APPENDIX B

Background Materials

B-1

2005 Agreement

Pacific Gas and Electric Company

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San Francisco, CA 94120
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77 Beale Street, B30A
San Francisco, CA 94105
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Annette Faraglia
Attorney at Law

ORIGINAL

PG&E

March 30, 2005

Magalie R. Salas, Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 1st Street, NE, Docket Room 1A-East
Washington D.C. 20426-0002

Re: Kilarc-Cow Creek, FERC Project No. 606

Dear Ms. Salas:

Enclosed please find an original and eight (8) copies of the executed Kilarc-Cow Creek Project Agreement ("Agreement") by and between Pacific Gas and Electric Company ("PG&E"), U.S. Fish and Wildlife Service, California Department of Fish and Game, National Park Service, California State Water Resources Control Board, NOAA Fisheries, Trout Unlimited, and Friends of the River in regard to the above referenced Kilarc-Cow Creek Project ("Project"). Under the Agreement, PG&E will not seek a new FERC license for the Project but will continue operating it until the current license expires on March 27, 2007 and on annual licenses thereafter until the Project is: (1) acquired by another license applicant; or (2) decommissioned by FERC order.

PG&E extensively analyzed anticipated new license conditions and determined that such conditions would make the Project an uneconomic source of power. This determination led to the development and execution of the Agreement. In the event FERC orders the Project to be decommissioned, the Agreement identifies what the signatory parties believe are the subjects that would need to be addressed and the desired condition of each of these subjects after decommissioning. PG&E used this indication of decommissioning scope along with other considerations in reaching its decision to enter into the Agreement and not file an application for new license. Specific actions necessary to achieve the desired conditions would be determined in the future. The Agreement also addresses the transferring of water rights, upon decommissioning, to a resource agency or other entity to support spring run Chinook salmon and steelhead trout.

On August 17, 2004 FERC representatives participated in a meeting, via conference call, with the signatory parties to discuss the possibility of PG&E not filing a relicensing application. Prior to and after that call, Steve Nevares, PG&E's Project Manager for the

Kilarc-Cow Creek Relicensing Project, has been in contact with FERC staff regarding developments. Most recently, on January 19, 2005, Mr. Nevares updated FERC's Tim Welch, Emily Carter, and Alan Mitchnick on the status of the Agreement.

If you have any questions regarding the attached Agreement, you may contact Steve Nevares at (415) 973-3174, e-mail SAN3@pge.com, or myself at (415) 973-7145, e-mail ARF3@pge.com.

Very truly yours,

Annette Faraglia

Attachment

cc: Ms. Emily Carter
Mr. Robert Fletcher
Mr. Hossein Ildari
Mr. Alan Mitchnick
Mr. Timothy Welch

Mr. Wayne White, Field Supervisor, U.S. Fish & Wildlife Service
Mr. Donald B. Koch, Regional Manager, California Department of Fish & Game
Mr. Jonathan B. Jarvis, Regional Director, National Park Service, Pacific West Region
Ms. Victoria A. Whitney, Chief Div. of Water Rights, CA State Water Resources Control Bd.
Mr. Rodney McInnis, Regional Administrator, NOAA Fisheries
Mr. Steven Evans, Conservation Director, Friends of The River
Charles Bonham, Esq., California Counsel, Trout Unlimited

Service List for Kilarc Cow-Creek Project, FERC Project No. 606

Kilarc-Cow Creek Project Agreement

This Agreement regarding the Kilarc-Cow Creek Project ("Agreement") is signed as of March 22, 2005 ("Effective Date") by and among Pacific Gas & Electric Company, a California corporation (the "Company"), U.S. Fish and Wildlife Service, California Department of Fish and Game, National Parks Service, California State Water Resources Control Board, Nation Marine Fisheries Service, Friends of the River, and Trout Unlimited. The signatories to this Agreement are referred to individually as a "Party" or collectively as the "Parties".

PROJECT BACKGROUND

A. The Kilarc-Cow Creek Project is licensed by the Federal Energy Regulatory Commission ("FERC") as FERC Project No. 606 (the "Project"). The Project is located in Shasta County, California along Old Cow Creek and South Cow Creek. The Project consists of Kilarc Powerhouse and Cow Creek Powerhouse along with related canals, penstocks, forebays and other structures.

B. The current FERC license for the Project expires on March 27, 2007. For the last two years the Company has been following the process prescribed in the Federal Power Act to obtain a new license. The Company's application for a new license is due to FERC by March 27, 2005. The Parties to this Agreement have been participants in the Company's relicensing process for the Project.

C. Due to the complex and competing resource issues associated with the Project, in early 2004 the Company decided to explore decommissioning as an alternative to relicensing the Project. The Company requested that the Parties participate in evaluating actions that would be necessary should the Project be decommissioned. This led to the Parties identifying a list of subjects and desired conditions to be addressed should the Project be decommissioned. The subjects and desired conditions are listed in Attachment A, which is incorporated herein by reference.

D. The Company's evaluation of the cost of decommissioning the Project based on the subjects and desired conditions in Attachment A versus operating the Project under a new license with the anticipated conditions, show that under a new license the Project would be a high cost source of energy and would not be competitive with other generation sources. This evaluation was only possible once the relicensing work had proceeded to the point where potential conditions of a new license could be identified by the Parties.

E. Based on the Parties' consensus regarding the subjects and desired conditions in Attachment A, the Company is willing to stop work on relicensing the Project and not file a new license application. The Company is also willing to support decommissioning the Project based on its determination that decommissioning is a viable and cost-effective alternative to relicensing.

F. By not filing an application for new license by the statutory deadline of March 27, 2005, the Company will lose its incumbent licensee status and forgo its opportunity to relicense the Project. Under 18 C.F.R. §16.18, FERC is authorized to issue annual licenses to the Company pending determination of the future status of the Project. The United States may seek to take over the Project, or other entities may apply for the Project license within a time period set by FERC under 18 C.F.R. §16.25. Other entities may also apply for the Project license prior to March 27, 2005. If no timely applications are received, FERC will order the Company to prepare and file a license surrender application in compliance with FERC's rules that provides for the disposition of Project facilities.

AGREEMENT

1. RELICENSING

1.1 The Company agrees not to file an application for new license for the Project. The other Parties support this action.

1.2 Entities other than the Company may seek to acquire a new license for the Project following the FERC prescribed process. The Parties accept that if an entity other than the Company indicates an interest in licensing the Project, the Company will need to provide such entities with Project information as required, including the results of relicensing studies performed to date. Additionally, the Parties accept that in such circumstances the Company will not hinder the efforts of such entities to obtain a license for the Project.

1.3 The Company will continue to operate the Project under the terms and conditions of the existing license until it expires on March 27, 2007, and then on annual licenses issued by FERC under 18 C.F.R. §16.18 until the Project is transferred to another licensee, or is decommissioned. The Company recognizes that during the period of annual license, if any, the Parties may work together, or individually, or with FERC to establish mutually acceptable environmental measures that improve water quality and/or conditions for state and federally protected species. The Parties recognize that FERC may incorporate additional or revised interim conditions in annual licenses if necessary and practical to limit adverse impacts on the environment under 18 C.F.R. §16.18(d). Any Company application for license surrender filed pursuant to 18 C.F.R. §16.25 shall provide for disposition of the Project facilities.

2. GOVERNMENTAL PARTIES RETAIN AUTHORITIES

2.1 Notwithstanding this Agreement, the Parties ~~which are~~ that governmental agencies retain all of their authorities and mandates related to the Project, the Project-affected resources and the Company's ongoing relicensing or surrender of license proceeding, and to any new licensing proceeding that may be initiated for this Project. Such authorities and mandates are not diminished in any way by these Parties entering into this Agreement. Entering into this Agreement is not in any manner a pre-decisional act or commitment by any of the governmental agencies as to the disposition of the Project assets or water rights.

2.2 Notwithstanding this Agreement, the Parties that are non-governmental organizations retain all of their rights related to the Project, the Project-affected resources and the Company's ongoing relicensing proceeding, and to any new licensing proceeding that may be initiated for this Project. Such rights are not diminished in any way by these Parties entering into this Agreement. Entering into this Agreement is not in any manner a pre-decisional act or commitment by any of the non-governmental organizations as to the disposition of the Project assets or water rights.

3. DECOMMISSIONING

3.1 The Company commits to supporting decommissioning the Project based on decommissioning being the viable and cost effective alternative to relicensing.

3.2 If FERC authorizes or orders the Company to decommission the Project, upon a final order from FERC ending Project power operations, the Company intends to transfer its appropriative water rights held for operation of the Project ("water rights") to a resource agency or other entity that: 1) agrees to use the water rights to protect, preserve, and/or enhance aquatic resources, as authorized by applicable laws and regulations, such as Water Code section 1707; and 2) is acceptable to the Parties. Additionally, prior to transferring of its water rights, the Company will work in good faith with other non-Parties to resolve potential water rights issues with the goal of having the water rights used to preserve, protect and/or enhance aquatic resources.

3.3 In the event the Company files or is ordered by FERC to file a surrender application, which the Company agrees will include a decommissioning plan, the subjects and desired conditions in Attachment A represent the Parties' good faith effort at this time to identify the subjects that would need to be addressed and the desired condition of each of these subjects after decommissioning of the Project. It is the Parties' intent that the surrender application and decommissioning plan will define these subjects and desired conditions more fully and identify the actions to be taken by which the desired conditions will be met. If a consensus agreement cannot be reached, the dissenting Party will submit written documentation in the form of a letter to the other Parties explaining the dissenting Party's reasons for not agreeing with the other Parties. This letter will become part of the decommissioning record.

3.4 The subjects and desired conditions in Attachment A are based on limited information and subject to change by consensus of the Parties based on additional information that may become available or compliance with applicable laws and regulations. Consensus means that all Parties involved in a decision can "live with" that decision even if the decision is not exactly as each Party would desire.

3.5 Additional subjects and desired conditions may be added to this Agreement by a consensus decision-making process among the Parties.

3.6 If the Company files, or is ordered by FERC to file a surrender application and a decommissioning plan, the Parties will work collaboratively to develop the surrender schedule and decommissioning plan. The decommissioning plan will identify and refine the actions necessary to address the subjects and desired conditions in Attachment A following decommissioning of the Project and will be consistent with legal requirements and obligations to FERC, and other applicable state and federal laws. Decisions on actions to address the subjects and desired conditions in Attachment A will be made by consensus of all Parties involved in the decommissioning plan's development.

3.7 To the extent permissible, the Parties will support the Company in the necessary regulatory processes to decommission the Project, including the Company's efforts before the CPUC to recover the costs the Company incurs to decommission the Project in accordance with Attachment A.

4. NEW PARTIES

Additional governmental agencies, groups and individuals may become Parties to this Agreement.

5. COMMUNICATIONS TO THE PUBLIC

This Agreement and the work that may be needed to assist the Company and the Parties in developing a detailed decommissioning proposal are open to members of the public.

6. TERM OF AGREEMENT

6.1 This Agreement shall remain in effect until the later of 1) March 27, 2007; 2) the date the Project license is transferred to a new licensee; or 3) completion of the decommissioning of the Project under a FERC order and the final order from FERC ending the Company's responsibilities as the licensee of the Project, unless this Agreement is terminated sooner pursuant to the terms of this Agreement.

6.2 Each Party has the option of withdrawing from this Agreement by providing written notice to the other Parties explaining the reasons for the proposed withdrawal and affording the other Parties thirty (30) calendar days to consult and seek alternatives to such withdrawal. All Parties agree they will not arbitrarily withdraw from the Agreement and will make a good faith effort to consult with the other Parties to resolve any dispute prior to withdrawal.

6.3 Withdrawal by the Company terminates this Agreement. Grounds for Company withdrawal include, but are not limited to, the CPUC's failure to authorize the Company to fully recover in rates its decommissioning costs.

6.4 This Agreement can also be terminated by unanimous agreement of the Parties.

7. MISCELLANEOUS PROVISIONS

7.1 There are no intended third-party beneficiaries of this Agreement.

7.2 This Agreement does not create any rights, interests, claims or causes of action at law or in equity for any Party against another Party, or for any non-party against any Party.

7.3 Each person signing this Agreement on behalf of a Party represents that she or he is authorized to sign the Agreement on the Party's behalf.

7.4 This Agreement does not make any Party the agent or representative of any other Party, and this Agreement does not create any partnership or venture between or among the Parties.

7.5 This Agreement may be signed in counterparts by the Parties, and the signed counterparts taken together shall constitute one complete Agreement. A facsimile signature by a Party on a counterpart of this Agreement is as valid as the original signature.

Attachment A: Kilarc-Cow Creek Project Decommissioning Agreement Subjects and Desired Conditions

The Parties have signed this Agreement as of the dates listed below.

U. S. Fish and Wildlife Service

By: ____________________________
Wayne White, Field Supervisor

Dated: ____________________________

California Dept. of Fish and Game

By: ____________________________
Donald B. Koch, Regional Manager

Dated: ____________________________

National Park Service
Pacific West Region

By: ____________________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________________

California State Water
Resources Control Board

By: ____________________________
Victoria A. Whitney, Chief, Div. of Water Rights

Dated: ____________________________

NOAA Fisheries

By: ____________________________
Rodney McInnis, Regional Administrator

Dated: ____________________________

Friends of The River

By: ____________________________
Steve Evans, Conservation Director

Dated: ____________________________

7.2 This Agreement does not create any rights, interests, claims or causes of action at law or in equity for any Party against another Party, or for any non-party against any Party.

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Attachment A: Kilarc-Cow Creek Project Decommissioning Agreement Subjects and Desired Conditions

The Parties have signed this Agreement as of the dates listed below.

U. S. Fish and Wildlife Service

By: Kenneth Sanchez

for Wayne White, Field Supervisor

Dated: 3/4/05

California Dept. of Fish and Game

By: ______________________

Donald B. Koch, Regional Manager

Dated: ______________________

National Park Service
Pacific West Region

By: ______________________

Jonathan B. Jarvis, Regional Director

Dated: ______________________

California State Water
Resources Control Board

By: ______________________

Edward Anton, Chief, Div. of Water Rights

Dated: ______________________

NOAA Fisheries

By: ______________________

Rodney McInnis, Regional Administrator

Dated: ______________________

Friends of The River

By: ______________________

Steve Evans, Conservation Director

Dated: ______________________

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By: ____________________
Wayne White, Field Supervisor

Dated: ____________________

California Dept. of Fish and Game

By: Donald B. Koch [signature]
Donald B. Koch, Regional Manager

Dated: March 1, 2005

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

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Wayne White, Field Supervisor

Dated: ____________________

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: George J. Turnbull
Jonathan B. Jarvis, Regional Director

Dated: 3/16/05

California State Water Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

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Donald B. Koch, Regional Manager

Dated: ______________________

National Park Service
Pacific West Region

By: ______________________
Jonathan B. Jarvis, Regional Director

Dated: ______________________

California State Water Resources Control Board

By: Victoria A. Whitney
Victoria A. Whitney, Chief
Div. of Water Rights

Dated: March 17, 2005

NOAA Fisheries

By: ______________________
Rodney McInnis, Regional Administrator

Dated: ______________________

Friends of The River

By: ______________________
Steve Evans, Conservation Director

Dated: ______________________

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Dated: ____________________

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: Rodney R McInnis
Rodney McInnis, Regional Administrator

Dated: 3-3-05

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

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Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water
Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: [signature]
Steve Evans, Conservation Director

Dated: Feb 25, 2005

Trout Unlimited

By: CMBonham
Chuck Bonham, California Counsel

Dated: 03/03/2005

Pacific Gas and Electric Company

By: ____________________
Gregory M. Rueger
Sr. Vice President Generation and Chief Nuclear Officer

Dated: ____________________

Trout Unlimited

By: ______________________________
Chuck Bonham, California Counsel

Dated: ______________________________

Pacific Gas and Electric Company

By: ______________________________
Gregory M. Rueger
Sr. Vice President Generation and Chief Nuclear Officer

Dated: March 22, 2005

Attachment A

Kilarc-Cow Creek Project Agreement
Subjects and Desired Conditions

Subjects Addressed
Following is a list of subject areas (numbered items) and desired conditions (lettered items) addressed the Decommissioning Alternative Agency and Stakeholder meetings in the context of an Agreement for decommissioning the Kilarc-Cow Creek Project.

1. Cost for Implementing Decommissioning
   a) Costs are known
   b) Economics are favorable (i.e., more favorable than relicensing)
   c) Funds for implementation, monitoring and contingency are identified

2. Disposition of Diversion Structures
   a) Safe, timely, and effective passage up/downstream for fish
   b) Geomorphically stable stream channel above/below/at diversions
   c) Retain as much spawning gravel as possible in active channel during deconstruction activities
   d) Safety issues addressed - public and wildlife

3. Disposition of Canals and Spillways (includes waterways, tunnels and flumes)
   a) Stable drainage of runoff to natural waterways including:
      - Safe, timely, and effective fish passage
      - Maintain good water quality
      - Does not contribute sediment to drainage and streams
   b) Preservation of riparian habitat during/after deconstruction wherever possible
   c) Maintain floodplain connectivity
   d) Safety issues addressed - public and wildlife

4. Disposition of Forebays
   a) Geomorphically stable sediment conditions
   b) Appropriate fish and wildlife rescue/salvage prior to deconstruction activities

5. Disposition of Penstocks
   a) Safety issues addressed - public and wildlife

6. Disposition of Powerhouses (includes switchyards)
   a) Safety issues addressed - public and wildlife
   b) Historical/cultural values preserved
   c) Preserve options for future reuse of structures other than powerhouses

7. Disposition of Water Rights
   a) PG&E appropriative water rights are protected and used to preserve or enhance aquatic resources
   b) Other water right holders rights are preserved
   c) All water rights preserved subject to the law
   d) Water rights are enforceable and permanent
   e) Maintain aquatic habitat values downstream of Hooten Gulch

8. PG&E Lands (as managed by a land trust)
   a) Promote land use consistent with ecological function of streams
   b) Safety issues addressed - public and wildlife

9. Public Recreation Opportunities
   a) Achieve balance between lost recreation opportunities at Kilarc forebay with other recreation opportunities (e.g., fishing and picnicking)
   b) Recreation stream fisheries opportunities enhanced
   c) Public access available to recreational opportunities

10. FERC Approval for Decommissioning
   a) Timely FERC approval of decommissioning alternative consistent with the Agreement

11. CPUC Rate Recovery for Decommissioning
   a) Full and timely rate recovery for decommissioning costs

12. Post Decommissioning Licensee Responsibilities
   a) Decommissioning desired conditions are maintained post-decommissioning for specified time period
   b) Scope and cost of responsibilities are known

13. Permit Approval Process
   a) Timely identification and issuance of required permits
   b) Permit conditions consistent with the Agreement
   c) Environmental benefits of decommissioning outweigh impacts to resources

14. Implementation Schedule
   a) Decommissioning schedule is approved with clearly defined timeframe

15. Roads and Access Routes
   a) Best management practices for retiring roads where possible to minimize sediment

16. Protection of Special Status Species
   a) Compliance with California Endangered Species Act and Endangered Species Act

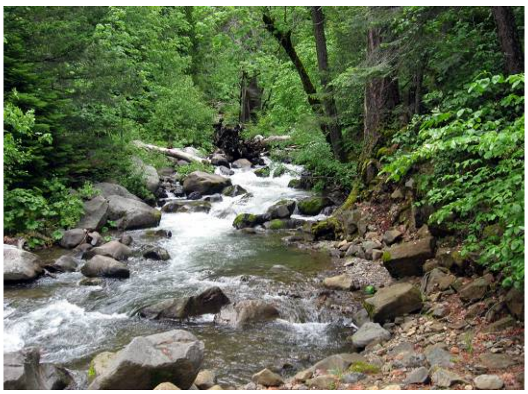
17. Deconstruction Activities
  a) Current water right holders continue to receive their water
  b) Where practicable, no net loss in the health of riparian and aquatic habitat areas as a result of deconstruction activities
  c) Allows natural revegetation
  d) Timing of decommissioning activities are scheduled to avoid adverse effects on fish/wildlife
  e) Minimal water quality impairment during deconstruction and immediately thereafter including turbidity, settleable solids, suspended solids
  f) Appropriate fish and wildlife rescue/salvage prior to deconstruction activities

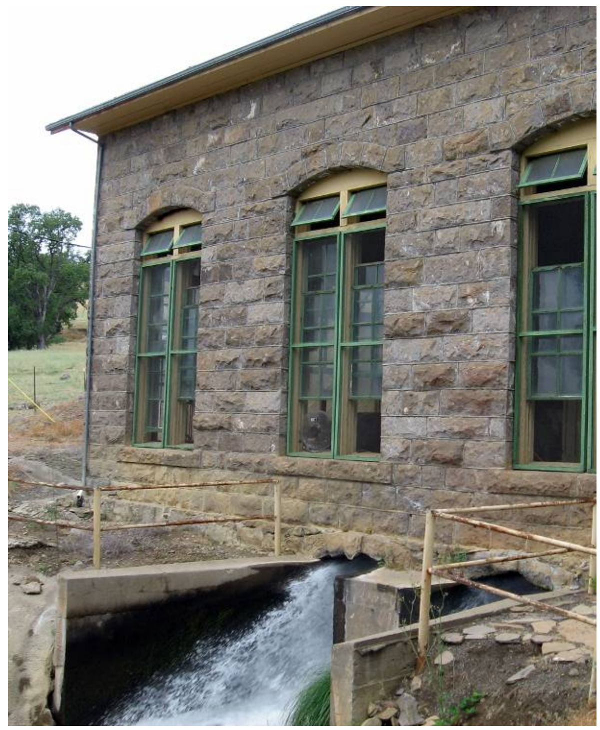
B-2

Proposed Decommissioning Plan

PACIFIC GAS AND ELECTRIC COMPANY

Kilarc-Cow Creek Hydroelectric Project
FERC Project No. 606





Proposed Decommissioning Plan

PACIFIC GAS AND ELECTRIC COMPANY

Kilarc-Cow Creek Hydroelectric Project

FERC Project No. 606

PROPOSED DECOMMISSIONING PLAN

KILARC-COW CREEK HYDROELECTRIC PROJECT
FERC PROJECT NO. 606

PROPOSED DECOMMISSIONING PLAN

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Attachments

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Section 1.0 Introduction

Pacific Gas and Electric Company (PG&E), the Licensee for the Kilarc-Cow Creek Hydroelectric Project, FERC No. 606 (Project), is applying to the Federal Energy Regulatory Commission (FERC) to surrender the license for the Project. As part of the surrender process, PG&E proposes to decommission and generally remove the Project facilities as described in this Proposed Decommissioning Plan (PDP).

The Project is located in Shasta County, California, approximately 30 miles east of the city of Redding, near the community of Whitmore. The Project consists of two developments constructed between 1904 and 1907: the Kilarc Development on Old Cow Creek (Figure 1-1) and the Cow Creek Development on South Cow Creek (Figure 1-2). Old Cow Creek and South Cow Creek are part of the Cow Creek Watershed. Old Cow Creek is a tributary to South Cow Creek and South Cow Creek is a tributary Cow Creek. Cow Creek drains to the Sacramento River. The Project comprises several small diversion dams, approximately 7 miles of water conveyance facilities, and two powerhouses with a total installed capacity of 5 megawatts (MW) with approximately 70 percent of that installed capacity attributable to the Kilarc Development. The Kilarc Development diverts water from North and South Canyon Creeks and Old Cow Creek. The Cow Creek Development diverts water from Mill Creek and South Cow Creek. The water is diverted for generating power through a canal system to the Kilarc and Cow Creek forebays, where penstocks direct the water to the powerhouses (Figure 1-3).

The current license for the Project was issued by FERC on February 8, 1980, with an effective date of February 1, 1980 and an expiration date of March 27, 2007. PG&E initially sought a new license for the Project, filing with FERC in 2002 a Notice of Intent (NOI) to relicense the Project. However, after performing initial relicensing studies and consulting with resource agencies and other interested parties, PG&E ultimately concluded that the likely cost of providing the necessary level of protection, mitigation and enhancement measures for the resources affected by the Project will outweigh the economic benefit of generation at the Project over the life of a new license, and will result in the Project no longer being an economic source of power for PG&E's electric customers. Consequently, in March 2005, PG&E entered into the Kilarc-Cow Creek Project Agreement (Agreement) signed by eight resource agencies and Interested Parties (Attachment 1). Pursuant to the Agreement, PG&E agreed, among other things, not to file an application for a new license by the statutory deadline of March 27, 2005, and instead agreed to support decommissioning of the Project. In exchange, the other signatories agreed to support a scope of decommissioning which will address specified subjects, but provide PG&E flexibility to address these subjects in the most cost effective manner (e.g. the subject of fish passage may be addressed by breaching Project diversion dams rather than completing removing them).

Once the statutory deadline passed for PG&E to file an application for new license, FERC issued a public notice on March 7, 2005 inviting other entities to file NOIs to seek a new license for the Project. One entity did so: Synergics Energy Development, Inc. (Synergics) filed an NOI on June 7, 2005. Synergics, however, failed to file an application for new license by the December

27, 2006 deadline established by FERC, and FERC denied Synergics' request to extend the deadline.

After Synergics failed to timely file an application for new license for the Project, PG&E, as directed by FERC, began the process of preparing a License Surrender Application (LSA) for the Project.

PG&E held local public meetings in March, May, September, and November of 2007 to explain its decision not to seek a new license for the Project, to explain the license surrender process, and to seek public input regarding Project decommissioning. Notices for the meetings were placed in the local newspapers and letters were sent to resource agencies, local governments, Indian tribes, non-governmental organizations, members of the public, and other groups likely to be interested in the license surrender proceedings (Interested Parties). During the meetings, PG&E solicited comments from the Interested Parties to assist it in identifying issues with decommissioning. PG&E also hosted a public site visit of the Project facilities in June 2007.

