-year event flow rate is 5,480 cfs while the estimated 100-year flow rate is 8,490 cfs.

The channel capacity immediately upstream of the bridge site can only handle approximately 2,500 cfs; any additional discharge will overtop the banks and flood the surrounding area, mostly along the eastern bank. Since the capacity of the waterway opening of the proposed structure is greater than the channel capacity, the proposed bridge length is adequate. The design discharge for these structures is 2,500 cfs. The frequency of the channel capacity is approximately equal to a 25-year event. There have been previous reports of the channel overtopping the roadway at the project location.

Stage/Velocity:

The proposed bridge site was modeled using the data provided by Structures Design, Preliminary Investigations-North, historical Bridge Inspection Reports and HECRAS version 3.1 water flow analysis software. This analysis was used to estimate the water surface elevation, velocity and other hydraulic parameters. Water Surface Elevations for the design discharge of 2,500 cfs are 856.0 feet for the left structure and 857.0 for the right structure. Structures Hydraulics recommends that minimum soffit elevations, contained in the Planning Study provided by Structure Design, are maintained. These

minimum soffit elevations are 860.54 feet for the left structure and 860.47 feet for the right structure.

Water Surface Elevation at Design Discharge of 2,500 cfs	
50-0506L	856.0 ft
50-0506R	857.0 ft

Velocity is provided for use in sizing bank protection around abutments and embankments if desired by the district. The average velocity of the channel at the proposed bridge sites during the design discharge event is 12.7 fps. Upstream of the site, average velocity for the design flow of 2,500 cfs is as high as 15.2 fps approximately 120 feet upstream of the proposed right structure. Velocity increases to 23.1 fps downstream of the structures due to the steep slope caused by the previously installed drop structure. This drop structure, constructed of steel sheet piles and with filter fabric underlying ½-ton RSP, was installed around 2003 to halt the head cut that was occurring within the channel downstream of the current structure. Average velocity drops to 9.3 fps approximately 120 feet downstream of the drop structure.

Streambed:

In the vicinity of the structure the channel is relatively straight with average channel slopes upstream of the check dam of 1.1% to 1.25%. Channel slopes are slightly steeper in the immediate vicinity of the existing culvert, with slopes closer to 2.2%. The streambed is comprised of coarse sand, fine gravel and silt.

Drift:

There have been no previous inspection reports of significant debris accumulations at the substructure of the existing bridge with a few reports of tumbleweeds caught on Pier 2. The watershed is sparsely vegetated and the proposed structure is a single span bridge. Therefore, debris is not considered to cause a significant scour risk provided the minimum soffit elevation recommendations are followed.

Scour:

The existing structure is not considered to be scour critical, with an NBIS 113 code of 8. The 113 code was changed from a 3 to an 8 with the completion of the steel sheet pile check dam.

However, it is assumed that the check dam will eventually fail and the previous headcut will continue to progress through the project site. There has been no evidence of additional head cutting or channel degradation occurring in the vicinity of the checkdam. Therefore, it is recommended to place the bottom of the abutment diaphragms and the top of the abutment footings at or below elevation 842.0 feet for the left structure and 843.5 feet for the right structure. This should place the top of the footings approximately 2 feet below the minimum invert elevation for each structure.

Additional Design Considerations:

The channel should be graded to provide a uniform slope starting approximately 100 feet upstream of the right structure to the top of the check dam downstream of the left structure. The channel should be sized and shaped consistent with the check dam, with a base width of approximately 20 feet and 1.5H: 1V side slopes. No RSP is necessary along the abutments, but due to the channel bend, RSP should be considered along the western embankment between the two structures.

Summary Information for Bridge Designer:

Below is a summary of key design parameters based on the hydrology and hydraulic analysis performed for these structures. The minimum soffit elevations for the each structure were determined by using the water surface elevation at channel capacity of 2,500 cfs.

Hydrologic Summary Bitterwater Creek, 50-0506L		
Drainage Area: 81 mi^2		
	Design Flood	**Base Flood**
Frequency	Channel capacity	100 year
Discharge	2500 cfs	8490 cfs
Water Surface Elevation at Bridge	856.0 ft	856.0 ft*
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.		

Minimum Soffit Elevation	860.54 ft
Bottom of Abutment Diaphragm Elevation	842.0 ft

* It is assumed that all watershed flows greater than the channel capacity will result in the same water surface elevations at the bridges.

Hydrologic Summary **Bitterwater Creek, 50-0506R**		
Drainage Area: 81 mi^2		
	Design Flood	**Base Flood**
Frequency	Channel capacity	100 year
Discharge	2500 cfs	8490 cfs
Water Surface Elevation at Bridge	857.0 ft	857.0 ft*
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.		