PG&E used the comments received from Interested Parties, the general principles contained in the Agreement, and environmental, cultural, and recreational resource information collected during the initial phase of PG&E's relicensing process, to develop a Preliminary Proposed Decommissioning Plan (PPDP). PG&E presented the PPDP at a public meeting on September 12 and 13, 2007, followed by a 30-day public comment period through October 12, 2007. PG&E reviewed the comments and held public and agency meetings on November 7 and 8, 2007 to discuss the scope of decommissioning and the resource issues to be addressed in the LSA. Based on these meetings, PG&E finalized the scope for additional resource studies and for a Draft LSA (DLSA). Additional studies considered necessary to ensure that environmental resources are adequately protected during deconstruction activities were performed in spring and summer 2008.

Study results and a revised PDP were included in the DLSA, which was issued on September 4, 2008 and distributed to all Interested Parties. Public meetings were held on September 9 and 10, 2008 in Redding and Palo Cedro, California to provide the public an opportunity to comment on the document. The meeting on September 9 also started a 60-day comment period that ended on November 8, 2008. PG&E collected public and agency comments and incorporated them into the final PDP and Final LSA.

In summary, the PDP is based on consultation with Interested Parties, including resource agencies and affected landowners; the results of resource studies; and oral and written comments received during public meetings and the comment periods for the PPDP and the DLSA. PG&E developed its decommissioning plan with two main objectives: 1) achieving specific "Desired Conditions" once decommissioning is complete, as identified in the Agreement; and 2) addressing potential resource issues associated with decommissioning the Project. Specific decommissioning actions were developed in consultation with affected landowners.

The PDP is intended to be accompanied by the protection, mitigation and enhancement (PM&E) measures described in Exhibit E, Environmental Report. While the PM&E measures are oriented towards environmental and cultural resources, the PDP describes the detailed decommissioning of Project facilities.

Other alternatives considered for decommissioning Project facilities ranged from abandoning facilities in place to removing all facilities.[1] It was determined that these alternatives did not adequately address potential resource issues. For instance, abandoning the diversions in place will not allow fish passage, and removing all facilities could increase erosion at the diversion dam abutments.

The PDP is organized as follows:

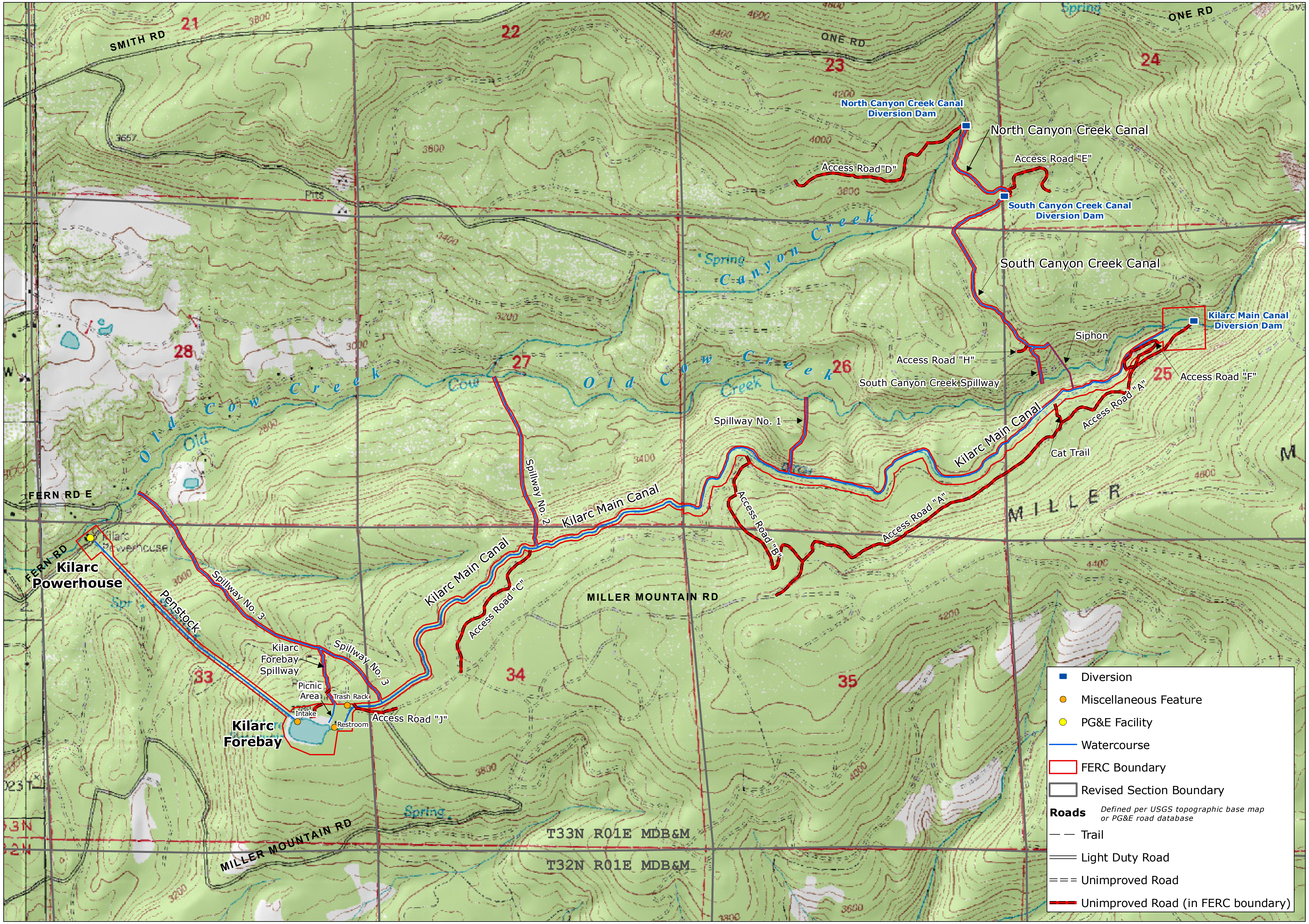
- **Section 1 – Introduction.** This section provides background information on the Project and events to date related to the decommissioning process.
- **Section 2 – Decommissioning Proposal.** This section describes the Project features and proposed decommissioning actions for each feature. The section also provides information on potential environmental effects associated with decommissioning activities and the final disposition of the facilities upon decommissioning.

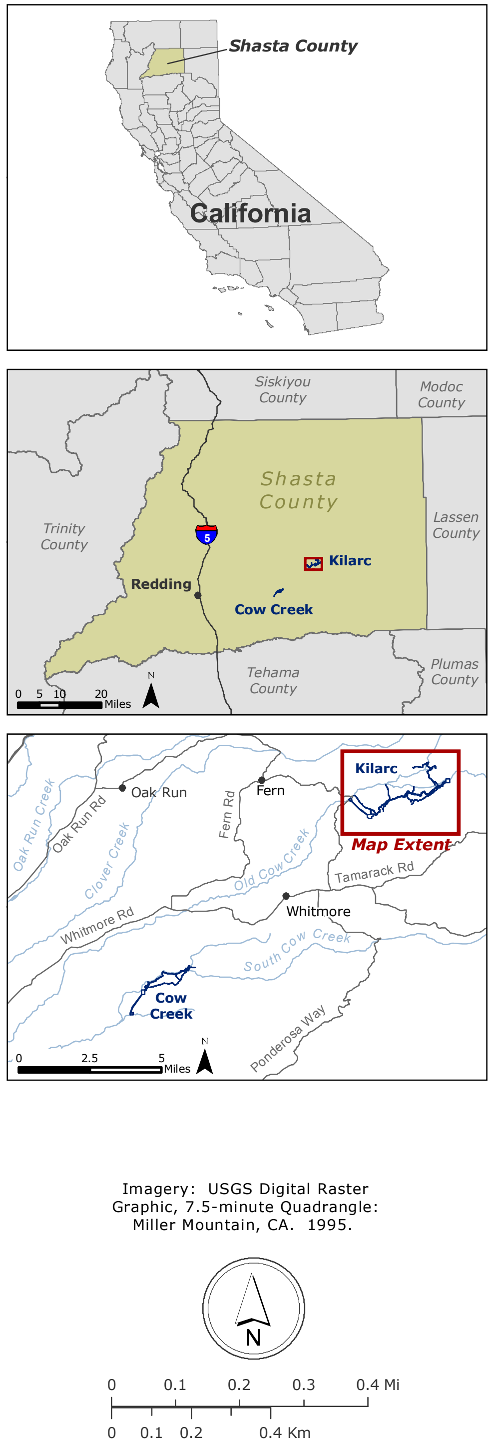
Other sections previously included in the Preliminary PDP have been superseded by the LSA.

- **Section 3 – Measures Addressing Potential Resource Issues.** This section identified potential resources that might be affected by decommissioning and proposed measures to protect them. These resources are described in LSA Exhibit E.2; Affected Environment. Potential impacts to these resources are addressed in Exhibit E.3, Project Impacts; and measures to protect, mitigate, or enhance the resources are described in Exhibit E.4, Protection, Mitigation, and Enhancement Measures.
- **Section 4 – Decommissioning Costs.** This section presented the preliminary estimated cost to decommission Project facilities. Costs are addressed in LSA Exhibit D.
- **Section 5 – Water Rights.** This section discussed PG&E's water rights and their disposition upon decommissioning. This information is updated in Exhibit E (hydrology and water resources).
- **Section 6 – Land Rights and Landownership.** This section described PG&E's land rights and landownership for operation and maintenance of the Project and their disposition following decommissioning. This information is updated in Exhibit E (land use).

[1] On September 17, 2007 and August 1, 2008, Davis Hydro filed with FERC what PG&E understands to be two proposals for the continued operation of the Project facilities. The Federal Power Act and FERC regulations preclude PG&E from obtaining a new license to operate the Project since PG&E declined to file an application for a new license. 16 U.S.C. Section 808; 18 C.F.R. Section 16.24**.** In addition, the Federal Power Act and FERC regulations preclude a third party, like Davis Hydro, from assuming operations of Project facilities from PG&E for power generation where that third party missed applicable deadlines for submitting a license application. 16 U.S.C. Section 808; 18 C.F.R. Section 16.25. Therefore, PG&E did not consider any alternatives for continued operations in the development of the PDP.

- **Section 7 – License Surrender Application Schedule.** This section outlines the LSA process and provides a schedule for the process. The schedule is presented in LSA Exhibit C.





Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure 1-1
Features of the Kilarc Development

Pacific Gas and Electric Company

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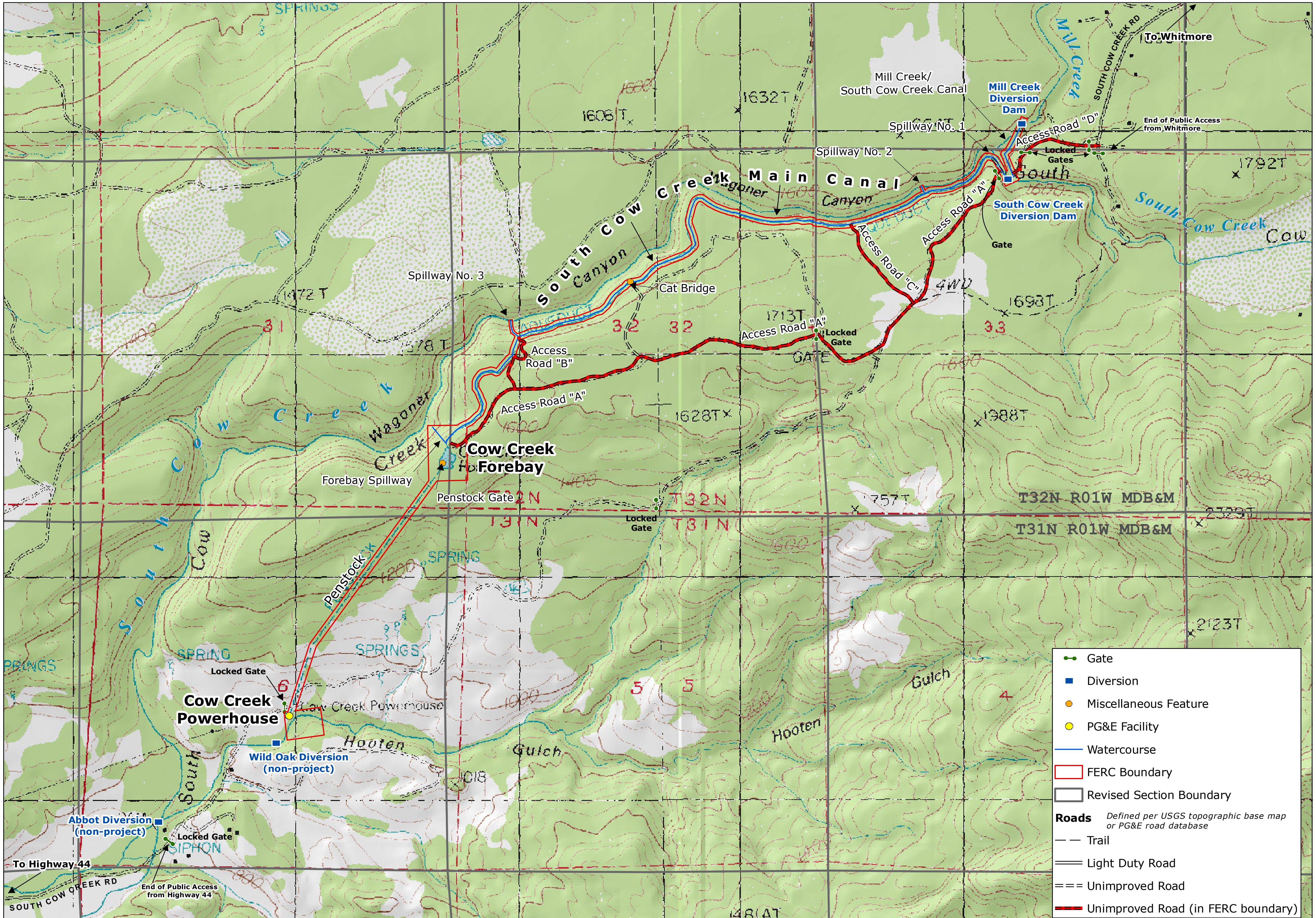

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangles: Clough Gulch, CA. 1985. Inwood, CA. 1985.

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Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure 1-2
Features of the
Cow Creek Development

Pacific Gas and Electric Company

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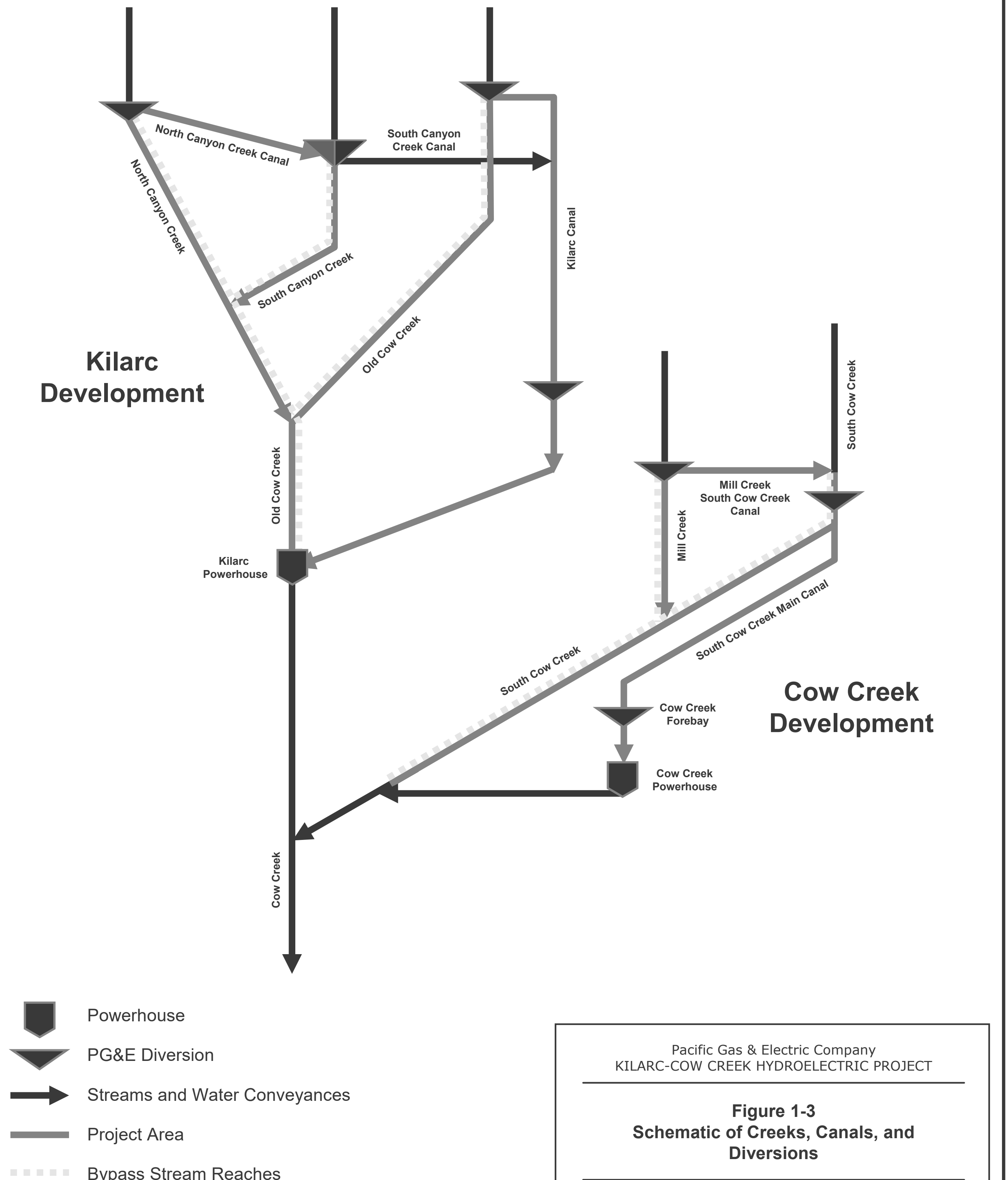

Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure 1-3
Schematic of Creeks, Canals, and Diversions

Pacific Gas and Electric Company®

Section 2.0 Decommissioning Proposal

This section presents PG&E's decommissioning proposal by Project feature. The Kilarc and Cow Creek developments are presented separately since they are independent developments located in different subwatersheds. The Kilarc Development, located in the Old Cow Creek subwatershed, is described first followed by the Cow Creek Development located in the South Cow Creek subwatershed. PG&E will obtain all federal, state, and local permits required to decommission the Project.

2.1 Desired Conditions and Potential Resource Issues

PG&E developed its PDP with two main objectives: 1) achieve specific "Desired Conditions"[2] once decommissioning is complete, as identified in the Agreement; and 2) address potential resource issues associated with decommissioning the Project.

Attachment 1 to the Agreement contains a list of subjects to be addressed through the decommissioning process, for example, the disposition of canals. For each of these subjects, the Agreement lists "Desired Conditions" to be achieved during the Project, such as stable drainage of runoff. Desired Conditions are intended to help frame how the subjects will ultimately addressed, while leaving PG&E flexibility to do so in the most cost-effective manner. As noted, PG&E considered these Desired Conditions in developing its PDP for the Project features. PG&E also identified potential resource issues associated with decommissioning Project features and attempted to address those issues in its PDP. The Desired Conditions are discussed below by Project feature, and the potential resources issues are described in Exhibit E of the LSA.

- **Diversion Structures.** With respect to the disposition of diversion structures, PG&E considered the following Desired Conditions: (1) safe, timely, and effective fish passage both upstream and downstream of the diversion; (2) a geomorphically stable stream channel above, below, and at the diversions; (3) retention of as much spawning gravel as possible in active channels during deconstruction activities; and (4) safety issues for both the public and wildlife.
- **Canals and Spillways.** With respect to the disposition of canals and spillways (including waterways, tunnels, and flumes), PG&E considered the following Desired Conditions: (1) stable drainage of runoff to natural waterways, including safe, timely and effective fish passage; maintaining good water quality; and preventing contributions of sediment to drainages and streams; (2) preservation of riparian habitat during and after deconstruction wherever possible; (3) maintaining floodplain connectivity; and (4) addressing safety issues for both the public and wildlife.

[2] Under NEPA, refers to the social, economic, and ecological attributes toward which management of the land and resources of a plan area are to be directed.

- **Forebays.** PG&E considered the following Desired Conditions: (1) maintain geomorphically stable sediment conditions; and (2) conduct appropriate fish and wildlife rescue and/or salvage prior to deconstruction activities.[3]
- **Penstocks.** PG&E considered the following Desired Condition: address safety issues for both the public and wildlife.
- **Powerhouses.** PG&E considered the following Desired Conditions: (1) address safety issues for both the public and wildlife; (2) preserve historical and/or cultural values; and (3) preserve options for future reuse of structures.
- **Access Roads**. PG&E considered the following Desired Condition: best management practices for retiring roads where possible to minimize sediment.
- **Deconstruction Activities.** With respect to general decommissioning activities, PG&E considered the following Desired Conditions (1) where practicable, prevent net loss in the health of riparian and aquatic habitat areas; (2) allow for natural revegetation; (3) schedule decommissioning activities to avoid adverse effects on fish and wildlife; (4) ensure minimal water quality impairment during deconstruction and immediately thereafter, including minimizing turbidity and deposition of settleable and suspended solids; and (5) conduct appropriate fish and wildlife rescue and/or salvage prior to deconstruction activities.

2.2 Kilarc Development Decommissioning Proposal

The Old Cow Creek subwatershed encompasses approximately 80 square-miles, including 25 square-miles located upstream from the Kilarc Main Canal Diversion Dam. The average yearly runoff at the dam is 48,900 acre-feet; on average, approximately 55 percent of the annual runoff is diverted from the stream to the Kilarc Powerhouse. The estimated dependable generating capacity of the Kilarc development is approximately 1.2 MW, and the estimated average annual energy generated is 19.1 million kilowatt-hours. Features of the Kilarc Development are illustrated in Figure 1-1.

Kilarc Development features include:

- North Canyon Creek Diversion Dam and Canal
- South Canyon Creek Diversion Dam and Canal
- South Canyon Creek Siphon
- Kilarc Main Canal Diversion Dam and Kilarc Main Canal (including tunnel, elevated flumes, and spillways)
- Kilarc Forebay and Forebay Dam

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[3] Recreational resources were also considered by PG&E in assessing potential impacts.

- Kilarc Penstock
- Kilarc Powerhouse
- Kilarc access roads (see Section 2.4)

The North Canyon Creek Canal diverts water from North Canyon Creek to South Canyon Creek. Water from South Canyon Creek is diverted to South Canyon Creek Canal, which enters Canyon Creek Siphon and then the Kilarc Main Canal. Water from Old Cow Creek is also diverted to the Kilarc Main Canal, which flows to Kilarc Forebay. From Kilarc Forebay, water flows through the penstock to Kilarc Powerhouse; near the powerhouse, the water is returned to Old Cow Creek.

2.2.1 North Canyon Creek Diversion and Canal

Photograph 2.2.1-1a North Canyon Creek – Diversion

Photograph 2.2.1-1b North Canyon Creek – Wooden Structure to be Removed

Photograph 2.2.1-1c North Canyon Creek – Canal

Description

Water is diverted from North Canyon Creek into the North Canyon Creek Canal at the North Canyon Creek Diversion Dam. The dam is a timber structure, 9.9 feet in length, 1 foot in height, with a crest elevation of 3,939.5 feet above mean sea level (MSL).

The canal is unlined, 3 feet in width by 1.5 feet in depth, and has a total length of 0.35 mile, with a capacity of 2.5 cubic feet per second (cfs) and an average grade of 0.0021 percent. The canal delivers water to a point just upstream of the South Canyon Creek Diversion Dam.

Proposal for Decommissioning

Diversion Dam

- Remove wooden stream bank supports and bottom boards.
- The small wooden structure will remain in place to minimize site disturbance caused by difficult access.

Canal

- Two options are proposed for decommissioning the earthen canal depending on accessibility to the canal section: abandoning in-place (for limited accessibility) and filling the canal (for full accessibility). If abandoned in-place, the canal will be strategically breached to address storm runoff and avoid potential erosion/sediment issues. Filling the canal will entail excavating one-half of the height of the canal berm and using the excavated materials as fill (the canal is constructed of native material and has no lining). If filled, the surface will be graded to drain rainwater and snowmelt; erosion control measures will be implemented consistent with Best Management Practices (BMPs) and Project-specific PM&E measures will be implemented.

2.2.2 South Canyon Creek Diversion and Canal

Photograph 2.2.2-1a South Canyon Creek – Diversion and Canal Inlet

Photograph 2.2.2-1b South Canyon Creek – Canal Flumes

Photograph 2.2.2-1c South Canyon Creek – Canal and Spillway

Photograph 2.2.2-1d South Canyon Creek – Canal Siphon Inlet

Photograph 2.2.2-1e South Canyon Creek – Canal Siphon Release To Kilarc Main Canal

Description

Water is diverted from South Canyon Creek into the South Canyon Creek Canal at the South Canyon Creek Diversion Dam. The dam is a concrete structure, 37.8 feet in length and 3 feet in height, with a crest elevation of 3,893.6 feet above MSL.

The canal has a total length of 0.74 mile with a capacity of 7.5 cfs and an average grade of 0.0021 percent. The conduit consists of 0.71 mile of unlined canal, 4 feet wide by 2 feet deep, and 0.03 mile of flume, 2 feet wide by 1.8 feet deep.

Water from the canal flows into the Canyon Creek Siphon. The siphon consists of a 0.17-mile, 12-inch diameter pipe, which then coveys the water into the Kilarc Main Canal.

Proposal for Decommissioning:

Diversion Dam

- Remove diversion walls to natural ground or streambed level, gate, operating mechanism, and all segments. Concrete will be removed from site with mechanical components.

Flume

- Remove wooden and corrugated metal pipe structures. Concrete foundations will be left in place.

Canal

- Two options are proposed for decommissioning the earthen canal depending on accessibility to the canal section: abandoning in-place (for limited accessibility) and filling the canal by excavating one-half of the height of the canal berm and using the excavated materials as fill (for full accessibility; the canal is constructed of native material and has no lining). If abandoned in-place, the canal will be strategically breached to address storm runoff and avoid potential erosion/sediment issues. If filled, the surface will be graded to drain rainwater and appropriate erosion controls will be implemented. The concrete spillway and concrete gate slots will be removed and backfilled with excavated berm material.