Minimum Soffit Elevation	860.47 ft
Bottom of Abutment Diaphragm Elevation	843.5 ft

* It is assumed that all watershed flows greater than the channel capacity will result in the same water surface elevations at the bridges.

All elevations given are referenced to the data provided by Structures Design and Preliminary Investigations-North, using the NAVD 88 vertical datum.

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

Engineer – report prepared by (Signature) Tony Nedwick	
Registration Number:	Date: February 9, 2010

State of California

Business, Transportation and Housing Agency

Memorandum

To: **Shahin Mansour**, Chief
Design Branch B
Office of Design IV
Central Region Project Development

Date: December 4, 2008

File: 06-Ker-46-PM 6.8/19.8

06-442521

From: **DEPARTMENT OF TRANSPORTATION**
Central Region Materials Engineering Branch – Fresno

Subject: Materials Information Handout

The Materials Engineering Branch has completed the necessary tests and has compiled the attached Materials Information requested for the potential imported borrow material sources for this project. A copy is attached. The District Office Engineer is being furnished with the reproducible package.

If you have any questions or need additional information, please call me at 488-4007 or Bob Voss at 488-4002.

Sarabjit Singh
Central Region Materials Engineering Branch – Fresno

C: OE
Attachments

MATERIALS INFORMATION
(Not a Part of the Contract)

For

Contract No. 06-442524
06-Ker-46-PM 6.8/19.8

In Kern County, from 0.53 mile East of Kecks Road to 0.7 mile West of Route 46/33 intersection.

Note: The records from which this compilation was made may be inspected at the Caltrans District 06 Materials Engineering Branch at 1352 West Olive Avenue, Fresno, California.

CONTENTS

Investigated Materials Sources	1
Vicinity Map	2
Investigated Materials Source Site Maps	3
Test Data Tabulation	4, 5
Agreements	6, 7

Investigated Materials Sources

1. Owner: H. M. Holloway Inc.

    a. Pile # 1 (500,000 cubic yards)
    1.5 miles from Route 46 and Holloway Road intersection,
    On West side of Holloway Road.

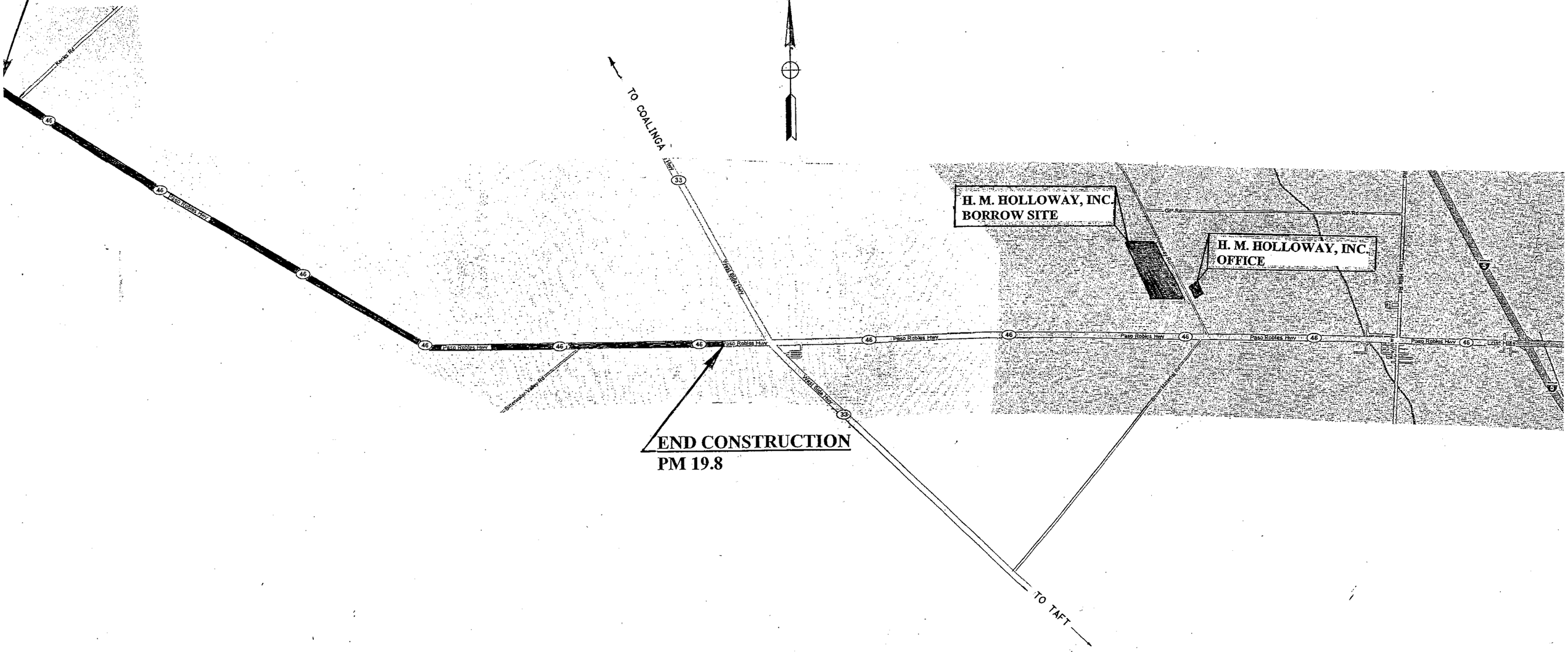
    b. Pile # 2 (500,000 cubic yards)
    1.6 miles from Route 46 and Holloway Road intersection,
    On West side of Holloway Road.