Siphon

- Remove trash bars and concrete wing walls, collapse a rubble wall and bury it with excavated berm material.
- Remove all above-grade pipe and install concrete block wall at the vertical intake. Buried portions of the siphon will be capped and abandoned in place.

2.2.3 Kilarc Diversion Dam

Photograph 2.2.3-1a Kilarc Diversion Dam (View from Upstream Side of Gate)

Photograph 2.2.3-1b Kilarc Main Canal Intake (View from Downstream Side of Gate)

Photograph 2.2.3-1c Kilarc Main Canal – Diversion Dam

Description

Water is diverted from Old Cow Creek into the Kilarc Main Canal at the Kilarc Main Canal Diversion Dam. The dam is a concrete structure, 83 feet in length, 8 feet in height, with a crest elevation of 3,814 feet above MSL.

Proposal for Disposition

- Remove the structures, guide walls, diversion gate and frame, gate operator, and debris from the site.
- A temporary cofferdam or diversion may be required.
- The diversion dam appears to be constructed on natural bedrock. The concrete portion that was added to construct the diversion will be removed.

2.2.4 Kilarc Main Canal

Photograph 2.2.4-1a Kilarc Main Canal – Concrete Section

Photograph 2.2.4-1b Kilarc Main Canal – Shotcrete-Lined Section

Photograph 2.2.4-1c Kilarc Main Canal – Wooden Flume

Photograph 2.2.4-1d Kilarc Main Canal – Steel Flume

Photograph 2.2.4-1e Kilarc Main Canal – Tunnel

Photograph 2.2.4-1f Kilarc Main Canal – Earthen Section

Description

The Kilarc Main Canal has a total length of 3.65 miles with a capacity of 52 cfs and an average grade of 0.0021 percent. The conveyance system consists of 2.03 miles of canal, 1.44 miles of metal and wood flume, and 0.18 mile of a 6-foot by 7-foot wood-lined tunnel.

Proposal for Disposition

- For the earthen canal sections, two options are proposed for decommissioning depending on accessibility to the canal section: abandoning in-place (for limited accessibility) and filling the canal (for full accessibility). A canal will be filled by excavating one-half of the height of the canal berm and using the excavated materials as fill (the canal is constructed of native material and has no lining). If filled, the surface will be graded to drain rainwater and appropriate erosion controls will be implemented. If abandoned in-place, the canal will be strategically breached to address storm runoff and avoid potential erosion/sediment issues.
- For the concrete and shotcrete-lined canal sections, several options are available for decommissioning depending on accessibility to the canal section. If the canal is easily accessible for heavy equipment, the concrete walls and bottom will be broken up and

pushed into the canal bottom. If there is little to no accessibility for heavy equipment to the canal section, the canal will be abandoned in-place. Abandoned-in-place sections will be strategically breached to address storm runoff and avoid potential erosion/sediment issues. Concrete sections with the downhill wall exposed may be hand cut, broken along the bottom edge, and pushed into the canal bottom. If excess native material is readily available, the canal will be filled with excavated berm material and graded, and erosion control measures will be implemented. Final disposition of sections not accessible by construction equipment will be determined on a case-by-case basis and the practicality of hand removal options will be considered.

- The flumes will be removed to their foundations, anchor bolts will be saw cut or ground flush, and foundation piers will be left in place.
- Mechanical equipment, a shed, and concrete sections, including foundations to grade, will be removed, grading will be conducted, and rip-rap will be installed, if required.
- Broken concrete will be used for rip-rap, if required, where removal of a structure damages the slope.
- Gates, frames, gate operators, support structures, the catwalk, guidewalls and any foundations to grade will be removed.
- The overflow spillway will be demolished, filled and graded, and appropriate erosion control measures will be implemented.
- The thermal electric generator and building will be removed along with slab or foundation concrete.

2.2.5 Kilarc Forebay

Photograph 2.2.5-1a Kilarc Forebay

Photograph 2.2.5-1b Kilarc Forebay – Intake

Photograph 2.2.5-1c Overflow Spillway

Photograph 2.2.5-1d Kilarc Forebay – Outlet Structure to Penstock

Photograph 2.2.5-1e Kilarc Picnic Area

Description

The dam at Kilarc Forebay is earth-filled and has a maximum height of 13 feet, a maximum base width of 43 feet, and a crest length of 1,419 feet at 3,782.4 above MSL. The spillway is 10 feet wide, 3 feet deep, and has a rated capacity of 50 cfs with 1.6 feet of freeboard. The intake structure has a 48-inch slide gate, with a manual lift, protected by a trash rack, over the opening to the Kilarc Penstock.

Kilarc Forebay has a surface area of 4.5 acres and a gross and usable storage capacity of 30.4 acre-feet at an elevation of 3,782.4 feet above MSL. Water surface elevation varies by approximately 1 foot during normal operations.

Proposal for Disposition

- The intake trash rake, telemetry, and electrical equipment will be removed; fencing and structures will be demolished and removed, along with any concrete foundations to grade; and the culvert will be backfilled when the canal is backfilled.
- The forebay will be filled with excavated bank material, graded for drainage, and seeded with appropriate seed mix; appropriate erosion control measures will be implemented in accordance with proposed PM&E measures.
- The overflow spillway will be demolished, filled, and graded (as part of reservoir fill work), and appropriate erosion control measures will be implemented.
- The bridge and platform will be disassembled and removed, control equipment will be removed, and the shaft will be cut off at the bottom of the reservoir. Concrete supports,

if any, will be left in the reservoir bottom and covered by fill during reservoir backfilling operations.

- The picnic tables and site furnishings will be removed. The restroom buildings and slabs will be demolished and removed. The toilet vaults will be pumped, backfilled and abandoned in-place.

2.2.6 Kilarc Penstock – Penstock

Photograph 2.2.6-1 Kilarc Penstock

Description

The Kilarc Penstock is a 4,801-foot-long buried pipe made of riveted steel with a diameter that varies from 48 to 36 inches; plate thickness varies from 0.19 inches to 0.25 inches. The maximum flow capacity is 43 cfs.

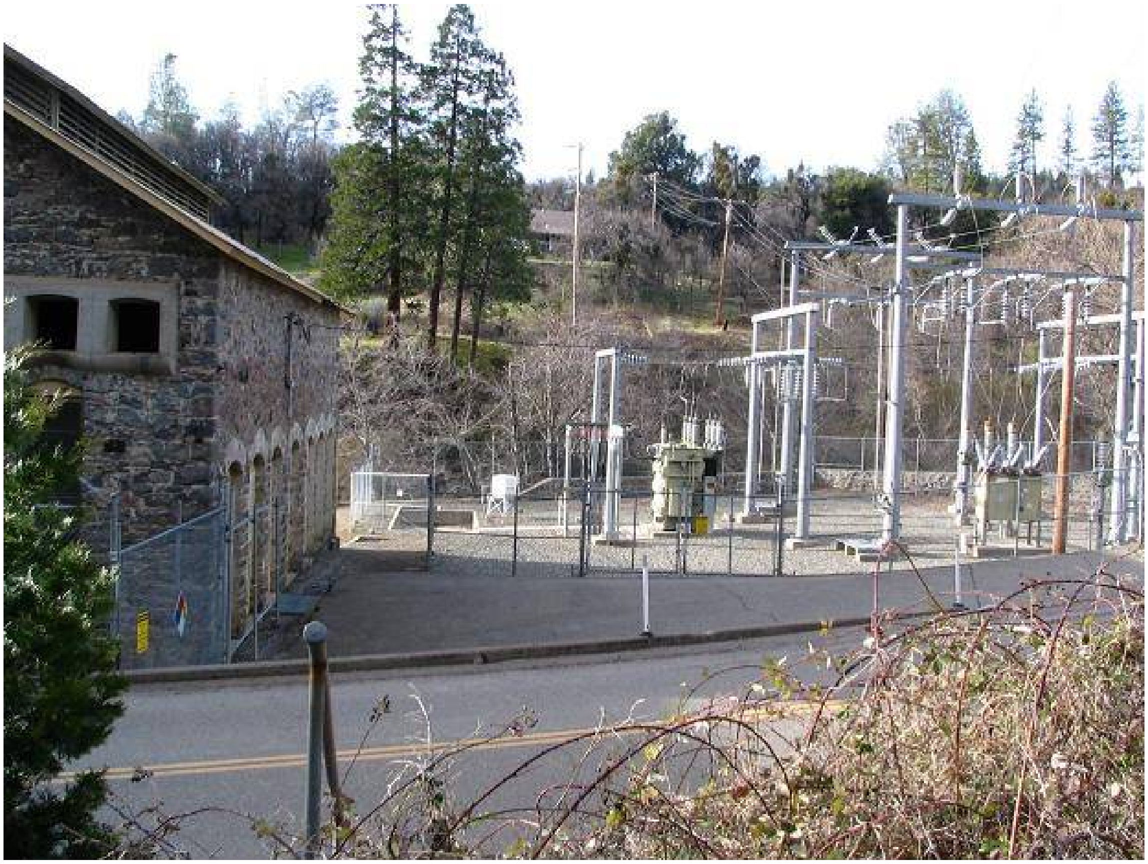
Proposal for Disposition

- The upper and lower ends of the penstock will be plugged with concrete and graded to cover the exposed section at the surge tower. Because removal of the buried pipe will cause significant site disturbance at a significant cost, the buried pipe will be left in place.

- The surge tower will be cut off and removed; the opening will be covered with a welded steel plate.

2.2.7 Kilarc Powerhouse and Switchyard

Photograph 2.2.7-1a Kilarc Powerhouse



Photograph 2.2.7-1b Kilarc Switchyard

Description

The Kilarc Powerhouse is a 65-foot by 40-foot steel frame structure (plan dimensions), composed of rubble masonry walls and a corrugated iron roof. The powerhouse contains two turbines and generators and other electrical mechanical equipment.

The Kilarc Switchyard includes an oil-immersed, outdoor type transformer. PG&E's interconnected transmission system passes through the powerhouse switchyard via a 7-foot-long, 60 kilovolt amperes transmission line tap, which will remain in-place.

Proposal for Disposition

- Turbines, generators and all associated electrical and mechanical equipment associated with the powerhouse will be removed and the structure will be abandoned in place.
- Turbine pits (located inside the Powerhouse structure) will be filled with mass concrete or other suitable fill material and capped with concrete to be flush with the surrounding floor.
- All exterior openings in the Powerhouse structure will be sealed in a manner dependent on their use. Draft tube openings will be sealed with formed concrete plugs;

penetrations for electrical connections will be sealed with foam type filler or plywood, depending on size; windows will be left in place but covered with plywood cut to match the opening and doors and windows will be closed and locked but not permanently sealed. The tailrace will be backfilled to the confluence using local earth materials.

- Powerhouse structure will be secured (in accordance with PM&E measures) and left in place during decommissioning; an option for future reuse of the structure will be preserved. The switchyard will be left in place as it is an integral part of the PG&E inter-connected transmission system.

2.3 Cow Creek Development Decommissioning Proposal

The South Cow Creek Watershed encompasses approximately 78 square-miles, including 53 square-miles located upstream from the South Cow Creek Diversion Dam. The average annual runoff at the dam is 79,500 acre-feet; on average, approximately 37 percent of the annual runoff is diverted to Cow Creek Powerhouse. The estimated dependable generating capacity of the Cow Creek Development is approximately 400 kilowatts, and the estimated average annual energy generated is 12 million kilowatt hours.

The Cow Creek Development features include:

- Mill Creek Diversion Dam
- Mill Creek-South Cow Creek Canal
- South Cow Creek Diversion Dam and Appurtenant Structures
- South Cow Creek Main Canal (including tunnel and spillways)
- Cow Creek Forebay Dam and Forebay
- Cow Creek Penstock
- Cow Creek Powerhouse
- Cow Creek Access Roads (see Section 2.4)

The Mill Creek Diversion Dam is located about 0.1 mile upstream of Mill Creek's natural confluence with South Cow Creek and diverts water from Mill Creek via the Mill Creek–South Cow Creek Canal to South Cow Creek. From South Cow Creek, the water is diverted to the South Cow Creek Main Canal and into Cow Creek Forebay. From Cow Creek Forebay, the water flows through a penstock to Cow Creek Powerhouse. The water is then discharged from the powerhouse to Hooten Gulch where it flows approximately 0.5 mile to South Cow Creek.

2.3.1 Mill Creek Diversion – Dam and Canal Intake

Photograph 2.3.1-1 Mill Creek Diversion – Dam and Canal Intake

Description

Water is diverted from Mill Creek into the Mill Creek-South Cow Creek Canal at the Mill Creek Diversion Dam. The dam is a concrete structure, 40.3 feet in length, 2.5 feet in height, with a crest elevation of 1,575.8 feet above MSL.

Proposal for Disposition

- Demolition and removal of gate and supporting structure from the site. Concrete from the dam and guide walls will be buried in the canal.
- Demolition may require construction of a temporary channel diversion.
- A temporary cofferdam may be required.

2.3.2 Mill Creek-South Cow Creek Canal

Photograph 2.3.2-1 South Cow Creek Canal

Description

The Mill Creek-South Cow Creek Canal is unlined, with a 5-foot-long by 3.3-foot-deep cross section, and has a total length of 0.17 mile, a capacity of 10 cfs and an average grade of 0.0021 percent.

Proposal for Disposition

- Abandon the canal and fill with excavated dam material, where reasonably feasible, to minimize environmental disturbance of the berm. This is the preferred alternative of the private landowner on whose property the canal is located. Strategic breaching will also be implemented to prevent retention of runoff water, where necessary.

2.3.3 South Cow Creek Diversion Dam and Appurtenant Structures

Photograph 2.3.3-1a South Cow Creek Diversion Dam

Photograph 2.3.3-1b South Cow Creek Diversion – Intake Structure and Fish Ladder

Photograph 2.3.3-1c South Cow Creek Diversion – Fish Screen Detail

Description

Water is diverted from South Cow Creek into the South Cow Creek Main Canal at the South Cow Creek Diversion Dam. The dam is a concrete capped steel bin wall and rock fill dam, 86.5 feet long, 12.3 feet wide, and 8.5 feet high with a crest elevation of 1,557.9 feet above MSL, built on top of independent upstream and downstream concrete cutoff walls (foundation footers) that are embedded in the stream bed. Water diverted by the dam passes through a concrete intake structure, with a trash rack and control gate, into a transition section. In the transition section, water is split between the South Cow Creek Canal and the South Cow Creek Fish Ladder. Water going to the fish ladder passes through a control gate and down the ladder; water going to the canal passes through a fish screen and then a control gate before entering the canal.

Proposal for Disposition

- Dam removal will include removing the concrete cap, removing fill, and removing the bin walls and interior baffles.
- A temporary cofferdam/diversion will likely be required.
- Some abutments and foundation structures, connecting to the steep side slopes and below the channel bed, will be left in place to minimize potential future erosion and disturbance to the slopes. These structures include the two parallel cutoff walls beneath the bin-wall dam structure and the retaining walls on both slopes. Retention of the cutoff walls will provide bed grade control after the dam is removed. A portion of the north bank retaining wall will be left in place, with fill behind the wall graded to match the existing slope. Retention of the wall will provide erosion protection and address bank stability. A portion of the south bank retaining wall adjacent to the intake will also

be left in place to avoid destabilizing the steep bank behind and above it. All other structures and equipment will be removed (e.g., electrical, mechanical devices, gates, screens, exposed rebar, rakes, metal cables, crib dam sheet metal panels, tie bars and drainage pipes). Where feasible, it is acceptable to the private landowner if structures at or below ground level are left in place so long as they are graded over with sediment fill or fill from elsewhere.

- Equipment access will minimize environmental damage to the surrounding vicinity. More detail about road access to these structures is provided in Section 2.4.
- The broken concrete from the dam and ancillary structure removal will be placed in the first reaches of the main canal and graded over with fill from the canal banks or with sediment from behind the dam if the sediment is not needed or not suitable for stream restoration.
- To allow recruitment of native material stored behind the dam to downstream reaches, sediment from behind the dam, composed mostly of gravel and cobble, will be distributed along stream margins, taking care to not affect riparian vegetation.
- Nonnative material, which may be removed from between the bin walls, may be used for backfill in canals. This nonnative material will not be placed in or along the margins of the stream.

2.3.4 South Cow Creek Canal and Tunnel

Photograph 2.3.4-1a South Cow Creek Canal

Photograph 2.3.4-1b South Cow Creek Tunnel

Photograph 2.3.4-1c South Cow Creek Canal-Earthen Section

Photograph 2.3.4-1d South Cow Creek-Shotcrete Section

Description

The South Cow Creek Canal, including the tunnel, has a total length of 2.06 miles with a capacity of 50 cfs and an average grade of 0.0015 percent. The canal section consists of 2.02 miles of 13-foot by 4.8-foot deep canal. Approximately the first 0.12 mile of the canal is lined with shotcrete and approximately 1.9 miles are unlined. The tunnel is about 200 feet long and is 6 feet by 6.8 feet tall. Two additional subfeatures are located along the canal: a Cross-over flume and a Cat Bridge. There is limited elevation and watershed drainage above the canal with a significant percentage of that seasonal runoff crossing the canal on a single Cross-over flume.

Proposal for Disposition

- Abandoning the canals in place, with strategic breaching, is the preferred alternative of the private landowners on whose property the canal is located. For the earthen section of the canal, strategic breaching will address storm runoff and avoid potential erosion/sediment issues. The short, shotcrete-lined canal segment, from the diversion structure to the bridge, will have the shotcrete removed and placed in the bottom of the canal. The canal segment will then be filled with material from the berm, burying the shotcrete
- The Cross-over flume is a metal structure that can be easily removed. Given the minimal amount of runoff from uphill sources and the difficulty of maintaining the structure after abandonment, the recommendation is to remove the flume. Removal can be done primarily through unbolting or cutting metal connections. Foundations will be left in place to avoid disturbance to the steep slopes.

- The Cat Bridge is a substantial structure tied into the walls of the canal. Given the landowners' preference for abandoning the canal in place, the bridge will also be abandoned to allow access across the dry canal.
- Tunnel work includes plugging the upstream and downstream ends of the tunnel with concrete and abandoning the tunnel in place.
- Spillways (2 or 3) will be modified such that spill height elevation is the same as the canal bottom.
- Detail about road access to these structures is provided in Section 2.4.

2.3.5 Cow Creek Forebay

Photograph 2.3.5-1a Cow Creek Forebay and Outlet Structure

Photograph 2.3.5-1b Cow Creek Forebay – Intake

Photograph 2.3.5-1c Cow Creek Forebay – Spill Channel

Photograph 2.3.5-1d Cow Creek Forebay – Spill Outlet

Description

Cow Creek Forebay has a gross and useable storage capacity of 5.4 acre-feet at an elevation of 1,537.2 feet above MSL, and a surface area of 1 acre. The dam is earth-filled berm and has a maximum height of 16 feet, a maximum base of 54 feet, and a crest length of 653 feet at an elevation of 1,538.9 feet above MSL. The spillway is 49.7 feet wide, 1.7 feet deep, and has a rated capacity of 50 cfs with 1.2 feet of freeboard. The spillway is a side discharge overflow section of shotcrete reinforcement leading to a natural waterway with the upper portion also armored with shotcrete.

The intake structure has a 42-inch slide gate, hydraulically operated and protected by a trash rack. The intake consists of a concrete structure supporting the control gate and automated trash rake.

The outlet structure consists of a submerged 42-inch pipe which transitions into the penstock. A metal catwalk provides access the intake and CMP telemetry shafts.

2.3.6 Cow Creek Forebay

Proposal for Disposition

- The Cow Creek Forebay will be dewatered and all removal work will occur when the forebay is dry.
- Work will involve removing the forebay by backfilling with the adjacent berm material, grading, and reseeding.

- Removal of the outlet structure will consist of removing structural steel elements, cutting off corrugated metal pipe flush with the bottom, breaking up concrete, and backfilling.
- Broken concrete will be placed in the forebay and covered with earth.
- The mechanical trash rake will be removed and the concrete walls will be demolished and removed.
- Below-grade structures will be left in place and graded over.
- The spillway will be abandoned in place to minimize disturbance to the slope that will be caused by its removal.

2.3.7 Cow Creek Penstock

Photograph 2.3.7-1 Cow Creek – Penstock

Description

The Cow Creek Penstock is a buried pipe 4,487 feet long. Beginning at the upstream end, the first 15 feet of the penstock consists of 0.19-inch thick steel pipe, with a diameter that tapers from 42 inches to 36 inches. The next 766 feet consists of 36-inch diameter, 0.5-inch welded steel pipe. The final 3,706 feet is made of riveted steel with a 30-inch diameter and plate thickness that varies from 0.19 to 0.44 inch and includes a short, tapered section.

Proposal for Disposition

- Upstream and downstream ends of the penstock will be plugged with an engineered concrete block.
- Because removing the remaining buried penstock will cause a significant environmental disturbance and be extremely costly, the buried penstock will be left in place.

2.3.8 Cow Creek – Powerhouse and Switchyard

Photograph 2.3.8-1a Cow Creek – Switchyard and Powerhouse

Photograph 2.3.8-1b Cow Creek Powerhouse

Description

The Cow Creek Powerhouse is an approximately 53.5-foot by 35-foot steel truss structure (plan dimensions) composed of cut-stone walls and a corrugated metal roof. The powerhouse contains two generators and other electric and mechanical equipment.

The switchyard includes a 3-phase, oil-immersed, self-cooled, outdoor unit. PG&E's interconnected transmission system passes through the powerhouse switchyard via a 70-foot long, 60-kilovolt amperes transmission tap line which will remain in place.

Immediately to the east of the powerhouse is Hooten Gulch, an intermittent water course that has been armored with shotcrete on its bottom and west bank to prevent erosion of the bank adjacent to the powerhouse.

Proposal for Disposition

- Powerhouse work will include removing turbines, generators, and all associated electrical and mechanical equipment, and abandoning the structure in place.
- Existing concrete will be left in place.
- Turbine pits (located inside the Powerhouse structure) will be filled with mass concrete or other suitable fill material and capped with concrete to be flush with the surrounding floor.

- The powerhouse structure will be secured (in accordance with PM&E measures) and left in place during decommissioning; an option for future reuse of the structure will be preserved.
- Switchyard work includes removing equipment and structures.
- Hooten Gulch will have the shotcrete armor removed for burial in the tailrace to allow a more natural stream bed for fish passage. Replacement bank stabilization measures will be installed.
- Decommissioning will end artificial water flows to the Wild Oak Hydro Powerhouse and the Abbott Diversion for irrigation. PG&E is working with the affected parties to address these issues.

2.4 Access Roads for Project Decommissioning

Description

Project decommissioning may require improvement of existing roads and/or new access for equipment required for decommissioning the Project facilities. A small number (approximately 0.5 mile total) of new, temporary access road segments may be built for the Kilarc Development, but no new access roads are anticipated to be needed for the Cow Creek Development. Existing access roads fall both within and outside of the Project boundary and cross a mix of PG&E and private lands. Environmental impacts from road improvement activities will be minimized to the extent possible through the application of BMPs as set forth in the United States Department of Agriculture Forest Service (USDA-FS) guidance on Water Quality Management for Forest System Lands in California (2000), and described in the applicable PM&E measures. Existing road improvements will be limited to the existing road bed and will consist primarily of surface smoothing and pothole filling with a motor grader. Equipment proposed for the decommissioning is relatively small due to the small size of the Project features and therefore it will have a low impact on existing roads. Typical equipment may include multi-terrain loaders and rubber tired backhoe loaders similar to Caterpillar models 297C and 450E, respectively. Construction equipment will be offloaded from haulers at locations served by major Project roads and travel under their own power to the work sites to minimize the need for extensive road improvements. In some areas on the Kilarc drainage, new, temporary road segments are proposed to allow access to canal segments that are otherwise rendered inaccessible by elevated flume structures. Some of these proposed access roads will cross private property, and PG&E will discuss proposed access with the private property owners. Proposed new access roads total approximately 0.5 mile, serving eight canal locations, accounting for less than 9 percent of the access road total.

Kilarc Access Roads – The Kilarc Development is accessed from Fern Road East via Whitmore Road. A junction connecting to Whitmore Road lies approximately 30 miles east of Redding along State Route (SR) 44. The paved Whitmore Road transitions into the partially graveled Miller Mountain Road as far as the Kilarc Forebay intake structure. Miller Mountain Road continues on, transitioning into a Project road for the length of the Kilarc Main Canal system (see Figure 2-1). Access to the North and South Canyon portion of the Kilarc Development from Fern Road is via Oak Run Fern Road to Smith Road.

The Kilarc Development has several main Project features, with numerous sub-features, as described in Section 2.2. Proposals for access road improvement, or development of temporary new road segments to Kilarc Development facilities, are presented below.

- Kilarc Powerhouse. The powerhouse is accessible from a paved road in Whitmore via Whitmore and Fern roads. No improvements are proposed for these roads.
- Kilarc Forebay. The Kilarc Forebay is accessed from Miller Mountain Road up to the Kilarc Forebay intake structure, K-5 (refer to Figure 2-1). From K-5 to the Kilarc Forebay, access is along the existing recreation area roads and parking lot. No work is proposed for access all the way to the start of the Kilarc Forebay. Access from the Kilarc Forebay to overflow and spillway features requires improvements to road sections K-1 to K-2, K-2 to K-3, K-3 to K-4 and K-4 to K-5, forming a loop from the Kilarc Forebay to the overflow spillway and back to the intake structure. Less than 0.25 road miles require minor improvements.
- Kilarc Penstock. The Kilarc Penstock is accessible at the lower end from the powerhouse and the upper end from the Kilarc Forebay. It is approximately 4,000 feet long and drops approximately 1,100 feet in elevation. Removal of the buried Kilarc Penstock is not recommended, and therefore no access road is proposed for this feature.
- Kilarc Main Canal. The Project road that continues from Miller Mountain Road, from K-5 to the Kilarc Main Canal Diversion Dam at K-7, is approximately 3.2 miles long and is in generally good condition, requiring only minor improvement with a motor grader. This road segment provides access to the two ends of the canal. Intermediate access is provided by road segments K-36 to K-38, K-25 to K-40, K-13 to K-14 and K-8 to K-9. With the exception of K-25 to K-40, these segments require minor to moderate improvement to provide construction access. K-25 to K-40 is a very steep segment with a tight bend in the middle that will be difficult to improve for good access. An existing road on private property, K-6 to K-26, provides access to the same canal point on a much flatter route of about 1 mile in length and requires only moderate improvement. The canal is broken up along its length by a number of flumes that are designated for removal. Because of the terrain gaps bridged by the flumes, the canal is not crossable along its length by accessing one end or the other. Even with the intermediate roads described above, there are canal segments that cannot be accessed without new road segments. Typically, these proposed new road segments will be very short and begin at an existing road near the canal. Without these new segments there are a number of canal segments that will have to be either abandoned in-place or hand cut. The range of alternatives for the Kilarc Main Canal based on accessibility is described in Section 2.2.4.

- Kilarc Main Canal Diversion. Access is via the main Project road K-5 to K-7, which has segments both inside and outside the Project boundary. This is a major logging road in reasonably good condition and requires minimum dressing with a motor grader.[4]
- North and South Canyon Creeks. Access was not possible due to impassable roads at the time of assessment. However, previous visits to the Project showed that an existing road network will reach the Canyon Creek area. Access to and removal of features will most likely be along the canal itself.

Cow Creek Access Roads – The Cow Creek Development is accessed from the southwest on SR 44 via South Cow Creek Road. South Cow Creek Road, a paved County road, connects with SR 44 approximately 35 miles east of Redding. South Cow Creek Road has been defined by Shasta County to end at the pavement terminus where it is gated. The unpaved road continues over private property to the Cow Creek Powerhouse a short distance beyond. From there, over private lands, a single lane unpaved rough road having steep grades climbs to the Cow Creek Forebay and South Cow Creek Diversion Dam via unpaved spur roads. The South Cow Creek Diversion Dam and Cow Creek Forebay can also be reached from the northeast through gates at the County-defined end of South Cow Creek Road on the Whitmore side. These single lane roads are unpaved and run across private land. This road segment crosses South Cow Creek over a wet crossing. The County maintained portion of South Cow Creek Road intersects Whitmore Road approximately 2 miles east of Whitmore. Since the County maintained portion of South Cow Creek Road is gated on the southwest and northeast of the Project, the Cow Creek Development is inaccessible to the public.

Cow Creek Development has six main Project features as described in Section 2.3. Access for each feature is discussed below. In general, the Cow Creek Powerhouse can be accessed from roads to the southwest, and the South Cow Creek Diversion Dam and Forebay can be accessed from roads to the northeast. An existing network of roads, both in and out of the Project boundary, interconnects all six features (Figure 2-2).

- Cow Creek Powerhouse. Access to the Cow Creek Powerhouse is via SR 44 and South Cow Creek Road. The Cow Creek Powerhouse is approximately 0.5 mile past a locked gate on an unpaved road. The unpaved road into the Cow Creek powerhouse is in very good condition and will not require any improvements for access.
- Cow Creek Penstock. Access to the lower end of the Cow Creek Penstock is from the Cow Creek Powerhouse on access roads described above. The upper end of the penstock is accessible from the Cow Creek Forebay on access roads described in the Cow Creek Forebay section below. The penstock runs approximately 4,200 feet in length and climbs approximately 720 feet in elevation between the Cow Creek Powerhouse and Cow Creek Forebay. Removal of the buried Cow Creek Penstock is not recommended, and therefore no access road is proposed for this feature.

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4 Refers to passing the road grader blade over the surface to smooth out ruts and wash boards; no patching, filling, widening or anything else is required.

- Cow Creek Forebay. The Cow Creek Forebay is accessed along the main access road segment connecting the South Cow Creek Diversion Dam to the Cow Creek Forebay, designated as C-3 to C-17. This road segment is approximately 2 miles long and needs only minor improvement to be suitable for construction access.

  There are two options for reaching the main access road segment C-3 to C-17; one from the Cow Creek Powerhouse on road segment C-1 to C-18, and the second from the north side on road segment C-9 to C-3.

  Road segment C-1 to C-18 is approximately 2.25 miles long and climbs over 800 feet in elevation. While the average grade is 6.5 percent, there are segments that are much steeper. In addition, there are areas on this road segment that appear to be subject to localized slumping, to over road flows, and are generally in bad condition. Given the length of the road and required improvements, the road segment C-1 to C-18 is not recommended for use or improvement.

  Road segment C-9 to C-3 is approximately 1 mile long. This road segment crosses South Cow Creek at a paved wet crossing and climbs less than 100 total feet to the main access road segment road, C-3 to C-17, although it may have a steeper grade into and out of South Cow Creek. The road segment C-9 to C-3, and C-3 to C-17 is recommended for access to Cow Creek Forebay because it is in much better condition than C-1 to C-18 and is in need of only minor improvement.

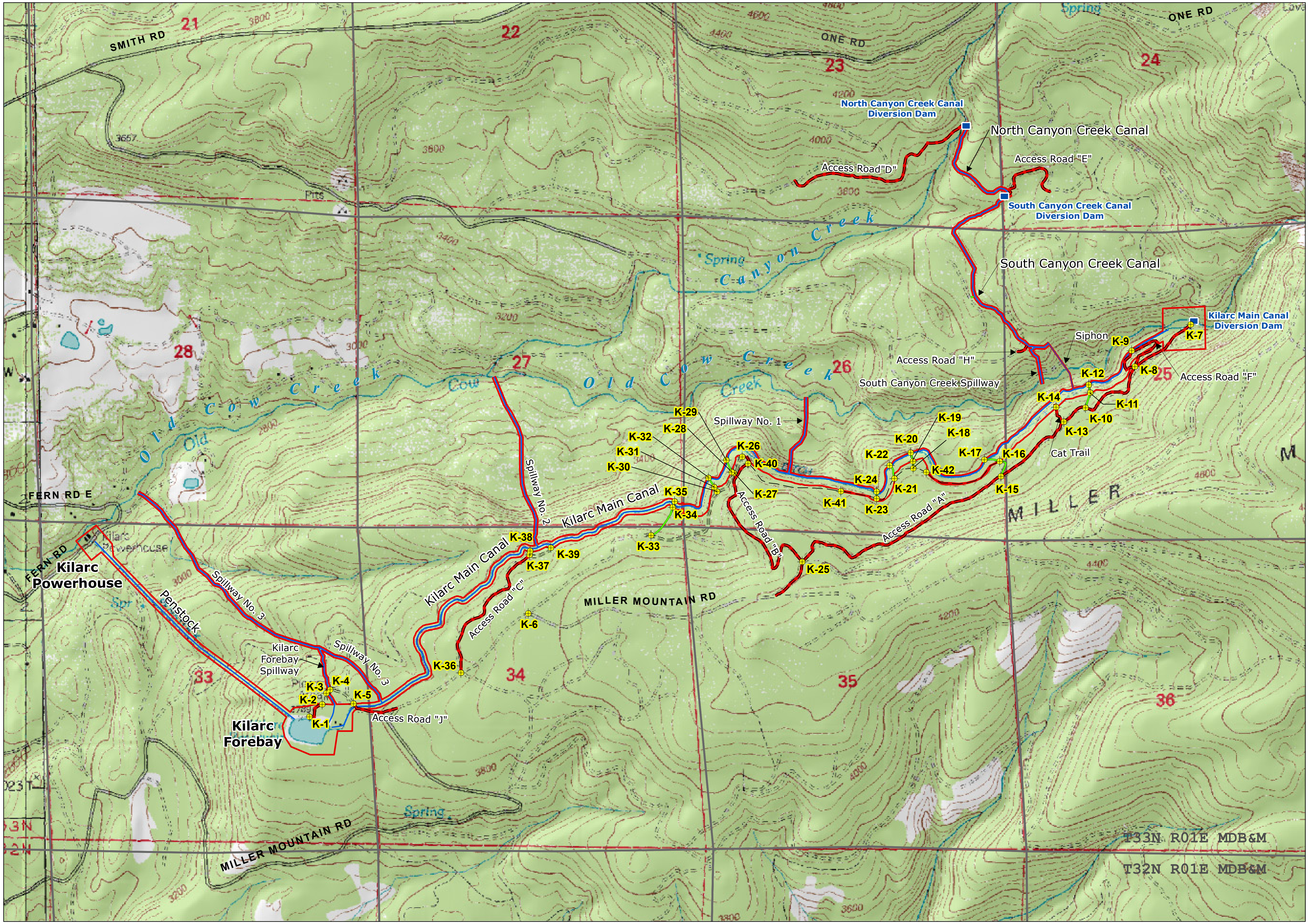
- South Cow Creek Main Canal. The South Cow Creek Main Canal can be accessed at four main points along its length: from the South Cow Creek Diversion Dam, the Cross-over Flume, the Cat Bridge, and the Cow Creek Forebay. The access is described as spurs from C-3, since C-3 is the main intersection of several access roads on the ridge above the South Cow Creek Diversion Dam and South Cow Creek Main Canal. As described in the Cow Creek Forebay section above, road access is recommended from the north side of the Project (from C-9 to C-3). C-3 is located in a wide, relatively flat meadow area, and is the central point proposed for off-loading and staging of construction equipment to avoid heavy truck traffic on the small, less improved connecting road segments. Access to the South Cow Creek Diversion Dam is from C-3 to C-4. Access to the Cow Creek Forebay is from road segment C-3 to C-17. Access to the Cat Bridge is from C-3 through C-13 to C-14. C-13 to C-14 is a road about 0.25 mile long in need of minor to moderate improvement. The Cross-over flume can be accessed from C-3 through C-10 to C-11. However, C-10 to C-11 is a 0.25-mile long rough road that only accesses the Cross-over flume from the uphill side and will require moderate to major improvement; therefore, this road is not recommended for use. The flume can instead be accessed from the canal side via C-3 to C-14 (recommended for the Cat Bridge access), which is also recommended for access to the Cross-over flume.

- South Cow Creek Diversion Dam and associated structures. The South Cow Creek Diversion Dam can be accessed from the north side via road segments C-9 to C-7, a 0.25-mile-long segment in the Project boundary needing moderate improvement, and C-7 to C-6, a 0.125-mile-long segment in the boundary needing moderate to major improvement. This northern approach from C-7 to C-6 via C-9 has a very steep final grade that is not suitable for equipment use. Use of this segment will likely cause heavy impacts to the road surface and immediate surroundings, requiring extensive rehabilitation. Therefore, this approach is not recommended for access to the South Cow Creek Diversion Dam. The south side of the South Cow Creek Diversion Dam and all the appurtenant structures can be accessed from C-9, through the wet crossing, to C-3 and on to C-4, which is the preferred and recommended access route. However, the northern end of the road segment from C-3 to C-4 is overly steep for over-the-road transport vehicle access, and there is limited room to maneuver at the bottom. Therefore, construction equipment will be off-loaded near C-3 and driven to the construction site as described in the South Cow Creek Main Canal section above. C-3 can also be accessed from the Cow Creek Powerhouse at C-1 through C-18, but, as described in the Cow Creek Forebay section above, the use of this road is not recommended for use for many reasons.

- Mill Creek Diversion Dam and Mill Creek-South Cow Creek Canal. Mill Creek Diversion can be accessed from road segment C-9 to C-7 and from a short, rough segment of logging access between points C-7 and C-8. This segment is approximately 373 feet long and will require moderate to major improvement; however it is not recommended for access. The Mill Creek-South Cow Creek Canal will be worked from the canal and does not require an access road. Light equipment and hand tools have been recommended for decommissioning the Mill Creek Diversion and the Mill Creek-South Cow Creek Canal. As the canal is decommissioned, it can serve as an access to reach the portion of the north bank retaining wall of the South Cow Creek Diversion Dam that is to remain in place for the associated minor backfilling and grading. This route is not recommended for heavier equipment access to the South Cow Creek Diversion Dam.

Proposal for Disposition

- For the disposition of existing Project roads, PG&E will leave them in-place per landowner requests, scarify and seed the surfaces of any roads to be rehabilitated, and erect barriers or obstacles to limit future access.
- If any new access roads are needed for decommissioning for Project facilities, PG&E will follow the protocols discussed in the applicable proposed PM&E measures to reduce or avoid impacts to environmental and cultural resources.
- For the disposition of any new access roads that are created for decommissioning, PG&E will leave them in-place per landowner requests, scarify and seed the surfaces of any roads to be rehabilitated, and erect barriers or obstacles to limit future access.



- Road Segment Endpoint
- Diversion
- Watercourse
- FERC Boundary
- Revised Section Boundary

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC boundary)
- Potential New Road

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

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Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure 2-1
Kilarc Development Access Roads

Pacific Gas and Electric Company®

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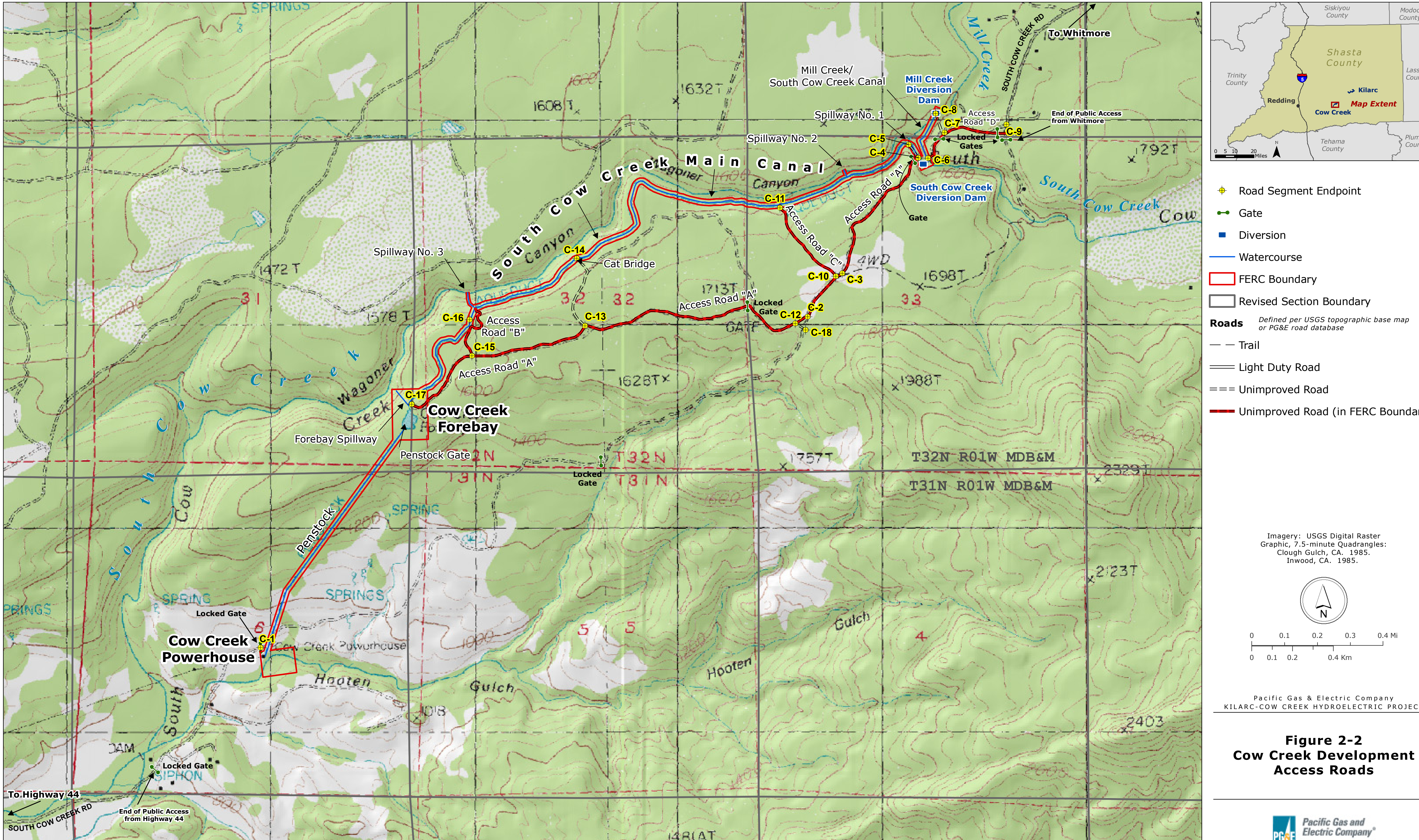

- Road Segment Endpoint
- Gate
- Diversion
- Watercourse
- FERC Boundary
- Revised Section Boundary

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC Boundary)

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangles: Clough Gulch, CA. 1985. Inwood, CA. 1985.

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Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure 2-2
Cow Creek Development Access Roads

Pacific Gas and Electric Company

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Attachment 1

Pacific Gas and Electric Company

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Annette Faraglia
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ORIGINAL

PG&E

March 30, 2005

Magalie R. Salas, Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 1st Street, NE, Docket Room 1A-East
Washington D.C. 20426-0002

Re: Kilarc-Cow Creek, FERC Project No. 606

Dear Ms. Salas:

Enclosed please find an original and eight (8) copies of the executed Kilarc-Cow Creek Project Agreement ("Agreement") by and between Pacific Gas and Electric Company ("PG&E"), U.S. Fish and Wildlife Service, California Department of Fish and Game, National Park Service, California State Water Resources Control Board, NOAA Fisheries, Trout Unlimited, and Friends of the River in regard to the above referenced Kilarc-Cow Creek Project ("Project"). Under the Agreement, PG&E will not seek a new FERC license for the Project but will continue operating it until the current license expires on March 27, 2007 and on annual licenses thereafter until the Project is: (1) acquired by another license applicant; or (2) decommissioned by FERC order.

PG&E extensively analyzed anticipated new license conditions and determined that such conditions would make the Project an uneconomic source of power. This determination led to the development and execution of the Agreement. In the event FERC orders the Project to be decommissioned, the Agreement identifies what the signatory parties believe are the subjects that would need to be addressed and the desired condition of each of these subjects after decommissioning. PG&E used this indication of decommissioning scope along with other considerations in reaching its decision to enter into the Agreement and not file an application for new license. Specific actions necessary to achieve the desired conditions would be determined in the future. The Agreement also addresses the transferring of water rights, upon decommissioning, to a resource agency or other entity to support spring run Chinook salmon and steelhead trout.

On August 17, 2004 FERC representatives participated in a meeting, via conference call, with the signatory parties to discuss the possibility of PG&E not filing a relicensing application. Prior to and after that call, Steve Nevares, PG&E's Project Manager for the

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Kilarc-Cow Creek Relicensing Project, has been in contact with FERC staff regarding developments. Most recently, on January 19, 2005, Mr. Nevares updated FERC's Tim Welch, Emily Carter, and Alan Mitchnick on the status of the Agreement.

If you have any questions regarding the attached Agreement, you may contact Steve Nevares at (415) 973-3174, e-mail SAN3@pge.com, or myself at (415) 973-7145, e-mail ARF3@pge.com.

Very truly yours,

Annette Faraglia

Attachment

cc: Ms. Emily Carter
Mr. Robert Fletcher
Mr. Hossein Ildari
Mr. Alan Mitchnick
Mr. Timothy Welch

Mr. Wayne White, Field Supervisor, U.S. Fish & Wildlife Service
Mr. Donald B. Koch, Regional Manager, California Department of Fish & Game
Mr. Jonathan B. Jarvis, Regional Director, National Park Service, Pacific West Region
Ms. Victoria A. Whitney, Chief Div. of Water Rights, CA State Water Resources Control Bd.
Mr. Rodney McInnis, Regional Administrator, NOAA Fisheries
Mr. Steven Evans, Conservation Director, Friends of The River
Charles Bonham, Esq., California Counsel, Trout Unlimited

Service List for Kilarc Cow-Creek Project, FERC Project No. 606

Kilarc-Cow Creek Project Agreement

This Agreement regarding the Kilarc-Cow Creek Project ("Agreement") is signed as of March 22, 2005 ("Effective Date") by and among Pacific Gas & Electric Company, a California corporation (the "Company"), U.S. Fish and Wildlife Service, California Department of Fish and Game, National Parks Service, California State Water Resources Control Board, Nation Marine Fisheries Service, Friends of the River, and Trout Unlimited. The signatories to this Agreement are referred to individually as a "Party" or collectively as the "Parties".

PROJECT BACKGROUND

A. The Kilarc-Cow Creek Project is licensed by the Federal Energy Regulatory Commission ("FERC") as FERC Project No. 606 (the "Project"). The Project is located in Shasta County, California along Old Cow Creek and South Cow Creek. The Project consists of Kilarc Powerhouse and Cow Creek Powerhouse along with related canals, penstocks, forebays and other structures.

B. The current FERC license for the Project expires on March 27, 2007. For the last two years the Company has been following the process prescribed in the Federal Power Act to obtain a new license. The Company's application for a new license is due to FERC by March 27, 2005. The Parties to this Agreement have been participants in the Company's relicensing process for the Project.

C. Due to the complex and competing resource issues associated with the Project, in early 2004 the Company decided to explore decommissioning as an alternative to relicensing the Project. The Company requested that the Parties participate in evaluating actions that would be necessary should the Project be decommissioned. This led to the Parties identifying a list of subjects and desired conditions to be addressed should the Project be decommissioned. The subjects and desired conditions are listed in Attachment A, which is incorporated herein by reference.

D. The Company's evaluation of the cost of decommissioning the Project based on the subjects and desired conditions in Attachment A versus operating the Project under a new license with the anticipated conditions, show that under a new license the Project would be a high cost source of energy and would not be competitive with other generation sources. This evaluation was only possible once the relicensing work had proceeded to the point where potential conditions of a new license could be identified by the Parties.

E. Based on the Parties' consensus regarding the subjects and desired conditions in Attachment A, the Company is willing to stop work on relicensing the Project and not file a new license application. The Company is also willing to support decommissioning the Project based on its determination that decommissioning is a viable and cost-effective alternative to relicensing.

F. By not filing an application for new license by the statutory deadline of March 27, 2005, the Company will lose its incumbent licensee status and forgo its opportunity to relicense the Project. Under 18 C.F.R. §16.18, FERC is authorized to issue annual licenses to the Company pending determination of the future status of the Project. The United States may seek to take over the Project, or other entities may apply for the Project license within a time period set by FERC under 18 C.F.R. §16.25. Other entities may also apply for the Project license prior to March 27, 2005. If no timely applications are received, FERC will order the Company to prepare and file a license surrender application in compliance with FERC's rules that provides for the disposition of Project facilities.

AGREEMENT

1. RELICENSING

1.1 The Company agrees not to file an application for new license for the Project. The other Parties support this action.

1.2 Entities other than the Company may seek to acquire a new license for the Project following the FERC prescribed process. The Parties accept that if an entity other than the Company indicates an interest in licensing the Project, the Company will need to provide such entities with Project information as required, including the results of relicensing studies performed to date. Additionally, the Parties accept that in such circumstances the Company will not hinder the efforts of such entities to obtain a license for the Project.

1.3 The Company will continue to operate the Project under the terms and conditions of the existing license until it expires on March 27, 2007, and then on annual licenses issued by FERC under 18 C.F.R. §16.18 until the Project is transferred to another licensee, or is decommissioned. The Company recognizes that during the period of annual license, if any, the Parties may work together, or individually, or with FERC to establish mutually acceptable environmental measures that improve water quality and/or conditions for state and federally protected species. The Parties recognize that FERC may incorporate additional or revised interim conditions in annual licenses if necessary and practical to limit adverse impacts on the environment under 18 C.F.R. §16.18(d). Any Company application for license surrender filed pursuant to 18 C.F.R. §16.25 shall provide for disposition of the Project facilities.

2. GOVERNMENTAL PARTIES RETAIN AUTHORITIES

2.1 Notwithstanding this Agreement, the Parties ~~which are~~ that governmental agencies retain all of their authorities and mandates related to the Project, the Project-affected resources and the Company's ongoing relicensing or surrender of license proceeding, and to any new licensing proceeding that may be initiated for this Project. Such authorities and mandates are not diminished in any way by these Parties entering into this Agreement. Entering into this Agreement is not in any manner a pre-decisional act or commitment by any of the governmental agencies as to the disposition of the Project assets or water rights.

2.2 Notwithstanding this Agreement, the Parties that are non-governmental organizations retain all of their rights related to the Project, the Project-affected resources and the Company's ongoing relicensing proceeding, and to any new licensing proceeding that may be initiated for this Project. Such rights are not diminished in any way by these Parties entering into this Agreement. Entering into this Agreement is not in any manner a pre-decisional act or commitment by any of the non-governmental organizations as to the disposition of the Project assets or water rights.

3. DECOMMISSIONING

3.1 The Company commits to supporting decommissioning the Project based on decommissioning being the viable and cost effective alternative to relicensing.

3.2 If FERC authorizes or orders the Company to decommission the Project, upon a final order from FERC ending Project power operations, the Company intends to transfer its appropriative water rights held for operation of the Project ("water rights") to a resource agency or other entity that: 1) agrees to use the water rights to protect, preserve, and/or enhance aquatic resources, as authorized by applicable laws and regulations, such as Water Code section 1707; and 2) is acceptable to the Parties. Additionally, prior to transferring of its water rights, the Company will work in good faith with other non-Parties to resolve potential water rights issues with the goal of having the water rights used to preserve, protect and/or enhance aquatic resources.

3.3 In the event the Company files or is ordered by FERC to file a surrender application, which the Company agrees will include a decommissioning plan, the subjects and desired conditions in Attachment A represent the Parties' good faith effort at this time to identify the subjects that would need to be addressed and the desired condition of each of these subjects after decommissioning of the Project. It is the Parties' intent that the surrender application and decommissioning plan will define these subjects and desired conditions more fully and identify the actions to be taken by which the desired conditions will be met. If a consensus agreement cannot be reached, the dissenting Party will submit written documentation in the form of a letter to the other Parties explaining the dissenting Party's reasons for not agreeing with the other Parties. This letter will become part of the decommissioning record.