    c. Pile # 3 (700,000 cubic yards)
    1.7 miles from Route 46 and Holloway Road intersection,
    On West side of Holloway Road.

    d. Pile # 4 (500,000 cubic yards)
    1.8 miles from Route 46 and Holloway Road intersection,
    On West side of Holloway Road.

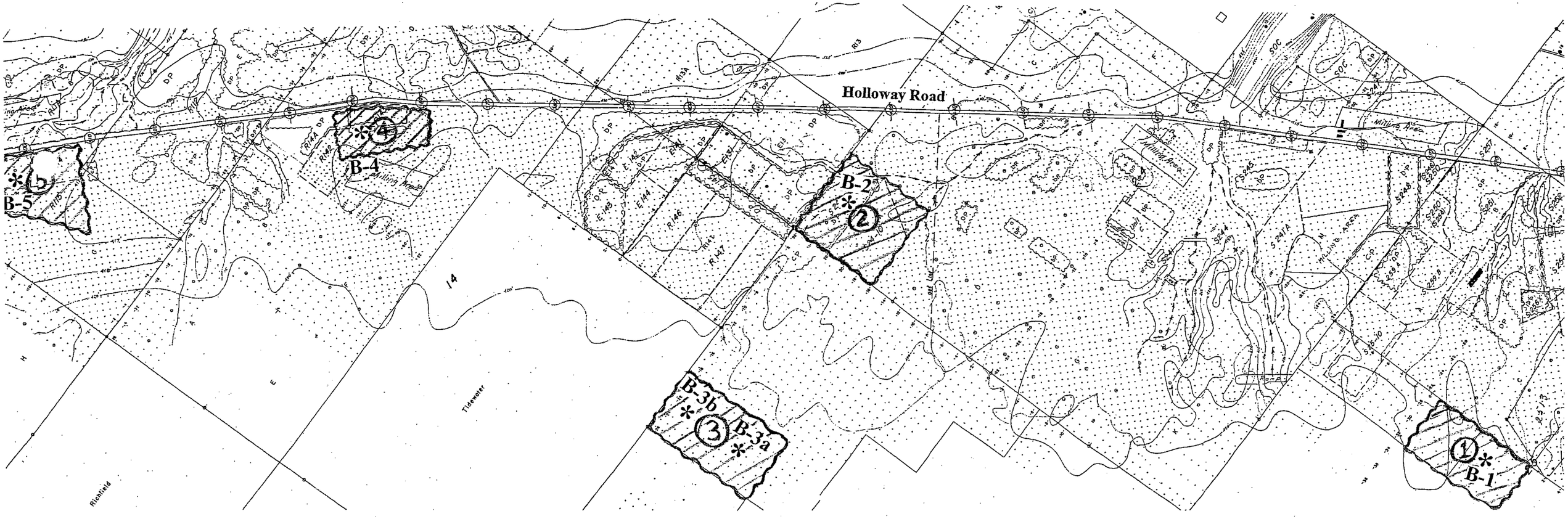
    e. Pile # 5 (550,000 cubic yards)
    1.9 miles from Route 46 and Holloway Road intersection,
    On West side of Holloway Road.