3.4 The subjects and desired conditions in Attachment A are based on limited information and subject to change by consensus of the Parties based on additional information that may become available or compliance with applicable laws and regulations. Consensus means that all Parties involved in a decision can "live with" that decision even if the decision is not exactly as each Party would desire.

3.5 Additional subjects and desired conditions may be added to this Agreement by a consensus decision-making process among the Parties.

3.6 If the Company files, or is ordered by FERC to file a surrender application and a decommissioning plan, the Parties will work collaboratively to develop the surrender schedule and decommissioning plan. The decommissioning plan will identify and refine the actions necessary to address the subjects and desired conditions in Attachment A following decommissioning of the Project and will be consistent with legal requirements and obligations to FERC, and other applicable state and federal laws. Decisions on actions to address the subjects and desired conditions in Attachment A will be made by consensus of all Parties involved in the decommissioning plan's development.

3.7 To the extent permissible, the Parties will support the Company in the necessary regulatory processes to decommission the Project, including the Company's efforts before the CPUC to recover the costs the Company incurs to decommission the Project in accordance with Attachment A.

4. NEW PARTIES

Additional governmental agencies, groups and individuals may become Parties to this Agreement.

5. COMMUNICATIONS TO THE PUBLIC

This Agreement and the work that may be needed to assist the Company and the Parties in developing a detailed decommissioning proposal are open to members of the public.

6. TERM OF AGREEMENT

6.1 This Agreement shall remain in effect until the later of 1) March 27, 2007; 2) the date the Project license is transferred to a new licensee; or 3) completion of the decommissioning of the Project under a FERC order and the final order from FERC ending the Company's responsibilities as the licensee of the Project, unless this Agreement is terminated sooner pursuant to the terms of this Agreement.

6.2 Each Party has the option of withdrawing from this Agreement by providing written notice to the other Parties explaining the reasons for the proposed withdrawal and affording the other Parties thirty (30) calendar days to consult and seek alternatives to such withdrawal. All Parties agree they will not arbitrarily withdraw from the Agreement and will make a good faith effort to consult with the other Parties to resolve any dispute prior to withdrawal.

6.3 Withdrawal by the Company terminates this Agreement. Grounds for Company withdrawal include, but are not limited to, the CPUC's failure to authorize the Company to fully recover in rates its decommissioning costs.

6.4 This Agreement can also be terminated by unanimous agreement of the Parties.

7. MISCELLANEOUS PROVISIONS

7.1 There are no intended third-party beneficiaries of this Agreement.

7.2 This Agreement does not create any rights, interests, claims or causes of action at law or in equity for any Party against another Party, or for any non-party against any Party.

7.3 Each person signing this Agreement on behalf of a Party represents that she or he is authorized to sign the Agreement on the Party's behalf.

7.4 This Agreement does not make any Party the agent or representative of any other Party, and this Agreement does not create any partnership or venture between or among the Parties.

7.5 This Agreement may be signed in counterparts by the Parties, and the signed counterparts taken together shall constitute one complete Agreement. A facsimile signature by a Party on a counterpart of this Agreement is as valid as the original signature.

Attachment A: Kilarc-Cow Creek Project Decommissioning Agreement Subjects and Desired Conditions

The Parties have signed this Agreement as of the dates listed below.

U. S. Fish and Wildlife Service

By: ____________________
Wayne White, Field Supervisor

Dated: ____________________

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water
Resources Control Board

By: ____________________
Victoria A. Whitney, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

7.2 This Agreement does not create any rights, interests, claims or causes of action at law or in equity for any Party against another Party, or for any non-party against any Party.

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The Parties have signed this Agreement as of the dates listed below.

U. S. Fish and Wildlife Service

By: Kenneth Sanchez
for Wayne White, Field Supervisor

Dated: 3/4/05

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water
Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

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By: ______________________
Wayne White, Field Supervisor

Dated: ______________________

California Dept. of Fish and Game

By: Donald B. Koch
Donald B. Koch, Regional Manager

Dated: March 1, 2005

National Park Service
Pacific West Region

By: ______________________
Jonathan B. Jarvis, Regional Director

Dated: ______________________

California State Water
Resources Control Board

By: ______________________
Edward Anton, Chief, Div. of Water Rights

Dated: ______________________

NOAA Fisheries

By: ______________________
Rodney McInnis, Regional Administrator

Dated: ______________________

Friends of The River

By: ______________________
Steve Evans, Conservation Director

Dated: ______________________

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Wayne White, Field Supervisor

Dated: ______________________

California Dept. of Fish and Game

By: ______________________
Donald B. Koch, Regional Manager

Dated: ______________________

National Park Service
Pacific West Region

By: [signature]
Jonathan B. Jarvis, Regional Director

Dated: 3/16/05

California State Water Resources Control Board

By: ______________________
Edward Anton, Chief, Div. of Water Rights

Dated: ______________________

NOAA Fisheries

By: ______________________
Rodney McInnis, Regional Administrator

Dated: ______________________

Friends of The River

By: ______________________
Steve Evans, Conservation Director

Dated: ______________________

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Dated: ____________________

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water Resources Control Board

By: Victoria A. Whitney
Victoria A. Whitney, Chief
Div. of Water Rights

Dated: March 17, 2005

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: ____________________

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By: ______________________
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Dated: ______________________

California Dept. of Fish and Game

By: ______________________
Donald B. Koch, Regional Manager

Dated: ______________________

National Park Service
Pacific West Region

By: ______________________
Jonathan B. Jarvis, Regional Director

Dated: ______________________

California State Water Resources Control Board

By: ______________________
Edward Anton, Chief, Div. of Water Rights

Dated: ______________________

NOAA Fisheries

By: Rodney R McInnis
Rodney McInnis, Regional Administrator

Dated: 3-3-05

Friends of The River

By: ______________________
Steve Evans, Conservation Director

Dated: ______________________

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Dated: ____________________

California Dept. of Fish and Game

By: ____________________
Donald B. Koch, Regional Manager

Dated: ____________________

National Park Service
Pacific West Region

By: ____________________
Jonathan B. Jarvis, Regional Director

Dated: ____________________

California State Water Resources Control Board

By: ____________________
Edward Anton, Chief, Div. of Water Rights

Dated: ____________________

NOAA Fisheries

By: ____________________
Rodney McInnis, Regional Administrator

Dated: ____________________

Friends of The River

By: ____________________
Steve Evans, Conservation Director

Dated: Feb 25, 2005

Trout Unlimited

By: CMBonham
Chuck Bonham, California Counsel

Dated: 03/03/2005

Pacific Gas and Electric Company

By: ____________________
Gregory M. Rueger
Sr. Vice President Generation and Chief Nuclear Officer

Dated: ____________________

Attachment A

Kilarc-Cow Creek Project Agreement
Subjects and Desired Conditions

Subjects Addressed
Following is a list of subject areas (numbered items) and desired conditions (lettered items) addressed the Decommissioning Alternative Agency and Stakeholder meetings in the context of an Agreement for decommissioning the Kilarc-Cow Creek Project.

1. Cost for Implementing Decommissioning
   a) Costs are known
   b) Economics are favorable (i.e., more favorable than relicensing)
   c) Funds for implementation, monitoring and contingency are identified

2. Disposition of Diversion Structures
   a) Safe, timely, and effective passage up/downstream for fish
   b) Geomorphically stable stream channel above/below/at diversions
   c) Retain as much spawning gravel as possible in active channel during deconstruction activities
   d) Safety issues addressed - public and wildlife

3. Disposition of Canals and Spillways (includes waterways, tunnels and flumes)
   a) Stable drainage of runoff to natural waterways including:
      - Safe, timely, and effective fish passage
      - Maintain good water quality
      - Does not contribute sediment to drainage and streams
   b) Preservation of riparian habitat during/after deconstruction wherever possible
   c) Maintain floodplain connectivity
   d) Safety issues addressed - public and wildlife

4. Disposition of Forebays
   a) Geomorphically stable sediment conditions
   b) Appropriate fish and wildlife rescue/salvage prior to deconstruction activities

5. Disposition of Penstocks
   a) Safety issues addressed - public and wildlife

6. Disposition of Powerhouses (includes switchyards)
   a) Safety issues addressed - public and wildlife
   b) Historical/cultural values preserved
   c) Preserve options for future reuse of structures other than powerhouses

7. Disposition of Water Rights
    a) PG&E appropriative water rights are protected and used to preserve or enhance aquatic resources
    b) Other water right holders rights are preserved
    c) All water rights preserved subject to the law
    d) Water rights are enforceable and permanent
    e) Maintain aquatic habitat values downstream of Hooten Gulch

8. PG&E Lands (as managed by a land trust)
    a) Promote land use consistent with ecological function of streams
    b) Safety issues addressed - public and wildlife

9. Public Recreation Opportunities
    a) Achieve balance between lost recreation opportunities at Kilarc forebay with other recreation opportunities (e.g., fishing and picnicking)
    b) Recreation stream fisheries opportunities enhanced
    c) Public access available to recreational opportunities

10. FERC Approval for Decommissioning
    a) Timely FERC approval of decommissioning alternative consistent with the Agreement

11. CPUC Rate Recovery for Decommissioning
    a) Full and timely rate recovery for decommissioning costs

12. Post Decommissioning Licensee Responsibilities
    a) Decommissioning desired conditions are maintained post-decommissioning for specified time period
    b) Scope and cost of responsibilities are known

13. Permit Approval Process
    a) Timely identification and issuance of required permits
    b) Permit conditions consistent with the Agreement
    c) Environmental benefits of decommissioning outweigh impacts to resources

14. Implementation Schedule
    a) Decommissioning schedule is approved with clearly defined timeframe

15. Roads and Access Routes
    a) Best management practices for retiring roads where possible to minimize sediment

16. Protection of Special Status Species
    a) Compliance with California Endangered Species Act and Endangered Species Act

17. Deconstruction Activities
    a) Current water right holders continue to receive their water
    b) Where practicable, no net loss in the health of riparian and aquatic habitat areas as a result of deconstruction activities
    c) Allows natural revegetation
    d) Timing of decommissioning activities are scheduled to avoid adverse effects on fish/wildlife
    e) Minimal water quality impairment during deconstruction and immediately thereafter including turbidity, settleable solids, suspended solids
    f) Appropriate fish and wildlife rescue/salvage prior to deconstruction activities

B-3

License Surrender Application – Environmental Report

EXHIBIT E: ENVIRONMENTAL REPORT

E.1 Introduction

Exhibit E presents the Environmental Report for the Kilarc-Cow Creek Hydroelectric Project (Project) License Surrender Application (LSA). The Environmental Report is divided into three major sections: Affected Environment (Section E.2), Project Impacts (Section E.3), and Protection, Mitigation, and Enhancement (PM&E) Measures (Section E.4). Within each section, the environmental and cultural resources of the Project Area[1] are addressed in the following order: geology and soils, hydrology and water resources, geomorphology, water quality, aquatic resources, wildlife resources, botanical resources, historical resources, archeological resources, recreation, aesthetics, and land use.

The Affected Environment section describes the existing environment of the Project Area. The Project Impacts section identifies the anticipated effects on environmental and cultural resources of decommissioning Project facilities. The PM&E Measures section presents Pacific Gas and Electric (PG&E's) proposed measures to protect, mitigate and enhance environmental and cultural resources.

The Environmental Report is based on new studies conducted in 2007–2008 for decommissioning by PG&E, and information gathered from resource studies conducted when the Project was in relicensing (2003). The relicensing studies collected information on a wide variety of resource areas in the vicinity of the Kilarc and Cow Creek developments. When PG&E made the decision not to pursue relicensing, research and data surveys had been conducted regarding water temperature, stream geomorphology, water quality, aquatic, wildlife, and botanical resources and their respective habitats, cultural and historical/architectural resources, recreation and aesthetic resources. The new studies were implemented to gather additional information needed for Project decommissioning.

Among the new studies (2007–2008) PG&E conducted in support of decommissioning were the following:

(1) Studies that collected resource information about botanical resources and cultural and historical/architectural resources. These studies collected resource information in land areas that may be impacted by decommissioning, but were not included in relicensing studies. The studies were conducted primarily in areas adjacent to Project roads that could require improvements to provide access for deconstruction equipment, and in habitat areas adjacent to canals that could be disturbed by decommissioning activities.[2] There were two surveys related to terrestrial/wetlands biological resources: 1) a wetland delineation that covered both developments and 2)

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[1] For the purposes of this LSA, the "Project Area" is the area within the defined FERC boundary where the Project decommissioning would occur. For some resources, the "Project vicinity" is used to describe areas within 5 miles of the Project Area depending on threshold guidelines.

[2] Landowner permission to access property outside of the FERC Boundary on the Kilarc Development was not granted.

a supplementary special-status plant survey performed only on the Cow Creek Development. The latter covered construction access roads and habitat areas adjacent to canals that could be disturbed by decommissioning activities on the Cow Creek Development. An additional special-status plant survey was not needed along canals on the Kilarc Development. An archival record search and a field inventory were conducted for archaeological and historical properties to supplement previously collected inventories.

(2) A study that collected information about the geomorphologic resources. This study collected information to estimate the quantity and particle size distribution of sediment accumulated behind the Kilarc and South Cow Creek diversion dams, the surface topography of the sediment and longitudinal bed profile up and downstream of the diversion dams, and concentrations of metals in stored sediments.

(3) A study to determine appropriate access roads for decommissioning activities. The study identified and evaluated existing roads to determine if improvements were recommended, and if additional access roads should be proposed for decommissioning activities.

The results of the relicensing studies and additional studies conducted in 2007–2008 were used to evaluate potential impacts to the affected resources. These study results and evaluations are included in the appropriate sections of the LSA.

EXHIBIT E: ENVIRONMENTAL REPORT

E.2 Affected Environment

The affected environment is described in the following sections for each environmental and cultural resource that would potentially be affected by the decommissioning of Project facilities.

E.2.1 Geology and Soils

Geologic, seismic, and soil conditions are described in this section for the Project Area. From a geologic and seismic perspective, the affected environment is of a regional nature, whereas from a soils perspective, the affected environment is local. Soils within the Kilarc and Cow Creek developments are described, with emphasis on the soils in the immediate vicinity of the Project facilities.

E.2.1.1 Geologic Conditions

The Project is in the Cascade Range geomorphic province. The California Division of Mines and Geology has subdivided California into 12 geologic provinces based on differences in geology, including rock type, structure, and mineral deposits. The Cascade Range geologic province occupies the eastern half of the Cow Creek Watershed, including the headwaters of South Cow Creek and Old Cow Creek.

The Cascade Range extends from northern California northward through Oregon and Washington, and into British Columbia. The range consists of extensive accumulations of volcanic flows, pyroclastic rocks,[1] and associated plugs that lap onto and cover the sedimentary rocks of the Great Valley. The sedimentary deposits are associated with ancient nearshore marine and fluvial depositional basins that were located adjacent to the Sierran magmatic arc. Prominent peaks of the Cascade Range in California include Mount Lassen and Mount Shasta, located approximately 24 miles and 50 miles, respectively, from the Kilarc and Cow Creek developments.

The most widespread rock type in the Cascade Range province is the Tuscan Formation. This volcanic formation is exposed near the Cow Creek Powerhouse and Forebay, as well as marine sedimentary rocks of the Chico Formation. The Tuscan Formation consists of resistant andesitic, dacitic, and basaltic volcanic breccia,[2] tuff breccia, and interlayered flows, sand, gravel, and tuff (Bailey, 1966).

Groundwater within the volcanic and marine sedimentary rocks of the area typically occurs either as seeps or springs. Groundwater typically accumulates within shallow alluvial deposits

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1 Pyroclastic is defined as any rock consisting of unreworked solid material of whatever size explosively or aerially ejected from a volcanic vent.

2 Breccia is defined as a course grained clastic rock, composed of angular broken rock fragments held together by a mineral cement of fine-grained matrix (e.g., volcanic breccia).

below rivers and creeks, but can also occur as hot springs that originate from deep faults and fractures in this volcanic environment.

E.2.1.2 Seismic Conditions

The Project Area is located in a seismically active region of California characterized by active volcanism of the Cascade Range. Volcanism in the Cascade Range is driven by offshore plate subduction, the same tectonic regime that creates earthquakes by generating the compression and extension that exists on either side of the Project Area. The Project Area is located within a seismic zone extending from Mount Lassen to Mount Shasta (Norris et al., 1997). Records indicate earthquakes in the range of magnitude 5.0 on the Richter Scale occurred within the Lassen Peak area in 1936, 1945, 1946, 1947, and 1950. Recorded seismic activity in the region appears linked to extension in the Basin and Range province, though magmatic injection can cause localized earth shaking as well (Norris et al., 1997). The California Geological Survey (CGS) estimates a 10 percent chance of a maximum credible earthquake producing between 0.1 to 0.2 g[3] within the next 50 years for the region encompassing the Project Area (CGS, 2003). There are no known or mapped active faults within the Project Area as defined by the Alquist-Priolo Earthquake Fault Zoning Act.

E.2.1.3 Soil Conditions

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) has synthesized soil survey data into an online database that can be queried where data are available. A custom soil resource report was generated for each of the Kilarc and Cow Creek development areas (NRCS, 2008a; 2008b). Figures E.2.1-1 and E.2.1-2 show the soil resources in the Project Area in the Kilarc and Cow Creek developments, respectively. Described below are the dominant soil types expected to be found during decommissioning work.

During decommissioning, the potential exists for both short-term and long-term erosion of natural soils with subsequent sediment deposition downslope of the eroded area. Sand and finer grained sediment, including silts and clays, can degrade aquatic habitats under some conditions. Unlike coarser sediments, silt and clay are cohesive as their grains are held together by chemical attractions, which increases their resistance to erosion. However, they often form aggregates and act like larger particles moving through the watershed. When silts and clays are not in aggregate form, they may remain in colloidal suspension for longer periods, affecting water quality differently than if they were to settle out.

Relative to the potential for soils to degrade water quality, the four principal factors related to erosion potential are soil characteristics, vegetative cover, topography, and rainfall intensity. Comparing different soils under similar vegetative and rainfall conditions, water quality degradation potential is higher from silt and clay materials than from gravel and course sands. The lower hydraulic conductivity of fine materials results in lower infiltration rates and thus,

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3 The unit "g" refers to the force of gravity. Standard gravity, usually denoted by "g," is the nominal acceleration due to gravity at the Earth's surface at sea level. By definition, it is equal to exactly 9.8 meters per second squared (approx. 32.2 feet per second squared). A force of 2 g is twice the force of gravity.

higher rates and volume of runoff. The fine grain nature of silts and clays increases turbidity in runoff water. Additionally, under similar conditions, soils found on steep slopes are more easily eroded than soils on gently sloping areas, due to lower infiltration and higher velocity of runoff during intense rainfall events.

Soil textures are typically a mixture of sand, silt, and clay size particles. For example, a clay soil has 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt. A loam is a soil material with 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles. In part, because clay has predominantly smaller particle size than loam, clay is more easily eroded.

In general, the soils in the vicinity of Project facilities are stony and rocky loam. These soils are typically composed of weathered volcanic or sedimentary rock, with low to moderately high hydraulic conductivity, and moderate available water capacity. The thickness of soil over the upper bedrock surface varies, but in general is less than 5 feet.

Kilarc Development Soils

Summarized in Table E.2.1-1 are the soils found along facilities in the Kilarc Development. Table E.2.1-2 lists the soils found in the Kilarc Development and summarizes key properties related to erosion potential, including soil type, percent slope, and hydraulic conductivity. In this section, each soil is described with context to where the soil is found in the area. In general, the description begins from the bottom of the Kilarc Powerhouse, and continues from the Kilarc Forebay, along the Kilarc Main Canal, to the upper reaches of the canal and various diversion dams (i.e., North Canyon and South Canyon diversion dams).

The Windy and McCarthy very stony sandy loams are found in the vicinity of the Kilarc Powerhouse, and underlie the Kilarc Main Canal at its headwaters, Spillway 1, and South Canyon Creek Spillway and Siphon, as well as border the canal through most of its length along its northern margin. The Windy and McCarthy very stony sandy loam is found on steep slopes (50 to 75 percent) ranging in elevation from 2,000 to 9,000 feet. The soil is composed of residuum of weathered volcanic rock and basalt, respectively. The loams are well drained, range in depth from 48 to 52 inches, have low to high hydraulic conductivity, and low available water capacity.

The Cohasset very stony loam underlies the Kilarc Penstock, Kilarc Forebay Spillway in the vicinity of the Kilarc Powerhouse, and Kilarc Main Canal Spillway 3. Cohasset very stony loam (moderately deep) occurs on 8 to 50 percent slopes, ranging in elevation from 2,000 to 5,500 feet. The unit is composed of residuum of weathered volcanic rock that is well drained, ranges in depth to more than 80 inches, has a very low to moderately low hydraulic conductivity, and low available water capacity.

The Kilarc unit underlies the Kilarc Forebay Spillway in the vicinity of the powerhouse. Kilarc very stony sandy clay loam occurs on 30 to 50 percent slopes, on mountains ranging in elevation from 1,000 to 3,600 feet. The soil is composed of weathered sedimentary rock that is moderately well drained, ranges in depth from 44 to 48 inches, has a moderately low to moderately high hydraulic conductivity, and a moderate available water capacity.

The Cohasset stony loam underlies the Kilarc Main Canal in its lowest and highest reaches, as well as underlying the penstock just below the forebay. The Cohasset stony loam, found on 30 to 50 percent slopes, is composed of residuum of weathered volcanic rock that is well drained. This unit occurs from elevations of 2,000 to 5,000 feet. The soil ranges in depth from 60 to 64 inches, has a very low to moderately low hydraulic conductivity, and a moderate available water capacity.

The Cohasset loam underlies the southern extent of the Kilarc Development, including the Kilarc Forebay, the western third of the Kilarc Main Canal, and Spillway 3. The Cohasset loam is found on 0 to 30 percent slopes and is composed of residuum of weathered volcanic rock that is well drained. This unit occurs from elevations of 2,000 to 5,000 feet. The loam ranges in depth from 68 to 72 inches, has a very low to moderately low hydraulic conductivity, and a moderate available water capacity.

The Toomes very rocky loam underlies a very small portion of the Kilarc Main Canal in its mid-portion. The Toomes very rocky loam occurs on 0 to 50 percent slopes and is composed of residuum of weathered tuff breccia that is somewhat excessively drained. This unit occurs from elevations of 600 to 3,500 feet. The loam ranges in depth from 11 to 15 inches, has a moderately high to high hydraulic conductivity, and a very low available water capacity.

An outcrop of the Aiken stony loam underlies the downstream end and mid-section of the Kilarc Main Canal Spillway approximately 0.8 mile from the forebay (Spillway 2). The Aiken stony loam is found on 8 to 15 percent slopes on ridges ranging in elevation from 1,200 to 1,500 feet. The soil is composed of weathered volcanic rock that is well drained, ranges in depth to more than 80 inches, has a moderately high hydraulic conductivity, and a high available water capacity.

The Cohasset stony loam underlies the Kilarc Main Canal in its middle reach and is also found in the vicinity of the North Canyon Creek Canal and North Canyon Creek Diversion Dam. This unit occurs from 2,000 from 5,000 feet in elevation. The Cohasset stony loam, found on 0 to 30 percent slopes, is composed of residuum of weathered volcanic rock that is well drained. It ranges in depth from 60 to 64 inches, has a low to moderately low hydraulic conductivity, and a moderate available water capacity.

The Lyonsville-Jiggs complex underlies a very small portion of the Kilarc Main Canal in its mid-portion. The Lyonsville-Jiggs complex occurs on 10 to 50 percent slopes and is composed of residuum of weathered volcanic rock that is well drained. This unit occurs from 3,000 to 6,500 feet above sea level. The soil ranges in depth from 33 to 37 inches, has a low to high hydraulic conductivity, and a low available water capacity.

The Cone very stony loam is present in the vicinity of the South Canyon Creek Canal and South Canyon Creek Diversion Dam and continues downslope to the area of the Canyon Creek Siphon. The Cone very stony loam (moderately deep) is found on 15 to 60 percent slopes, on volcanic cones ranging in elevation from 2,000 to 4,000 feet. The soil is composed of residuum of weathered volcanic rock that is somewhat excessively drained. It ranges in depth to more than 80 inches, has a high to very high hydraulic conductivity, and a very low available water capacity.

A general evaluation of soil resources with the potential to erode and/or adversely affect water quality is presented to give perspective on the varying soil conditions within the Kilarc Development. From these general considerations, the erosion potential is lowest on gentler slopes with relatively high hydraulic conductivity, such as in the vicinity of the Kilarc Forebay Spillway from the Kilarc Main Canal down to Old Cow Creek (Aiken stony loam). Higher erosion potential of fine materials, which can adversely impact water quality, is found on steep slopes with lower conductivity soils such as the Cohasset very stony loam, which underlies the Kilarc Penstock and Kilarc Forebay Spillway in the vicinity of the Kilarc Powerhouse.

Cow Creek Development Area Soils

Table E.2.1-3 lists soils found along the Cow Creek Development. Table E.2.1-4 lists soils found in the Cow Creek Development and summarizes key properties related to erosion potential, including soil type, percent slope, and hydraulic conductivity. Each soil is described with context to where the soil is found in the area. In general, the description begins from the Cow Creek Powerhouse, running northeast to the Mill Creek and South Cow Creek diversion dams.

The Sehorn very stony silty clay occurs in the Cow Creek Development from the Cow Creek Powerhouse and up the Cow Creek Penstock for approximately 0.25 mile. Found on 8 to 30 percent slopes, the Sehorn very stony silty clay occurs on hills ranging in elevation from 300 to 2,000 feet. The soil is composed of residuum from weathered sedimentary rock that is well drained. It ranges in depth to more than 80 inches, has a very low to moderately high hydraulic conductivity, and a low available water capacity.

The Kilarc soil unit occurs in the Cow Creek Development along the Cow Creek Penstock upslope of the Sehorn clay and upstream of the Cow Creek Forebay. The Kilarc very stony sandy clay loam is found on 10 to 30 percent slopes on mountains ranging in elevation from 1,000 to 3,600 feet. Composed of weathered sedimentary rock, the Kilarc very stony sandy clay loam is moderately well drained, ranges in depth from 44 to 48 inches, has a moderately low to moderately high hydraulic conductivity, and a moderate available water capacity.

The Rockland unit occurs in the Cow Creek Development along the Cow Creek Penstock upslope of the Kilarc loam, underlies most of the South Cow Creek Main Canal, and underlies Spillways 1, 2, and 3. The Rockland unit ranges in elevation from 650 to 4,000 feet and is found on 15 to 70 percent slopes. The unit is comprised of residuum from lithic bedrock ranging in depth from 0 to 10 inches. The Rockland unit is excessively drained, has a low to very high hydraulic conductivity, and a very low available water capacity.

The Guenoc very rocky loam occurs in the vicinity of the Cow Creek Forebay and the downstream portion of the South Cow Creek Main Canal as well as nearby portions of Access

Road A and Access Road B. The Guenoc very rocky loam is found on 0 to 30 percent slopes, on hills ranging in elevation from 400 to 3,000 feet. The soil is composed of weathered volcanic rock that is well drained, ranges in depth from 23 to 27 inches, has a low to moderately high hydraulic conductivity, and a low available water capacity.

The Aiken stony loam occurs in the Cow Creek Development along the South Cow Creek Main Canal for approximately 0.25 mile in length, where it is bordered on its northern edge by RxF Rockland soil. The Aiken stony loam occurs on 0 to 8 percent slopes, on ridges ranging in elevation from 1,200 to 1,500 feet. The soil is composed of weathered volcanic rock that is well drained, ranges in depth to more than 80 inches, has a moderately high hydraulic conductivity, and a high available water capacity.

The Toomes very rocky loam is present under much of the Cow Creek Forebay access road (Access Road A). The Toomes very rocky loam is found on 0 to 50 percent slopes, on hills ranging in elevation from 600 to 3,500 feet. The soil is composed of residuum of weathered tuff breccia that is somewhat excessively drained, ranges in depth from 11 to 15 inches, has a moderately-high to high hydraulic conductivity, and a very low available water capacity.

The Guenoc very stony loam is found along access roads A and C (northeastern end near the South Cow Creek Diversion Dam) and near the South Cow Creek Main Canal. The Guenoc very stony loam rests on 0 to 30 percent slopes on hills ranging in elevation from 400 to 3,000 feet. The soil is composed of weathered volcanic rock that is well drained, ranges in depth to 25 inches, has a low to moderately high hydraulic conductivity, and a low available water capacity.

The Aiken stony loam occurs at the uppermost end of the Cow Creek Forebay Dam spillway, underlying only a small percentage of the spillway length. Aiken stony loam is found on 8 to 15 percent slopes, on ridges ranging in elevation from 1,200 to 1,500 feet. The soil is composed of weathered volcanic rock that is well drained, ranges in depth to more than 80 inches, has a moderately high hydraulic conductivity, and a high available water capacity.

The Cohasset very stony loam underlies the Mill Creek-South Cow Creek Canal for approximately the first 0.10 mile at the canal's highest elevation. The Cohasset very stony loam (moderately deep) is found on 8 to 50 percent slopes, on mountains ranging in elevation from 2,000 to 5,500 feet. The soil is composed of residuum of weathered volcanic rock that is well drained, ranges in depth to more than 80 inches, has very low to moderately low hydraulic conductivity, and low available water capacity.

A general evaluation of soil resources with the potential to erode and/or adversely affect water quality is presented to give perspective on the varying soil conditions within the Cow Creek Development. From these general considerations, the erosion potential is lowest on gentler slopes with relatively high hydraulic conductivity such as in the vicinity of the Cow Creek Forebay (Guenoc loam) and the Aiken and Guenoc loams along the South Cow Creek Main Canal; See Figures E.2.1-1 and E.2.1-2). Underlying much of the South Creek Main Canal is the Rockland unit consisting mostly of bedrock and weathered bedrock. The Rockland unit has a very low potential to deliver fine sediments to streams as well as having a very low erosion potential. Higher erosion potential of fine materials, which can adversely impact water quality, are found on steep slopes such as the Sehorn silty clay found along a portion of the penstock and in the vicinity of the Cow Creek Powerhouse.

E.2.2 Hydrology and Water Resources

Hydrologic characteristics of the Project are described in this section, including climate, surface water, and water rights and usage. The emphasis of this section is on changes to stream flow that will result from decommissioning.

The hydrology information presented in this section was obtained primarily from long-term stream flow monitoring in the Cow Creek watershed by the U.S. Geological Survey (USGS), California Department of Water Resources (DWR), and Pacific Gas & Electric (PG&E) at numerous locations throughout the watershed.

E.2.2.1 Background

The Project is located in the Cow Creek Watershed, which encompasses 430 square miles and drains the base and foothills of Mount Lassen in a southwest direction into the Sacramento River. The basin area is roughly bordered by State Route (SR) 299 to the north, SR 44 to the south, and SR 89 to the east, as shown on Figure A.1-1 of Exhibit A, Project Description (Hannaford, 2000). Cow Creek Watershed is further divided into five main subbasins including Little Cow Creek, Oak Run Creek, Clover Creek, Old Cow Creek, and South Cow Creek. The Kilarc Development is located on Old Cow Creek, while the Cow Creek Development is located on South Cow Creek.

Old Cow Creek drains an 80-square-mile basin and originates at 6,500 feet elevation in the LaTour Demonstration State Forest (Beck and Rowe, 2008). Old Cow Creek flows 32 miles, conjoining with several smaller creeks, before its confluence with South Cow Creek 3 miles east of Millville.

South Cow Creek drains a 78-square-mile basin and originates at 5,800 feet elevation in the LaTour Demonstration State Forest (Beck and Rowe, 2008). South Cow Creek flows 28.5 miles, with several tributary streams combining before its confluence with Old Cow Creek near SR 44.

E.2.2.2 Climate

The Project is located in the foothills of the western flank of the junction between the Cascade and Sierra Nevada mountain ranges. The western flanks of the Cascade and Sierra Nevada ranges gradually rise from the eastern margin of the Great Valley of California. This gradual rise causes warm moist air coming off the Pacific Ocean to condense as it cools while moving up the slope, bringing precipitation and snow. The climate of the area fluctuates with the seasons, with warm dry summers (with possible thunderstorms) and cold wet winters, and regular snowfall above 4,000 feet mean sea level.

The nearest climatological station for the development is the Volta 1 Powerhouse located approximately 12 miles from the Project Area at an elevation of 2,200 feet above mean sea level. At this station, the mean annual temperature is 59.3 degrees Fahrenheit (°F); 15.2 degrees Celsius (°C). Temperature extremes span from a high of 110°F (43°C) in July to a low of 14°F (-10°C) in January. Based on the record from 1920 to 1994, normal annual total precipitation is 33.99 inches, with the highest monthly precipitation of 5.46 inches occurring in January.

E.2.2.3 Surface Water Hydrology

Flow Data

Streamflow in Old Cow Creek and South Cow Creek originates from runoff during precipitation events, snow melt in the winter and spring, and contributions from groundwater (baseflow) during the dry season. Because the creeks have undergone a history of extensive water diversion and consumptive use, the stream gage records reflect altered or “impaired” hydrologic conditions. The following sections summarize historic stream gage measurements within each development and analyze estimated unimpaired flows that will occur after decommissioning. Peak flows and average monthly flows are estimated to provide an understanding of the range of flows that would be expected.

Stream flow data (collected by the USGS and PG&E) are available from several gages located throughout the Cow Creek Watershed (Table E.2.2-1 and Figure E.2.2-1). Spot measurements of flow have been made periodically by PG&E and DWR. Due to the lack of sufficient time periods at any given location, the impaired or unimpaired flow regime could not be characterized for Project streams using these data. Additionally, there are no USGS gages upstream of the Project Area on either Old Cow or South Cow creeks that record unimpaired stream flows. However, synthesized unimpaired flows can be estimated using USGS gage records (see Section E.2.2.4, Impaired and Unimpaired Flow Rate Analysis). In addition to the diversions for hydroelectric generation, there are extensive diversions in the watershedused primarily in agriculture. These non-Project diversions are identified in Section E.2.2.5, Water Use. Although the permitted season and rate of diversions are identified, there is no recorded gaging associated with these diversions, so their cumulative influence on stream flow is undocumented.

While some flow data exist with respect to Old Cow Creek and South Cow Creek, there are no gaging stations and no recorded flow data associated with measurement of unimpaired flows, impaired bypass flows, or diversion rates at Project facilities on North and South Canyon creeks or Mill Creek. However, the Project has rights to divert 2.5 cubic feet per second (cfs) from North Canyon Creek, 7.5 cfs from South Canyon Creek, and 20 cfs from Mill Creek into the South Cow Creek Main Canal. What proportion of the unimpaired flows these diversions represent during high- and low-flow periods is not known. Additionally, flow data are also extremely limited for Hooten Gulch. After passing thorugh Cow Creek Powerhouse, water is discharged to Hooten Gulch, which flows approximately 0.5 mile before joining South Cow Creek. Without the contribution of artificial powerhouse flows, Hooten Gulch is an ephermal stream. No gaging station exists on Hooten Gulch, although flows through the powerhouse have been approximated by PG&E.

Available flow records from nearby USGS gaging stations within the watershed are briefly described below and are also listed in Table E.2.2-1.

Impaired Flow Records

The Cow Creek near Millville gage (gage No. 11374000) is the primary stream flow monitoring station with the longest gaging record in the watershed. It is located about 11.6 miles downstream from the confluence of South Cow and Old Cow creeks. Daily flow records are available from 1949 to present. The flow at this gaging station reflects the inflow of all of the Cow Creek tributaries.

The South Cow Creek near Millville gage (gage No. 11372200) is located downstream of the confluence with Hooten Gulch, and approximately 2.5 miles upstream of the confluence with Old Cow Creek. Sixteen years of daily flow records (1956 to 1972) are available at this gage.

There are limited impaired flow records for South Cow Creek and Old Cow Creek downstream of the South Cow Creek Diversion Dam and Kilarc Main Canal Diversion Dam. These gages record the flows in South Cow Creek Main Canal and Kilarc Main Canal for the purpose of making minimum instream flow releases back to the river downstream of the diversion dams. These gages only record instream flow releases and do not account for higher flows or spills over the diversion dams. Therefore, peak flow and average monthly flow are not recorded by these gages.

The Kilarc Canal Diversion to Old Cow Creek gage (gage No. 11372325) has flow data available from 1983 to the present. This gage only measures flow released back into Old Cow Creek downstream of the Kilarc Main Canal Diversion Dam, and does not account for higher flows that spill over the Kilarc Main Canal Diversion Dam. Instream flow requirements to Old Cow Creek are met by releasing water from the Kilarc Main Canal a few hundred feet downstream of the Kilarc Main Canal Diversion Dam. Based on inspection of the gaging records, average monthly flows from the the Kilarc Main Canal range between 3 and 4 cfs. Actual flows during the winter runoff period are much greater, since this gage only measures instream flow releases.

The South Cow Creek Canal Diversion to South Cow Creek gage (gage No. 11372080) measures instream flow releases at the South Cow Creek Diversion Dam. The flows to the South Cow Creek bypass reach are released from the South Cow Creek Main Canal through the fish ladder at the South Cow Creek Diversion Dam. Flow data are recorded and reported by the USGS (1984 to present). Average monthly flow releases from the fish ladder range between 4 and 5 cfs. Similar to the Old Cow Creek gage (gage No. 11372325), actual flows during the winter runoff period are much greater. There are additional gages located outside the Project Area in the watershed. These gages include Little Cow Creek near Ingot (gage No. 11373300), Clover Creek near Oak Run (gage No. 11372700), and Oak Run Creek near Oak Run (gage No. 11373200). These gages were established in 1957 but have been discontinued, having collected flow data ranging from two to nine years. Data from these gages were used as a comparison with the estimated flows developed within the Project Area.

E.2.2.4 Impaired and Unimpaired Flow Rate Analysis

There is little impaired and unimpaired stream flow information available within the Project Area. Using nearby gages, the annual peak flow and average monthly flows were estimated for the two larger Project streams, Old Cow Creek (downstream of the Kilarc Development) and South Cow Creek (downstream of the Cow Creek Development). The methodology and results used to characterize the unimpaired flow expected after decommissioning are described below. The peak flows are summarized first, followed by the average monthly flows. In addition, any flow data that were available for unimpaired flows within the Project Area are summarized.

Peak Flows

Naturally functioning stable channels are capable of transporting the water and sediment delivered to them while remaining within a state of dynamic equilibrium over time. The flow that transports the most sediment in the channel over the long term is commonly referred to as the bankfull discharge (Leopold, 1994). The bankfull discharge is nearly synonymous with the "channel forming flow or effective discharge" (Wolman and Miller, 1960) and is responsible for maintaining the channel dimensions, pattern, planform, and function. Bankfull discharge for most streams is approximated by the 1.5-year peak recurrence interval flow based on an annual flood frequency analysis. Peak flow is the the single largest discharge per year (based on water year type).

Methods

To estimate unimpaired peak flows and bankfull discharge (1.5-year recurrence interval), a proportional unit area comparison was developed for Old Cow Creek below the Kilarc Main Canal Diversion Dam and South Cow Creek below the South Cow Creek Diversion Dam. The proportional unit area comparison used two USGS gaging stations with instantaneous peak flow data that are located nearest to the Project streams. The USGS gage on Cow Creek near Millville (gage No. 11374000) has a drainage area of 425 square miles and provides 53 years of peak annual flows (1950 to 2003). The USGS gage on South Cow Creek near Millville (gage No. 11372200) has a drainage area of 77.3 square miles and provides 16 years of annual peak flow data (1957 to 1972).

The Cow Creek near Millville gage was selected to calculate peak flow primarily due to its relatively long period of record, which provided a more stable and reliable flood frequency curve.[4] When developing a stable flood frequency curve, it is best to have 20 to 25 years of data (USGS, 1982). However, some margin of error was introduced in the extrapolation of flow data from this gage due to its much larger drainage area relative to the smaller drainage areas associated with the bypass reaches on South Cow Creek and Old Cow Creek. Therefore, the South Cow Creek near Millville gage was used as a secondary check on the estimated unimpaired peak flows because of its similar smaller drainage area, even though it has a relatively short gaging record (16 years). To ensure the South Cow Creek near Millville gage

4 A flood frequency curve is a graph that shows the frequency with which discharges of different magnitudes are equaled or exceeded.

had reasonable peak flow data to use as a comparision, the peak flows from the overlapping 16 years of flow data (water years 1957 to 1972) between the two gages were analyzed. Peak flows at the South Cow Creek near Millville gage are approximately 17 to 20 percent of the peak flows at the Cow Creek near Millville gage. On a proportional drainage area basis, the South Cow Creek gage is about 18 percent of the drainage area (77.3 square miles/425 square miles) represented by the Cow Creek near Millville gage. Thus, the South Cow Creek near Millville gage provided reasonable data to use as a secondary check on the impaired flow data calculations.

Results

Kilarc Development – The drainage area at the Kilarc Main Canal Diversion Dam is 23.8 square miles. Peak flows on Old Cow Creek should be approximately 5.6 percent (23.8 square miles/425 square miles) of the peak flow at the Cow Creek near Millville gage (Figure E.2.2-1). The annual peak flow exceedance curve for the Cow Creek near Millville gage using 53 years of flow data is shown in Appendix C. The bankfull discharge (1.5-year recurrence interval) on the annual peak flow exceedance curve is approximately 18,700 cfs. Applying the proportional relationship to the Kilarc Main Canal Diversion Dam on Old Cow Creek, the 1.5-year bankfull discharge is:

Old Cow Creek at Kilarc Main Canal Diversion Dam: 18,700 cfs x 5.6 % = **1,047 cfs**

Additional peak flow discharges for the 2-, 5-, 10- and 25-year peak flows were also calculated using the same method. The results are shown in Table E.2.2-2.

As a secondary check on the impaired flow calculations, the South Cow Creek near Millville gage was used (77.3 square miles). The peak flows on Old Cow Creek at Kilarc Main Canal Diversion Dam should be approximately 30.8 percent (23.8 square miles/77.3 square miles) of the peak flow at the South Cow Creek near Millville gage. The bankfull discharge (1.5-year recurrence interval) on the annual peak flow exceedance curve is approximately 4,300 cfs. Applying the same proportional drainage area relationship method to the point of diversion on Old Cow Creek, the 1.5-year bankfull discharge is:

Old Cow Creek at Kilarc Main Canal Diversion Dam: 4,300 cfs x 30.8 % = **1,324 cfs**

Thus, the estimated 1.5-year bankfull discharge flows compare reasonably well using the extrapolation technique from the two gaging stations.

Cow Creek Development – The drainage area at the South Cow Creek Diversion Dam is 47 square miles. Peak peak flows on South Cow Creek should be approximately 11 percent (47 square miles/425 square miles) of the peak flow at the Cow Creek near Millville gage (Appendix C). Using the same 1.5-year bankfull discharge from the annual peak flow exceedance curve (18,700 cfs), the proportional relationships to South Cow Creek Diversion Dam on South Cow Creek, the 1.5-year bankfull discharge is:

South Cow Creek at South Cow Creek Diversion Dam: 18,700 cfs x 11 % = **2,057 cfs**

Additional peak flow discharges for the 2-, 5-, 10- and 25-year peak flows were also calculated using the same method. The results are shown in Table E.2.2-2.

As a secondary check to the estimated unimpaired flows described above, the South Cow Creek near Millville gage (77.3 square miles) was used. The peak flows on South Cow Creek should be approximately 60.8 percent (47 square miles/77.3 square miles) of the peak flow at the South Cow Creek near Millville gage. Applying the same proportional drainage area relationship methods and 1.5-year bankfull discharge from the annual peak flow exceedance curve (4,300 cfs) to the points of diversion on South Cow and Old Cow creeks, the 1.5-year bankfull discharge is:

South Cow Creek at South Cow Creek Diversion Dam: 4,300 cfs x 60.8 % = **2,614 cfs**

Thus, the estimated 1.5-year bankfull discharge flows compare reasonably well using the extrapolation technique from the two gaging stations.

Average Monthly Flows

The monthly trend in stream flows for the entire Project Area can be characterized using the Cow Creek at Millville gage. Seasonal trends indicate that average monthly flows are highest during January and February and lowest from July through September. Using this gage and the observed seasonal trends, unimpaired average monthly flows were estimated for Old Cow and South Cow creeks. Monthly flows cannot be estimated for the North and South Canyon creeks, Mill Creek, or Hooten Gulch due to the limited amount of flow data available within the Project Area.

Estimating the unimpaired monthly flow requires stream flow data that cover the longest possible record. For this, the Cow Creek at Millville and South Cow Creek near Millville gage records were used (Table E.2.2-1). The period from 1957 to 1972 provides a continuous record for both gages. These records were supported with short-term records at Little Cow, Clover, and Oak Run creeks. In addition, PG&E has monitored flow in the Kilarc Main and South Cow Creek Main canals. The average monthly flow data from these gaging stations are provided in Appendix D.

Methods

The flow per unit area approach was used to compute unimpaired monthly flows. There are several steps involved in determining the unimpaired average monthly flow in the Cow Creek watershed. In general, the steps include (1) adjusting the flows for the effects of the diversions, (2) determining flow per unit area at the downstream gaging station, (3) developing a regression equation for Cow Creek and South Cow Creek flows, and (4) applying the regression to other points in the watershed.

There are extensive diversions in the watershed that occur seasonally and annually. While these flows are not gaged and the total amount of flow actually diverted is not known, the diverted flows were estimated by applying a monthly consumptive use estimate with the total irrigation flow diversion rights. The measured flows at the Cow Creek near Millville gage were adjusted for these diversions by adding this consumptive use amount to the measured flow. This provides an estimate of the unimpaired flow at the downstream gages. It should be noted that these diversions are unrelated to the Project; consequently, these flows would not be restored to the respective channels as a result of decommissioning.

The daily flow records for Cow Creek at Millville and South Cow Creek near Millville gages were summed for each month of their record to compute average monthly flows. The monthly flow data were divided by their respective watershed areas (425 and 77.3 square miles, respectively) to yield the flow per unit of drainage area.

The average monthly flow calculated above for the Cow Creek and South Cow Creek gages was segregated to develop monthly regression equations. Linear regression equations relating unit flow from these gages were developed for each month or a combination of months (if similar runoff patterns existed over several months).

Finally, the unit flows were multiplied by the appropriate watershed areas at the Kilarc Main Canal and South Cow Creek diversion dams (23.8 and 47.0 square miles, respectively) to estimate the average monthly flow at their respective diversion.

As a comparison to the estimated monthly flows for Old Cow and South Cow creeks, the limited data set of average monthly flows collected for the Little Cow (eight years), Clover (two years), and Oak Run (nine years) creeks were used. The comparison indicated that low-flow periods were underestimated. To correct for this, the linear regression equations developed for flows on South Cow and Cow creeks were adjusted using patterns developed from the flows in these tributaries. This adjustment factor was applied to the results of the estimates of the unimpaired flow at Old Cow and South Cow creeks.

<u>Results</u>

Kilarc Development – The average estimated monthly flows and percent of flows for Old Cow Creek downstream of the Kilarc Main Canal Diversion Dam are shown in Table E.2.2-3 and in Figure E.2.2-2. The percent of flows are the flows that are less than or equal to a given flow. Highest average monthly flows for Old Cow Creek (127 cfs) occur in January and February, while low flows typically occur in September and October (28 cfs).

The results of the average monthly flows for each of the 50 years of record simulated (1950 to 2000) from the regression analysis is located in Appendix E.

Cow Creek Development – The average estimated monthly flows and percent of flows for South Cow Creek below the South Cow Creek Diversion Dam are shown in Tables E.2.2-4 and in Figure E.2.2-2. Similar to the Kilarc Development, highest average monthly flows (259 cfs) occur in January and February, while low flows typically occur in September and October (57 cfs).

The results of the average monthly flows for each of the 50 years of record simulated (1950 to 2000) from the regression analysis is located in Appendix E.

E.2.2.5 Water Use

Water is diverted from the springs and creeks of the Cow Creek Watershed to serve agricultural, domestic, and power production needs. Many of the diversions use unlined canals to convey the water from the springs and creeks to the places of use.

PG&E diverts water from Old Cow Creek and South Cow Creek into mostly unlined ditches for power generation. Its use is non-consumptive, as the water is returned to the creek after passing through the Kilarc and Cow Creek powerhouses, respectively.

The Kilarc Development diverts water in the upstream reaches of Old Cow Creek, North Canyon Creek and South Canyon Creek, and conveys the water to the Kilarc Forebay. From the Kilarc Forebay, the water enters the Kilarc Penstock, dropping about 1,192 feet to the Kilarc Powerhouse before returning to Old Cow Creek. Approximately 4 miles of Old Cow Creek are affected by this diversion.

The Cow Creek Development diverts water from Mill Creek and South Cow Creek. The water is conveyed by a mostly unlined canal to Cow Creek Forebay and then into the Cow Creek Penstock where it drops 715 feet to the Cow Creek Powerhouse before returning to South Cow Creek through Hooten Gulch. Approximately 4 miles of South Cow Creek are affected by this diversion.

E.2.2.6 Water Rights

For the Kilarc Development, PG&E holds four pre-1914 water rights in the Old Cow Creek[5] watershed. The three main water rights are for non-consumptive use for power generation at Kilarc Powerhouse. PG&E has a right to divert 2.5 cfs from North Canyon Creek into the North Canyon Creek Canal, a right to divert 7.5 cfs from South Canyon Creek into the South Canyon Creek Canal, and a right to divert 52 cfs from Old Cow Creek into the Kilarc Main Canal. PG&E has filed Statements of Water Diversion and Use (SWDU) numbers 9977, 1020, and 828 respectively for these three diversions. The remaining water right (200 gallons per minute) is for domestic use at Kilarc Powerhouse. PG&E reports this water right in SWDU 869.

For the Cow Creek Development, PG&E holds two pre-1914 water rights in the South Cow Creek watershed. Both of these rights are for the non-consumptive use for power generation at the Cow Creek Powerhouse. PG&E has a right to divert 20 cfs from Mill Creek into the Mill Creek Canal and a right to divert 50 cfs from South Cow Creek into the South Cow Creek Main Canal. PG&E has filed SWDU numbers 849 and 829 respectively for these diversions.

A summary of the water rights associated with the Project is presented in Table E.2.2-5.

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5 The names Old Cow Creek and North Cow Creek are used interchangeably in the Water Rights discussions for Old Cow Creek (see also Appendix A, Proposed Decommissioning Plan).

There are three non-PG&E hydropower diversions in the watershed. The Olson Powerhouse is FERC-licensed and diverts water from Old Cow Creek 1.2 miles downstream of the Kilarc Powerhouse. The Wild Oak Powerhouse obtains water from the Cow Creek Powerhouse tailrace in Hooten Gulch. This microhydro project is not FERC-licensed. The Toucher project diverts water from South Canyon Creek at the same location as PG&E, but with a senior water right.

Project Agreement on Water Rights

The Project Agreement (Attachment 1 of Appendix A) addressed water rights as follows:

> *If FERC authorizes or orders the Company to decommission the Project, upon a final order from FERC ending Project power operations, the Company intends to transfer its appropriative water rights held for operation of the Project ("water rights") to a resource agency or other entity that: 1) agrees to use the water rights to protect, preserve and/or enhance aquatic resources, as authorized by applicable laws and regulations, such as Water Code section 1707; and 2) is acceptable to the Parties. Additionally, prior to transferring of its water rights, the Company will work in good faith with other non-Parties to resolve potential water rights issues with the goal of having the water rights used to preserve, protect and/or enhance aquatic resources.*

In addition, the Project Agreement included the following goals with respect to water rights:

- PG&E appropriative water rights are protected and used to preserve or enhance aquatic resources;
- Other water right holders' rights are preserved;
- All water rights preserved subject to the law;
- Water rights are enforceable and permanent; and
- Maintain aquatic habitat values downstream of Hooten Gulch.