BEGIN CONSTRUCTION
PM 6.8



END CONSTRUCTION
PM 19.8

VICINTY MAP
NO SCALE


N
Holloway Road
B-1
B-2
B-3a
B-3b
B-4
B-5
Tidewater
Richfield

Test Data Tabulation

H. M. Holloway Inc. at 1.7 miles from Route 46 and Holloway Road intersection,
On West side of Holloway Road.

Boring No.	Sample Designation	Depth	R-Value	Sand Equivalent	% Passing No.200 Sieve	pH	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
Pile No. 1									
B-1	C10001	0' – 10'	22	35	64.0	7.98	340	450	6000
B-1	C10002	10' – 20'	13	14	66.0	8.00	270	780	6300
B-1	C10003	20' – 30'	13	30	68.1	7.88	250	910	6600
B-1	C10004	30' – 40'	10	9	71.1	7.89	240	850	6900
B-1	C10005	40' – 50'	11	6	74.2	7.94	250	680	7400
Pile No. 2									
B-2	C10006	0' – 5'	17	7	70.4	7.81	390	360	6600
B-2	C10007	5' – 15'	18	8	73.4	8.00	230	920	6900
B-2	C10008	15' – 20'	14	9	69.6	7.80	220	610	8200
B-2	C10009	20' – 30'	10	9	71.1	7.89	240	610	9700
B-2	C10010	30' – 40'	11	6	74.2	7.94	250	580	9700
B-2	C10011	40' – 50'	5	2	85.9	7.99	260	450	8600
Pile No. 3 (Northside)									
B-3b	C10029	0' – 10'	30	8	63.4	7.76	370	530	5000
B-3b	C10030	10' – 20'	15	11	69.2	7.87	270	850	6100
B-3b	C10031	20' – 30'	10	3	75.5	7.99	220	1000	8100
B-3b	C10032	30' – 40'	8	3	75.5	7.95	240	830	7100
B-3b	C10033	40' – 50'	12	3	77.2	7.86	250	750	6800

Test Data Tabulation

H. M. Holloway Inc. at 1.7 miles from Route 46 and Holloway Road intersection,
On West side of Holloway Road.

Boring No.	Sample Designation	Depth	R-Value	Sand Equivalent	% Passing No.200 Sieve	pH	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
Pile No. 3 (Southside)									
B-3a	C10012	0' – 10'	19	6	77.2	7.70	380	680	6100
B-3a	C10013	10' – 20'	21	12	79.6	7.73	240	1400	6600
B-3a	C10014	20' – 30'	19	8	78.5	7.82	250	1000	6500
B-3a	C10015	30' – 40'	13	8	69.3	7.75	240	1100	6200
B-3a	C10016	40' – 50'	12	3	78.3	7.95	230	930	7400
Pile No. 4									
B-4	C10017	0' – 10'	23	11	69.1	7.87	300	570	6500
B-4	C10018	10' – 15'	19	13	72.4	7.76	210	1400	7000
B-4	C10019	15' – 25'	21	20	59.9	8.00	290	780	6200
B-4	C10020	25' – 35'	18	17	61.2	8.00	280	920	7000
B-4	C10021	35' – 45'	18	5	70.8	8.14	220	810	8200
B-4	C10022	45' – 50'	10	11	76.7	8.15	210	760	8300
Pile No. 5									
B-5	C10023	0' – 5'	14	7	68.7	8.04	240	600	7200
B-5	C10024	5' – 15'	10	3	75.8	8.00	240	780	7800
B-5	C10025	15' – 25'	12	3	80.1	7.98	200	920	7200
B-5	C10026	25' – 35'	10	3	75.2	7.99	200	950	8300
B-5	C10027	35' – 45'	11	11	67.7	8.02	220	750	5400
B-5	C10028	45' – 50'	12	11	72.3	8.02	250	600	6400

AGREEMENTS

1. H. M. Holloway Inc.

   Agreement has been made between Caltrans and H. M. Holloway Inc. regarding the H. M. Holloway Inc. willingness to negotiate with potential Caltrans bidders for any of their possible materials sources.

   No other agreement has been made.

   Information concerning availability, SMARA, volume, cost, conditions, permits, and environmental issues may be obtained by contacting:

   Allen Terry
   Mine Superintendent

   Cell 661-333-1857,
   Lost Hills Mine Office 661-797-2320,
   Res. 661-758-1569
   Lost Hills Fax 661-797-2234

   Office Address
   137 F Street, Wasco, CA 93280

   Material Site Office Address
   13850 Holloway Road

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DISTRICT 6
P.O. Box 12616
Fresno, California 93778

MATERIAL SOURCE AGREEMENT

Project: Segment 3 of the Ker-46 to convert the two-lane conventional highway to a four-lane expressway between PM 6.8 and PM 19.8.

EA: 06-442521

The undersigned owner is willing to enter into negotiations with potential bidders and/or the successful bidder for earth materials for use in the construction of this project.

Limited access shall be granted to Department of Transportation personnel for purposes of soil sampling.

Print Name: H M Holloway Inc
Property Owner

Signature: Allen Terry Date: 5-14-08
Owner/Authorized Representative

Address: 13850 Holloway Road

Phone: 661-797-2320 or 333-1857

California Department of Transportation

By: 5/27/08
Ted Mooradian
Central Region Materials Engineer