Disposition of Water Rights

PG&E remains committed to ensuring that its water rights are used to enhance aquatic resources once they are no longer needed for hydroelectric generation.

PG&E proposes to dispose of the six water rights described above by abandoning them upon receiving a final Order from FERC approving the decommissioning and removing the Project from FERC's jurisdiction. PG&E proposes to abandon its Project-related-water rights rather than transfer them as originally envisioned by the Project Agreement, because abandonment would accomplish the Project Agreement's goals more easily and with greater certainty. Specifically, abandonment would return the water to the streams without legal proceedings and with minimum impacts to the other parties with adjudicated water rights in the watershed. Upon abandonment, which simply involves PG&E taking affirmative steps to discontinue its diversions with the intent not to resume the diversions, PG&E's pre-1914 rights will cease to exist and will not impact any other water rights or the priorities of those rights.

In addition to the water rights discussed above, PG&E holds shares in the South Cow Creek Ditch Association for water associated with the German Ditch. The German Ditch diversion is located upstream from PG&E's diversion for the South Cow Creek Main Canal. PG&E's shares allow the utility to retain up to 1.44 cfs in the German Ditch to be delivered to Mill Creek. The water then flows to PG&E's Mill Creek Diversion Dam and into the Mill Creek-South Cow Creek Canal where it is diverted by PG&E for generation at Cow Creek Powerhouse. An additional 2 cfs are left in the South Cow Creek and are diverted at PG&E's South Cow Creek Main Canal for generation at Cow Creek Powerhouse. Upon decommissioning, PG&E intends to divest its shares in the South Cow Creek Ditch Association.

Hooten Gulch Water Users

Cow Creek Powerhouse currently discharges water into Hooten Gulch, which flows into South Cow Creek. Releases into Hooten Gulch are artificial flows; but for PG&E's powerhouse releases into Hooten Gulch, there would be minimal natural flow in Hooten Gulch.

An irrigation diversion known as the Abbott Ditch diverts water from Hooten Gulch. Pursuant to an adjudication of the watershed, Abbott Ditch water users are entitled to divert 13.13 cfs from the natural flow of the east channel of South Cow Creek below the confluence with Hooten Gulch (and not from Hooten Gulch itself). In addition, a mini-hydro facility known as the Wild Oak Development, with a generating capacity of 110 kilowatts, has operated since 1984 by taking water from Hooten Gulch for power generation. Upon decommissioning of the Cow Creek Development, there will no longer be artificial flows in Hooten Gulch.

E.2.3 Geomorphology

The geomorphology of streams within the Project is addressed in this section, which includes a discussion on channel types, channel and bank stability, sediment storage, and sediment transport characteristics associated with Project streams. In addition, sediment characterization studies were performed on the deposits stored behind the South Cow Creek Diversion Dam on South Cow Creek and the Kilarc Main Canal Diversion Dam on Old Cow Creek.

E.2.3.1 Relicensing Resource Reports and Analyses

PG&E conducted studies in 2003 for relicensing to characterize stream type, sediment transport, and channel stability on Old Cow Creek, South Cow Creek, and Hooten Gulch. No studies were conducted on North Canyon and South Canyon creeks or on Mill Creek. Approximately 0.5 mile of non-Project, unregulated stream above the South Cow Creek Diversion Dam and 0.25 mile of channel above the Kilarc Main Canal Diversion Dam on Old Cow Creek were surveyed to compare to the Project-affected bypass stream reaches (Figures E.2.3-1 and E.2.3-2). In addition, Hooten Gulch above the Cow Creek Powerhouse was inspected for comparison to the downstream segment between the powerhouse and confluence with South Cow Creek. These studies provide useful information needed to address the likely effects of Project decommissioning on stream morphology and channel stability. Field studies were also performed in 2008 to obtain data related to sediment volume and particle sizes in storage behind the Kilarc Main Canal Diversion Dam and the South Cow Creek Diversion Dam. The purpose of the 2008 studies is described further in Section E.2.3.3.

Photograph E.2.3-1. South Canyon Creek Dam and Diversion

Photograph E.2.3-2. Mill Creek Diversion and Dam

E.2.3.2 Channel Type and Channel Stability

For purposes of describing distances along the stream reaches, river stationing is provided in 0.10-mile increments. River station increments start at their respective diversions (RS 0.0) and progress downstream (Figures E.2.3-1 and E.2.3-2). To distinguish river stations upstream of diversion facilities, negative stationing is used (i.e., 0.1 mile upstream of a diversion is designated at RS -0.1).

Channel Type

This study applied two stream classifications: Rosgen (1996) and Montgomery-Buffington (1997). The Rosgen classifications are discussed first, followed by a discussion of the Montgomery-Buffington classification results.

Rosgen Classification

The Rosgen classification system uses a hierarchical approach to consider different morphological variables at increasing levels of spatial resolution. Based on four main morphological parameters (entrenchment ratio, width-depth ratio, water surface slope, and sinuosity), streams can be classified into different stream types. Measurements of these morphological parameters were made during the 2003 relicensing studies. A detailed description of the morphological parameters and the Rosgen stream type classification system is provided in Appendix F. Data collected to classify the stream channel based on parameters developed by

Rosgen (1996) are also presented in Appendix F. Rosgen stream classifications for South Cow Creek, Old Cow Creek, and Hooten Gulch are summarized in Table E.2.3-1.

Kilarc Development

Upstream from the Kilarc Main Canal Diversion Dam on Old Cow Creek, the channel type is an A2/A2a+, with steep gradients (denoted by the "a+"), and boulders (denoted by the "2") representing the dominant bed material. This reach is unlike most of the channel downstream from the Kilarc Main Canal Diversion Dam. Rosgen (1996) describes the A-channel type as a high-energy, moderate to steep gradient, low sinuosity, and highly entrenched channel. The A-channel type is very efficient at transporting its sediment load, and is considered to be quite stable, although the canyon walls above the channel may be subject to side-slope rejuvenation from mass-wasting or other erosion processes that episodically deliver sediments to the river channel.

Old Cow Creek is predominantly a B2-channel type downstream from the Kilarc Main Canal Diversion Dam. Dominant bed material is overwhelmingly boulder, interspersed with smaller bedrock sections. The B2-channel type has a moderately high gradient, low sinuosity, is moderately entrenched in its valley, and is considered a very stable channel type (e.g., limited capacity to alter channel planform, dimensions, or vertical changes in the bed elevation).

Cow Creek Development

Upstream from the South Cow Creek Diversion Dam, the channel is designated a B4c/B3c type (the smaller "c" subscript indicates lower channel gradients, less than 2 percent, within the B-channel type). Gravel (denoted by the "4") and cobble (denoted by the "3") are about equally represented as the dominant material in the channel.

South Cow Creek is also predominantly a B-channel type downstream from the South Cow Creek Diversion Dam (Table E.2.3-1). The bed material alternates between cobble (B3), boulder (B2), cobble-gravel (B3/B4), and boulder-cobble (B2/B3).

Hooten Gulch

Hooten Gulch is also identified as a B-channel type upstream and downstream of the Cow Creek Powerhouse. Cobble (B3) or cobble and gravel (B4/B3) were the dominant particle sizes present.

Montgomery–Buffington Classification

The Montgomery–Buffington (1997) classification recognizes seven distinct streambed types based upon visual observation (Table E.2.3-2). Under its broadest categorization, most of Old Cow Creek, South Cow Creek, and Hooten Gulch are identified as alluvial channel types. Alluvial streams are characterized by channels that can erode, transport, and deposit sediments, such that they are self-forming and self-maintained (Dunne and Leopold, 1978). Although the channels are predominantly alluvial types, field observations frequently revealed short segments of the diverted reaches, usually less than 500 linear feet, dominated by bedrock interspersed between the alluvial reaches. These bedrock segments are highly stable, and exert some control on the vertical bed stability throughout the alluvial segments.

Kilarc Development

Above the Kilarc Main Canal Diversion Dam, the channel has a cascade bedform, exemplified by steep gradients, large boulder bed elements, and a random bedform pattern.

The Old Cow Creek Project affected bypass reach is entirely classified as cascade/step-pool. According to Montgomery and Buffington (1997), cascade channels have a random bedform and are very steep, entrenched, high energy streams. The step-pool is characteristic of steep-gradient mountain channels that have short, steep plunges punctuated by flats, indicative of a stair-stepped bedform. The hybrid form expressed by cascade/step-pool denotes features that are characteristic of both cascade and step-pool bedforms.

Cow Creek Development

Above the South Cow Creek Diversion Dam, the channel is primarily pool-riffle. There is an 800-foot segment of channel above the diversion that is step-pool. The confining hillslopes are bedrock and boulder.

South Cow Creek is classified as a step-pool/plane-bed for the first 1.5-mile segment immediately downstream of the South Cow Creek Diversion Dam. Montgomery and Buffington (1997) describe the plane-bed channel as featureless, with few vertical oscillations of the bed (i.e., few pools and riffles). For the next 12,000 feet (RS 1.5 to 3.8), the river is classified as a cascade/step-pool. Along the next 0.25 mile of the creek (ending at the confluence with Hooten Gulch), the gradient flattens and the channel type is classified as pool-riffle/plane-bed. The pool-riffle bedform tends to have a moderate gradient, with sequences of bar deposits and pools, usually moderately sinuous, and moderately to poorly entrenched (Montgomery and Buffington, 1997).

Hooten Gulch

Hooten Gulch above and below the powerhouse is classified as a pool-riffle/plane-bed channel type.

Channel Bank Stability

Channel bank stability was rated high, medium, or low based on visual observations related to dominant bank particle size, evidence of active bank erosion, and bank steepness. This assessment was conducted along the same reaches as described above for Old Cow Creek, South Cow Creek, and Hooten Gulch. The channel banks are predominantly defined by the hillslope valley walls, which is typical for A and B steep-gradient, highly to moderately entrenched channel types. Overall, below the respective diversions, bank stability was highest along South Cow Creek, moderate to low on Old Cow Creek, and moderate below the Cow Creek

Powerhouse on Hooten Gulch. A summary of the bank stability ratings is shown in Table E.2.3-3 and discussed below.

Kilarc Development

Hillside failures were observed immediately upstream (approximately 700 feet) of the Kilarc Main Canal Diversion Dam, delivering large quantities of sediment and large woody debris to the channel. The channel was dominated by bedrock/boulder falls upstream of this 700-foot reach, where the bank stability was high.

In the 0.75 mile immediately downstream of the Kilarc Main Canal Diversion Dam, Old Cow Creek flows through boulder-dominated reaches (high bank stability) interspersed with vertical cut-banks that appear to be active erosional features. Further downstream from the Kilarc Main Canal Diversion Dam, Old Cow Creek flows through areas where the hillslopes and channel banks (typically the valley walls) are extremely unstable. Most of the channel banks along this reach are composed of exposed soil or finer sediment with little to no vegetation. The composited bank stability ratings were 18 percent high, 41 percent moderate, and 41 percent low over the 3.02 miles of channel surveyed below the Kilarc Main Canal Diversion Dam (Table E.2.3-3).

Cow Creek Development

No active bank erosion was observed within the 0.4-mile reach that was assessed upstream of the South Cow Creek Diversion Dam. Approximately 0.25 mile upstream of the South Cow Creek Diversion Dam, the channel passes through a boulder-dominated reach and a bedrock gorge where the bank stability rating was high (Table E.2.3-3).

Bank material was either bedrock or large boulders and the bank stability was generally high for almost 3 miles directly downstream of the South Cow Creek Diversion Dam. Below this reach, the streambank material was no longer predominantly bedrock. Overall bank stability ratings for this reach were moderately high, because most of the streambank length was armored with large boulders. For the entire channel length surveyed below the South Cow Creek Diversion Dam, bank stability rating was 92 percent high, 5 percent moderate, and 4 percent low. Areas of low bank stability were primarily located near isolated hillslope failures within the inner gorge (Table E.2.3-3).

Hooten Gulch

In the first 750 feet upstream of the Cow Creek Powerhouse, bank material was rated moderately stable (Table E.2.3-3). In this reach, there was some evidence of livestock causing bank erosion. Further upstream, the valley wall is composed of friable mudstone that is actively sliding into the channel (rated low bank stability).

Downstream of the Cow Creek Powerhouse, the channel banks are moderately stable to the Hooten Gulch confluence with South Cow Creek (Table E.2.3-3). Within the first 0.5 mile of the surveyed section below the powerhouse, one 90-foot-long section of Hooten Gulch below the powerhouse was actively eroding into the channel.

E.2.3.3 Channel Sediment Storage and Transport Characteristics

Sediment storage above and below the Kilarc Main Canal Diversion Dam and the South Cow Creek Diversion Dam was evaluated during the 2003 relicensing studies. Bars and pools were two important sediment storage features that were evaluated. Studies to determine the amount of sediments and the associated particle sizes in storage behind the Kilarc Main Canal Diversion Dam and the South Cow Creek Diversion Dam were performed in 2008. The sediment storage assessment, in conjunction with the channel typing and the peak flow assessment (Section E.2.2, Hydrology and Water Resources), provides a context for understanding the extent to which past Project operations may have influenced the transport of sediments, and how the sediment transport characteristics and channel morphology would be affected by decommissioning. For the decommissioning of Project facilities, it is also of particular importance to determine the disposition of sediments in storage behind these two diversion dams; whether they would need to be excavated and removed from the channel, or if they could be released from storage and allowed to be naturally transported downstream. The sediment storage and transport characteristics from the 2003 and 2008 studies are provided here. The sediment storage, channel typing, and peak flow information is synthesized in Section E.3.3 to determine potential impacts of decommissioning and the potential disposition of sediments behind the Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam.

Sediment Storage in Bars

Only bar deposits containing gravel or finer material that could be readily mobilized by approximately a bankfull flow were inventoried. The field assessment included approximate length and width measurements of each bar, visual approximation of surface median (D_{50}) particle size across the entire length of the bar, and the amount of vegetation present. Excluded from this inventory were highly stable bar deposits dominated by cobbles and boulders that are not readily transported except by relatively infrequent larger magnitude flow events.

The frequency and amount of in-channel sediment storage represented by the more easily mobilized bar deposits was very low for all Project-affected bypass reaches. The small amount of in-channel sediment storage is characteristic of higher-gradient mountain stream reaches that have more than sufficient energy to transport the sediment load delivered to the channel. The ratio of total channel length to total bar length, hereafter referred to as “channel-bar ratio,” was calculated above and below the Kilarc Main Canal Diversion Dam and the South Cow Creek Diversion Dam. The ratio is defined as an index of the amount of readily transportable sediments in storage in the channel bars. The higher the ratio, the less alluvial material stored in the channel. For purposes of this assessment, a ratio of less than 2 to 5 is considered to be indicative of high sediment storage, 5 to 10 indicates moderate sediment storage, and greater than 10 indicates low sediment storage. A summary of the bar characteristics is presented in Table E.2.3-4.

Kilarc Development

No bars were observed above the Kilarc Main Canal Diversion Dam on Old Cow Creek, and only four bars were inventoried in the 3.02-mile channel survey below the diversion dam. The channel-bar ratio below the Kilarc Main Canal Diversion Dam was 38. The surface D_{50} (median bed particle size) of bars inventoried below the diversion was predominantly gravel to coarse gravel, ranging from 22 to 64 millimeters (mm) (0.9 to 2.5 inches). Well-established alder vegetation was observed on two bars below the Kilarc Main Canal Diversion Dam.

Cow Creek Development

Two bars were observed upstream of the South Cow Creek Diversion Dam, with a channel-bar ratio of 12. The surface D_{50} of bars above the South Cow Creek Diversion Dam consisted of coarse gravel, ranging from 45 to 90 mm (1.8 to 3.5 inches). Grasses dominated vegetation on the bars above the South Cow Creek Diversion Dam. For the first 1.5 miles below the South Cow Creek Diversion Dam, seven bars were inventoried with a calculated channel-bar ratio of 15. Comparing above and below diversion bar ratios on South Cow Creek suggests that over the first 1.5 miles, bar sediment storage was nearly equivalent above and below the South Cow Creek Diversion Dam. Proceeding downstream from RS 1.5 to 4.1, only one bar was recorded along this steeper gradient segment. The surface D_{50} of all the bars inventoried below the South Cow Creek Diversion Dam ranged from 16 to 90 mm (0.6 to 3.5 inches), with most of the bars having a D_{50} less than or equal to 32 mm (1.3 inches). Some of the bars in this reach (RS 0.6 to 1.1) were heavily vegetated (85 to 90 percent cover) with well-established alders, indicating they had not been recently scoured or mobilized. Other bars downstream of the South Cow Creek Diversion Dam typically exhibited a much smaller amount of vegetative cover.

Hooten Gulch

No bars were observed on Hooten Gulch above or below Cow Creek Powerhouse.

Fine Sediment Storage in Pools

Fine sediment storage in pools was assessed in Project streams, Project-affected bypass reaches, and non-Project stream segments above the Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam. Sediment storage in pools was quantified by estimating the surface area of the pool covered by fines (sand size particles less than 2 mm, or 0.08 inch). Sediment depth was estimated by taking multiple random depth measurements with a long piece of reback where sand was present to characterize the varying thickness of sediment deposits. Pools were randomly selected in the field for this sediment storage analysis.

Kilarc Development

On Old Cow Creek, four pools along 0.22 mile (approximately one pool per 300 feet per length of channel) were inspected above the Kilarc Main Canal Diversion Dam, and 42 pools along 3.01 miles (one pool per 380 feet per length of channel) were inspected downstream of the diversion dam. The proportion of fine sediment (percent of pool surface area) present in pools in

Old Cow Creek was very low. The average pool bed surface area covered with fine sediment was very similar in pools above and below the Kilarc Main Canal Diversion Dam (Table E.2.3-5). In the Old Cow Creek Project-affected bypass reach, the average surface area of pools covered by fines was 13 percent, while above the Kilarc Main Canal Diversion Dam the average was 14 percent. Review of the data also indicates that 10 out of the 42 pools inspected downstream of the Kilarc Main Canal Diversion Dam had no fine sediment on any portion of the bed.

Cow Creek Development

On South Cow Creek, six pools were inspected within a 0.25-mile reach above the South Cow Creek Diversion Dam. From the South Cow Creek Diversion Dam to just downstream of the confluence with Hooten Gulch (a 4.1-mile-long reach), 43 pools were inspected. The results for South Cow Creek are summarized in Table E.2.3-5.

Overall, fine sediments in South Cow Creek covered a very small proportion of the pool area, about 11 percent on average below the South Cow Creek Diversion Dam. Additionally, the thickness of those fine sediments was typically a thin layer (0.4 inch thick on average), over much coarser bed material. The pool fine sediment storage below South Cow Creek Diversion Dam was similar to the pool fine sediment storage above South Cow Creek Diversion Dam. This indicates that past Project operations have caused very little fine sediments to deposit and infill pools. However, the downstream-most pool measured (located at the confluence of Hooten Gulch and South Cow Creek), has the highest percentage of fine sediment. This strongly suggests that Hooten Gulch is a potential source of fine sediment.

Hooten Gulch

Seven pools were examined within a 0.5-mile reach below the Cow Creek Powerhouse. Although about a 0.25-mile segment of Hooten Gulch was observed upstream from the powerhouse, data were not collected to quantify sediment storage in this reach. However, sand deposits were evident on the dry streambed in Hooten Gulch above the Cow Creek Powerhouse.

Hooten Gulch had a much greater amount of fine sediment covering the bed surface area of its pools (56 percent average) than either Old Cow Creek or South Cow Creek (Table E.2.3-5). It was noted above that fine sediments covered most of the bed surface at the confluence pool on South Cow Creek. Although there was no “delta” of fine sediment deposition at the mouth of Hooten Gulch or South Cow Creek downstream of the confluence pool, it was obvious that Hooten Gulch was actively contributing fine sediment to South Cow Creek. The dominant bed particle size in Hooten Gulch upstream from the Cow Creek Powerhouse (within the surveyed reach) consisted of cobble, with mixtures of boulder, sand and gravel. Downstream from the Cow Creek Powerhouse, the dominant particle size was gravel and cobble. Although fine sediment was not a dominant component of the bed material anywhere along Hooten Gulch, it was the dominant component of the eroding hillsides downstream of the Powerhouse. This fine-grained eroded sediment is delivered to the channel and is deposited in pools or mixes with coarser particles on the bed.

Sediment Transport Characteristics

The extent to which channel adjustments on regulated streams occur is related to two important factors: channel type and magnitude of change in the flow and sediment regime. Some channel types are more responsive and likely to adjust their channel form in response to changes in the flow and/or sediment regime than other channel types. The magnitude of change in the flow and sediment regime under regulated conditions, and back to unregulated conditions for Project decommissioning, was in part evaluated by assessing the change in the magnitude of geomorphically significant streamflow. The geomorphically significant streamflow is approximated as the bankfull discharge, or the 1.5-year recurrence interval flow (Section E.2.2, Hydrology and Water Resources). Under decommissioning activities, the full, natural, gemorphically significant peak flows along South Cow and Old Cow creeks would be nearly the same as under past Project operations. Streamflows that are less than the bankfull discharge (the 1.5-year flow) may have an influence on aquatic habitat or riparian conditions, but have very little influence on channel morphology because these streamflows are usually too small to transport sufficiently large volumes or sizes of sediments that comprise the bedload fraction, to affect the channel morphology.

The steeper alluvial Project-affected bypass reaches of Old Cow and South Cow creeks classified as cascade/step-pool are supply-limited. This means that the transport capacity (ability to move sediment) is much greater that the sediment supply. Although supply-limited channels can have a large sediment supply, their capacity to transport the sediment load greatly exceeds the supply. Supply-limited conditions are a common characteristic of many mountain streams (Montgomery and Buffington, 1997). These channels are also supply-limited due to the abundance of immobile bedrock, boulder, and cobble material comprising the channel. Sediment transport along these reaches occurs in two phases. In the first phase, flows that are approximately bankfull discharge will move the finer (silt, sand and gravel) material over the more stable larger bed elements. In the second phase of transport, much higher and very infrequently occurring flows are necessary to mobilize the large bed elements comprising the cascade and step-pool channel types.

Hooten Gulch is a pool-riffle/plane-bed channel type and is considered transitional between supply-limited and transport-limited. This means that smaller and more easily mobilized bed particles are present in storage along the channel (primarily pools and mixed with the bed material) and the capacity to transport the finer sediments is not much greater relative to the available supply, as it is in supply-limited channels.

E.2.3.4 Sediment Storage at Diversions

The run-of-river diversions at Old Cow and South Cow creeks have virtually no water storage capacity and relatively little sediment storage capacity. Sediments have in-filled behind both the Kilarc Main Canal and South Cow Creek diversion dams, probably decades ago when the diversions were first constructed, so that bedload transported along the streambed passes over the impounded sediments and dams and into the downstream reaches. The run-of-river diversion facilities on South Cow Creek and Old Cow Creek also have had an insufficent capacity to attenuate high stream flows, due to the limited capacity to divert peak flows (Section E.3.2, Geomorphology Impacts). Thus, past Project operations have had a very limited influence on either the natural sediment regime or the sediment transport characteristics of these streams.

Summary of Recent Field Studies Conducted

A characterization of the particle sizes in storage at Kilarc Main Canal Diversion Dam on Old Cow Creek and at the South Cow Creek Diversion Dam on South Cow Creek was performed by collection of bulk samples in 2007 and 2008. The bulk sampling was used to characterize the percentage of cobble, gravel, sand, and silt that is stored behind the dams. Additionally, the chemical composition of the sediments in storage was evaluated using the bulk samples, focusing on the presence of heavy metals (see Section E.2.4, Water Quality). Topographic surveys were performed to estimate the volume of sediment in storage behind the Kilarc Main Canal and South Cow Creek diversion dams, and a longitudinal profile was also surveyed to quantify the local stream gradient through the diversions. The purpose of these field studies was to determine if the sediments in storage would need to be excavated and removed from the channel, or if the sediments could remain in the channel to be naturally transported downstream after the Kilarc Main Canal and South Cow Creek diversion dams are removed for the decommissioning of Project facilities.

Kilarc Main Canal Diversion Dam

<u>Particle Size Characteristics</u>

Four surface bulk particle size samples were collected in Old Cow Creek behind the Kilarc Main Canal Diversion Dam (Figure 1 in Appendix G) to characterize the sediments in storage. The results are summarized in Tables E.2.3-6 and E.2.3-7 and cumulative particle size plots are located in Appendix G. Sampling sites are labeled K-I through K-IV.

Most of the sediment (76 to 99 percent of the sample by weight) stored behind the Kilarc Main Canal Division Dam was gravel (2 to 64 mm, 0.08 to 2.5 inches) or cobble- to boulder-sized (cobble is greater than 64 mm [2.5 inches], and boulder is at least 256 mm [10.1 inches]) material at each of the sampling locations. The sediment collected at each location ranged from sand to cobble sized particles. The percentages of silt, sand, gravel, and cobble or coarser material at each sampling location is shown in Table E.2.3-6. Silt was virtually not present, and sand represented about 11 percent or less in three out of the four samples taken. The particle size statistics for the D_{50} (median particle size), D_{16} (percent finer than 16 percent of cumulative sample) and D_{84} (percent finer than 84 percent of cumulative sample) for each bulk sample were calculated and are presented in Table E.2.3-7.

<u>Sediment Volume</u>

The potential scour volume resulting from stream channel incision following the removal of the Kilarc Main Canal Diversion Dam was estimated in 2008 (Appendix G). The total volume that has the potential to be scoured and transported downstream is estimated to be about 580 cubic yards (0.36 acre-foot). Field survey results indicate that between 40 and 50 percent of the active stream channel is occupied by boulders, suggesting that approximately 230 to 290 cubic yards would not be readily mobilized.

The stream gradient above the Kilarc Main Canal Diversion Dam is very steep, approximately 6.7 percent, and below the Kilarc Main Canal Diversion Dam the gradient is approximately 5.3 percent. Once the dam is removed, stream gradients in this area would adjust to approximately 6.3 percent (Appendix G). These steep gradients would promote very high sediment transport rates during high flow events. Therefore, it is expected that most of the finer matierial (cobble sized and smaller) will be readily mobilized and the larger boulder sized material will only be mobilized during extreme flood events.

The anticipated maximum depth of scour is estimated to be 8 feet just upstream of the dam face, with decreasing scour depths moving in the upstream direction, until the control point that defines an equilibrium gradient is reached approximately 110 feet upstream from the dam (Appendix G). It is unknown how long it would take for Old Cow Creek to naturally mobilize and transport this volume of sediment since it would be dependent upon the frequency and magnitude of flood events following dam removal.

South Cow Creek Diversion Dam

Particle Size Characteristics

Six bulk particle size samples were collected behind the South Cow Creek Diversion Dam (Figure 1 in Appendix H). Sampling locations are identified as C-I through C-VI.

Most of the sediment (78 to 100 percent of the sample weight) stored behind the South Cow Creek Division Dam was gravel or cobble to boulder sized material. The sediment collected from bulk sampling at each location ranged from silt (0.004 to 0.062 mm [0.0002 to 0.002 inch]) to cobble-sized particles. The percentages of silt, sand, gravel, and cobble or coarser material at each sampling location is shown in Table E.2.3-8. Silt was virtually not present, and sand represented less than 10 percent of the stored sediment. The particle size statistics for the D_{50} (median particle size), D_{16} (percent finer than 16 percent of cumulative sample) and D_{84} (percent finer than 84 percent of cumulative sample) for each bulk sample were calculated and are presented in Table E.2.3-9. The cumulative particle size plots are located in Appendix H.

Sediment Volume

The potential scour volume resulting from stream channel incision following the removal of the South Cow Creek Diversion Dam was estimated in 2008 (Appendix H). The total volume that would be scoured and transported downstream is estimated to be about 1,400 cubic yards (0.87 acre-foot). The potential depth of scour is approximately 8.5 feet just upstream of the dam to about 0.5 foot near the upstream control point that defines the upstream extent of scour, approximately 400 feet from the dam. Channel slopes are moderate upstream and downstream of the diversion dam, approximately 1 percent. It is unknown how long it will take for Old Cow Creek to naturally mobilize and transport this volume of sediment, as it would be dependent upon the frequency and magnitude of flood events following dam removal. Therefore, it is expected that most of the finer matierial (cobble-sized and smaller) will be readily mobilized and the larger boulder sized material will only be mobilized during extreme flood events. It is expected that the entire 1,400 cubic yards of sediment will be transported downstream.

Mill Creek, North Canyon Creek, and South Canyon Creek

There are three other Project diversion dams located within the Project Area: North Canyon Creek and South Canyon Creek diversion dams (Photograph E.2.3-1) in the Kilarc Development, and Mill Creek Diversion Dam located on Mill Creek (Photograph E.2.3-2) within the Cow Creek Development.

All of these impoundments are small in size, resulting in a very small volume of potentially stored sediment, if at all. Sediments most likely have been passing over these small diversions into the downstream reaches throughout the period of past Project operations. The removal of the Mill Creek, North Canyon Creek, and South Canyon Creek diversion dams under the decommissioning of Project facilities would restore the annual peak runoff magnitude, and the associated sediment transport capacity of these channels.

E.2.4 Water Quality

E.2.4.1 Background

Water quality within the Kilarc and Cow Creek developments is well documented. Past and present investigations of water quality are described below. Available data are summarized with comparison to relevant water quality standards. Sediment chemistry data are also presented with consideration of potential effects on water quality.

The water quality information described in this section was obtained from extensive studies performed in 2003 as part of the relicensing effort for the Project. The 2003 results were not published at that time; therefore both methods and results are presented herein. The 2003 investigation included the following studies:

- Collection and laboratory analysis of water quality samples at numerous locations
- *In-situ* monitoring of field parameters within each development
- *In-situ* study of temperature fluctuations

In 2007, sediment sampling was performed behind the Kilarc Main Canal Diversion Dam on Old Cow Creek and behind the South Cow Creek Diversion Dam on South Cow Creek. Sediments were analyzed both for size and volume and for trace metals to determine if they should be excavated and removed from the channel, or allowed to remain and be naturally transported downstream after the diversion dams are removed. The methods and results of this recent study are also summarized in the sections to follow.

E.2.4.2 Sacramento River Basin Plan

The state of California, through the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs), is required to adopt Water Quality Control Plans (Basin Plans) by the California Water Code (Section 13240). The Basin Plans are region-specific plans that identify the "beneficial uses" of water bodies and set numeric criteria to protect these beneficial uses.[6] The current Sacramento River Basin and San Joaquin River Basin Plan was adopted in 1998 and has been amended numerous times since. The version cited herein was most recently revised in October 2007 with approved amendments (RWQCB-CVR, 2007).

The Basin Plan establishes water quality objectives to protect beneficial uses of waters within specific areas, and provides a regulatory implementation framework for achieving these objectives. A summary of Basin Plan water quality objectives relevant to the beneficial uses of water in the Cow Creek hydrologic area is presented in Table E.2.4-1.

The Basin Plan includes by reference the maximum contaminant levels (MCLs) and the Secondary Maximum Contaminant Levels specified in Title 22 of the California Code of Regulations (CDPH, 2008). These levels are established for water designated for use as domestic or municipal supply. The RWQCB may apply limits more stringent than MCLs to protect all beneficial uses of the waters, and in fact, many of the objectives listed in Table E.2.4-1 are stricter than the MCLs to ensure protection of aquatic habitats.

The RWQCB has not adopted numeric objectives for sediments. Rather, the RWQCB relies on narrative toxicity objectives to protect and manage ambient sediment quality. Specifically, the Basin Plan states the following:

> *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

E.2.4.3 Storm Water Regulations

The 1987 Clean Water Act (CWA) amendments required the U.S. Environmental Protection Agency (USEPA) to establish regulations to control storm water discharges associated with industrial activity and discharges from construction sites. The SWRCB first adopted a statewide general National Pollutant Discharge Elimination System (NPDES) permit (Order No. 92-08-DWQ, General Permit No. CAS000002) in 1992, which applies to construction projects resulting in land disturbance of 5 acres or greater. On August 19, 1999, the SWRCB reissued the General Construction Storm Water Permit (Water Quality Order 99-08-DWQ referred to as "General Permit"), reducing the areal requirement to 1 acre or greater, among other changes (SWRCB, 1999). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling, or excavation.

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6 A beneficial use is one of the various ways that water can be used for the benefit of people and/or wildlife. Examples include drinking, swimming, industrial, and agricultural water supply, and the support of fresh and saline aquatic habitats.

A new revised General Permit is expected to be adopted this year (Water Quality Order 2008-XX-DWQ) and is likely to be in effect at the time of decommissioning (SWRCB, 2008). The revised draft General Permit includes many more specific requirements than the minimum requirements in USEPA's regulations and in the current General Permit. The revised draft General Permit includes, for example, numeric action levels (NALs), numeric effluent limitations (NELs), and very detailed management practices. These are discussed in more detail in Section E.3.4.

E.2.4.4 2003 Water Quality Sampling Investigation

A water quality monitoring study was performed in 2003 as part of the relicensing effort for the Project. The investigation included collection and laboratory analysis of water quality samples at numerous locations.

Sampling and Analysis Methods

Water samples were collected from 12 locations throughout the Project Area in March and October, 2003. Sampling locations are summarized in Tables E.2.4-2 and E.2.4-3 for the Kilarc and Cow Creek developments, respectively. Water quality parameters measured included general chemical, mineral, trace metals, nutrients, polychlorinated biphenyls (PCBs), and coliform bacteria. A schematic indicating the relative spatial locations of the sampling sites is presented in Figure E.2.4-1. A list of sampling parameters, analytical methods used, and the rationale for analyses are presented in Table E.2.4-4.

Chemical analyses were performed at the California Department of Fish and Game (CDFG) water quality laboratories in Rancho Cordova and Moss Landing, California. Coliform bacteria were analyzed at Basic Laboratories in Redding, California. All samples analyzed for trace metal concentrations were collected as grab samples using USEPA Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (USEPA, 1995), also known as ultra clean methodology. All other constituents of interest were sampled following USEPA 1669 ultra clean methodology. Appropriate sample handling and preservation techniques were followed during sample collection.

<u>Kilarc Development</u>

For each of the two sampling episodes conducted in the 2003 relicensing study, seven water quality stations were sampled and analyzed within the Kilarc Development. One sample was collected in North Canyon Creek (NC1) above the North Canyon Creek Canal, two samples were collected in South Canyon Creek (CC1 and CC2), three samples in Old Cow Creek (OC1, OC3, and OC4), and one sample in Kilarc Forebay (KF1).

<u>Cow Creek Development</u>

For each of the two sampling episodes conducted in the 2003 relicensing study, five water quality stations were sampled and analyzed within the Cow Creek Development. One sample was collected in Mill Creek (MC1), three samples were collected in South Cow Creek (SC1, SC4, and SC5), and one sample in Cow Creek Forebay (CCF1).

Evaluation of Results

Results of the 2003 water quality investigation are summarized in Tables E.2.4-5 and E.2.4-6 for metals and in Tables E.2.4-7 and E.2.4-8 for minerals, nutrients, and other parameters. Data summaries and laboratory data reports are presented in Appendix I. The water quality data were compared not only against the Basin Plan objectives (RWQCB-CRV, 2007), but also against several other criteria: California MCLs (CDPH, 2008), the California Toxics Rule Freshwater Aquatic Life Protection (FALP) Standards, the USEPA ambient water quality criteria for freshwater organisms (USEPA, 2006); and the National Recommended Water Quality Criteria for Freshwater Organisms (USEPA, 2000).

With a few minor exceptions, no water quality exceedances were observed.

Kilarc Development

Metal concentrations measured in the Kilarc Development area were either undetected or below the Basin Plan water quality objectives. Total metal concentrations were below California primary and secondary drinking water MCLs. Dissolved metals were below the FALP standards.

All nutrient and mineral parameters measured in the Kilarc Development were at concentrations below both the Basin Plan criteria and the California primary and secondary MCLs. PCBs were not detected for all samples collected. Ranges for these parameters measured within the Kilarc Development are provided in Tables E.2.4-7 and E.2.4-8.

One fecal coliform sample, collected in October 2003 in Old Cow Creek above the Kilarc Powerhouse (OC3), exceeded the Basin Plan water quality objective for waters used in contact recreation, and had a concentration of 240 most probable number per 100 milliliters (MPN/100 mL). This result is likely a result of cows, native mammals, or other animals having access to the stream. The Basin Plan water quality objective is based on the geometric mean of a minimum of five samples in a 30-day period. No more than 10 percent of the total number of samples collected during a 30-day period should exceed 400 MPN/100 mL (RWQCB-CRV, 2007). For this study, only one sample was analyzed from each station, for each of the two sampling episodes (therefore, a geometric mean cannot be calculated).

Cow Creek Development

Metal concentrations measured in the Cow Creek Development area were either undetected or fell below the Basin Plan criteria. Total metal concentration results fell below California primary and secondary drinking water MCLs. Dissolved metals were below the FALP standards.

All nutrient and mineral parameters measured in the Cow Creek Development were at concentrations below both the Basin Plan criteria and the California primary and secondary MCLs. PCBs were not detected for all samples collected. Ranges for these parameters evaluated within the Cow Creek Development are provided in Tables E.2.4-7 and E.2.4-8.

As discussed above, mean fecal coliform levels cannot be calculated due to a limitation in the number of samples collected. However, based on the limited data obtained in this monitoring study, fecal coliform levels exceeded 200 MPN/100 mL for this watershed in one sample in the March sampling episode (station MC2) and two samples in the October sampling episode (stations SC1 and CCF1). The March sample was collected in Mill Creek above South Cow Creek (MC1) and had a measurement of 900 MPN/100 mL. The first October sample was collected in South Cow Creek above the Project Area (SC1) and had a fecal coliform measurement of 500 MPN/100 mL. The second October sample was collected in the Cow Creek Forebay (CCF1) and had a fecal coliform measurement of 280 MPN/100 mL. These fecal coliform measurements are most likely a result of livestock or native mammals accessing the stream for water.

E.2.4.5 2003 *In Situ* Water Quality Study[7]

In addition to analytical water quality parameters and temperature monitoring, *in situ* water quality parameters were measured at 17 Project station locations. PG&E personnel took field measurements once during each of the following months in 2003: March, May, June, July, August, and October. The *in situ* measurements included pH, water temperature, specific conductance, dissolved oxygen, and turbidity. All instrumentation was maintained and calibrated according to manufacturer's specifications. *In situ* water quality station locations are presented in Tables E.2.4-9 and E.2.4-10 and shown on Figure E.2.4-1.

Sampling and Analysis Methods

Nine *in situ* water quality stations were sampled and analyzed within the Kilarc Development during monitoring episodes conducted in March, May, June, July, August, and October, 2003. Two samples were collected in North Canyon Creek (NC1 and NC2), two samples were collected in South Canyon Creek (CC1 and CC2), four samples were collected in Old Cow Creek (OC1, OC2, OC3, and OC4), and one sample was collected in Kilarc Forebay (KF1).

Eight *in situ* water quality stations were sampled and analyzed within the Cow Creek Development during monitoring episodes conducted in March, May, June, July, August, and October, 2003. One sample was collected in Mill Creek (MC1 and MC2), four samples were collected in South Cow Creek (SC1, SC3, SC4, and SC5), one sample was collected in Cow Creek Forebay (CCF1), and one sample was collected in Hooten Gultch above the Abbott Diversion (HG1).

7 Meaning "in place" to confirm uniform functionality.

Evaluation of Results

Results of the *in situ* water quality measurements performed during May to October 2003 in the Project Area are summarized in Tables E.2.4-9 and E.2.4-10. With the exception of nominal water quality exceedances observed with pH, water quality parameters were generally within acceptable ranges for both the Kilarc and Cow Creek developments.

<u>Kilarc Development</u>

Dissolved oxygen ranged from 8.1 to 11.1 milligrams per liter (mg/L) within the Kilarc Development, a range that is within the Basin Plan water quality objective (greater than 7 mg/L). Specific conductivity ranged from 54 to 109 µmho/cm, a range that did not exceed the Basin Plan criterion for specific conductivity (less than 230 µmho/cm in the Sacramento River).

The pH in the Kilarc Development ranged from 7.5 to 8.7. One sample slightly exceeded the Basin Plan criterion of 8.5, and was found within the Kilarc Forebay (KF1) in October with a pH measurement of 8.7. The turbidity measured in the Kilarc Development ranged from less than 0.1 to 5.8 NTUs.

<u>Cow Creek Development and Hooten Gulch</u>

Dissolved oxygen ranged from 7.3 to 11.2 mg/L within the Cow Creek Development, a range that is within the Basin Plan water quality objective for dissolved oxygen. Specific conductivity ranged from 59 to 168 µmho/cm, and does not exceed the Basin Plan water quality objective.

The pH in the Cow Creek Development ranged from 7.2 to 8.6. Two samples collected in the August 2003 sampling effort slightly exceeded the Basin Plan criterion. A sample collected in South Cow Creek above the Abbott Diversion (SC4) had a measurement of 8.6. The turbidity measured in the Cow Creek Development ranged from less than 0.1 to 8.5 NTUs.

E.2.4.6 2007 Sediment Chemistry Evaluation

Sediments stored behind the Kilarc Main Canal and South Cow Creek diversion dams were collected in 2007 to determine the size and volume of materials present, as well as to characterize the presence or absence of mercury, methyl mercury, copper, silver, and arsenic. These metals were selected based on natural occurrence of these metals within the geologic formations of the area. (See also Section E.2.1, Geology and Soils).

PG&E performed the sediment sampling and coordinated the laboratory analytical work. The reports for Kilarc Main Canal and South Cow Creek diversion dam sediments are in Appendices F and G.

Sampling and Analysis Methods

Bulk sediment samples were collected from alluvial deposits in a spatially stratified manner to best represent the depositional features associated with the stored sediment. This sampling scheme was designed to detect the aerial spatial heterogeneity of the depositional features associated with both diversion dams.

Boreholes dug into the channel thalweg encountered very little fine material. Boreholes were drilled at each site using a barrel sampler and were limited to about 2 feet due to the large cobble and coarse gravel texture of the stored sediment.

Behind the Kilarc Main Canal Diversion Dam, four sediment samples (K-1, K-II, K-III, and K-IV) were collected. Initial chemical testing was performed on Samples K-II and K-III. After receiving preliminary laboratory results, additional analysis of copper was performed on all four samples.

Seven bulk sediment samples were collected from alluvial deposits stored behind the South Cow Creek Diversion Dam. The bulk sediment sample locations were chosen to best represent the depositional features associated with the stored sediment. Two of the seven samples were selected for chemical analysis, C-I and C–III, which were collected from a gravel bar on the upstream northeast side of the diversion.

The bulk samples were field-sieved using stainless steel sieves and sand-size material (less than 2 mm) was collected in certified pre-cleaned fluorinated high-density polyethylene (FLPE) containers, per standard practice, and sent to Brooks Rand Laboratory for analysis. An attempt was made to collect sediment less than 63 microns (silt and clay); however, there was not enough clay or silt in the bulk samples to collect the minimum sample volume (a minimum of about 10 grams for chemical analysis) except at sample location K-1 behind the Kilarc Main Canal Diversion Dam.

The sediment samples were analyzed for total solids and the dry weight total concentration of mercury, methyl mercury, copper, silver, and arsenic using EPA Method 1638.

Freshwater Sediment Screening Values

Sediment chemistry criteria have not been established by the state of California. Interpretation of potential effects to aquatic life from freshwater sediments is complicated not only by the varying nature of sediment samples themselves, but also by the varying nature of natural waters. The interpretation of sediment chemistry data is site-specific and must be based on the type and nature of the sediment itself and the related water environment. To help with interpretation of sediment chemistry, background and screening values have been defined as guidance to investigators.

The measured concentrations of metals in sediment samples taken from behind the Kilarc and South Cow Creek diversion dams may be compared to screening values provided by the National Oceanic and Atmospheric Administration (NOAA) (Buchman, 2004). Several studies were synthesized and tabulated in Buchman (2004), including from the Canadian Council of Ministers of the Environment (2000) where regulatory criteria are in place.

NOAA reports the range of "background" concentrations[8] (sediment quality screening levels), and presents a Threshold Effects Level (TEL) and Probable Effect Level (PEL) proposed by Buchman (2004) for freshwater sediments. These "background values" are not developed from data obtained from Cow Creek Watershed. The TEL is loosely defined as a base concentration that may produce an effect in benthic organisms. The PEL is defined as a concentration that probably produces an effect in benthic organisms.

These sediment concentration ranges need to be considered with respect to individual metals of concern. The speciation of metals within a natural water body and thus, the relative concentration of a toxic form of a metal to be present, are dependent on many water quality factors, particularly pH, hardness, alkalinity, dissolved oxygen, and the presence of other metals and organic matter. Thus the TEL and PEL cannot be strictly interpreted, but rather used as guidance to investigators.

Evaluation of Results

Sediment samples collected behind the Kilarc and South Cow Creek diversion dams in 2007 are compared to sediment quality screening values in Tables E.2.4-11 and E.2.4-12. Copies of the chain of custody and laboratory analysis reports are appended to Section E.2.3, Geomorphology.

Kilarc Development

In general, the Kilarc Main Canal Diversion Dam sediment data indicate that all metals except copper are found at levels below sediment quality screening levels. Table E.2.4-11 summarizes data for mercury, arsenic, copper, and silver, while Table E.2.4-12 summarizes data for copper.

Mercury, Arsenic, and Silver

Mercury concentrations in sediments in samples K-II and K-III were near the sediment quality screening levels. The concentration of methyl mercury was 0.011 milligram per kilogram (mg/kg) in both samples collected, less than 1 percent of the total mercury concentration. The concentrations of arsenic and silver in samples K-II and K-III were near "background."

The comparison of the sediment chemistry data to the screening values indicate that there is a low potential to release mercury, methyl mercury, silver, and arsenic from the depositional material stored behind the Kilarc Main Canal Diversion Dam (Table E.2.4-11). Overall, the data suggest that sediment samples from this impoundment have concentrations of mercury, silver and arsenic near or below background levels and below the TEL and PEL sediment quality screening values.

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8 "Background" values are derived from a compilation of United States and Canadian sources, but come primarily from *Int. Joint. Comm. Procedures for Assessment of Contaminated Sediment in the Great Lakes*, 1988. These "background values" are not specific to the geologic environment of the Cow Creek Watershed (Buchman, 2004).

Copper

Copper sediment data are summarized in Tables E.2.4-11 and E.2.4-12. Initial testing of samples K-II and K-III indicated that copper was present above NOAA screening levels. Therefore, additional analysis of copper sediments was performed, including duplicate samples from K-II and K-III and additional testing of samples K-1 and K-IV, with analysis of both total and leachable copper.[9] Note that sample K-I was composed of only the silt and clay fraction of the sediments (sieve size less than 0.063 mm), while the other samples were made up of the sand, silt, and clay fraction (sieve size less than 0.2 mm).

In general, the results indicate that copper concentrations within the typical sediment sample composed of sand, silt, and clay are at or slightly greater than the TEL (35.7 mg/kg), but well below the PEL (197 mg/kg). For Sample K-1, composed of only silt and clay, the measured concentration for both total and leachable copper analyses is above both the TEL and PEL. One hundred percent of the copper in this sample was found to be leachable, whereas in the more stratified samples, the leachable fraction was an average of 24 percent. To give perspective on these findings, the stored sediment particle size results and volume calculations indicate that the silt/clay size fraction is less than 0.5 percent of the measured dry weight of stored sediments and represents a total of less than 0.5 ton of silt and clay material for all of the sediments stored behind the Kilarc Diversion Dam (See Section E.2.3, Geomorphology). Based on a bulk density of 165.43 pounds per cubic foot (2.65 grams per cubic centimeter), this weight translates to an equivalent volume of less than 0.23 cubic yard.

<u>Cow Creek Development</u>

Field observations and geochemical data indicate that there is a low potential to release mercury, methyl mercury, silver, arsenic, and copper from the depositional material stored behind the South Cow Creek Diversion Dam (Table E.2.4-11). The geochemical data indicate that sediment samples from this impoundment have concentrations of trace metals near or within background levels and are below the TEL and PEL sediment quality screening levels. Note that background levels presented in Table E.2.4-11 are established based primarily on a different geologic environment than is present in northern California. A comparison to generally found background levels is a common practice that allows a general understanding of differences observed.

More specificially, mercury concentrations in Samples C-I and C-II were below background levels according to the NOAA sediment quality standards. The concentrations of methyl mercury in samples C-I and C-II were 0.032 mg/kg and 0.011 mg/kg, respectively, and were less than 1 percent of the total mercury concentration.

The concentrations of arsenic in Cow Creek Development samples were below NOAA sediment screening levels. The concentration of silver was within background levels according to the

9 Copper analysis was performed using EPA Methods 1638 (Total) or Method 1638 (mod) – leachable. The leachable copper test extracts the copper that is weakly adsorbed to the sediment surface by running a weak hydrochloric acid over the sample for a fixed amount of time and measuring the resulting dissolved copper concentration (Giddings et al., 1991). This is considered the bio-available fraction.

NOAA screening levels. Concentrations of copper fell below the PEL and TEL values and were within background levels.

E.2.4.7 2003 Water Temperature Conditions

Temperature is a significant limiting factor for aquatic biota. Excessive temperatures can induce high metabolic rates and oxygen-debt stress in fish and invertebrates. The Basin Plan objectives state that temperatures for cold or warm interstate waters are not to be increased by more than 5°F (2.8°C) above natural receiving water temperature and no increase is allowed which impacts beneficial uses (Table E.2.4-1). Although the diversion of water for hydropower reduces flow in the natural water courses and can cause an increase in temperature in the water remaining in the natural channel (i.e., bypass reach), the decommissioning of the Kilarc and Cow Creek developments will eliminate any effect of the Project on water temperatures. A Water Temperature Monitoring Study, as outlined in the First Stage consultation document (PG&E, 2002), was conducted in 2003 to support the relicensing of the Project. The study's important results are presented below.

Sampling and Analysis Methods

Stream temperatures were monitored in the downstream bypass reaches from May 14, 2003 to September 30, 2003.

Stream temperatures were automatically measured *in situ* at 20-minute intervals using Vemco MiniLog12 TR continuous temperature recorders at stations located above the diversions, throughout each bypass reach, in the forebays, and below the powerhouses (Figure E.2.4-1). The Minilog12 TR is a miniature microprocessor-controlled temperature logger that stores data in non-volatile memory. The temperature transducer is mounted on one end of the Minilog12 in a polycarbonate endcap. The MiniLog12 TR has a manufacturer's stated accuracy of ±0.1°C between 5 and 40°C (or ±0.18°F between 41 and 104°F). Data were transferred from the Minilog12 to a personal computer by an RS-232 interface using an infrared optical link. Data were downloaded and stored to disk at monthly intervals.

Temperature recorders were deployed inside a protective metal housing secured to the streambank with a chain. At each station, the recorder was placed *in situ* at a location chosen to provide representative homogeneous thermal conditions as well as accessibility and acceptable security from vandalism or theft. Each unit was calibrated prior to being deployed.

All information collected during field trips was recorded in a field data book, including station number, temperature recorder serial numbers, date and time of temperature recorder retrieval, *in situ* temperature, Global Positioning System (GPS) coordinates, if available, and other ancillary information. Water temperature monitoring station locations are shown in Figure E.2.4-1. The data are presented in Tables E.2.4-13 and E.2.4-14 and Figures E.2.4-2 to E.2.4-4.

Kilarc Development

Nine temperature monitoring stations were evaluated within the Kilarc Development from May through September in 2003. Two stations were located in North Canyon Creek (NC1 and NC2), two stations were located South Canyon Creek (CC1 and CC2), four stations were located in Old Cow Creek (OC1, OC2, OC3, and OC4), and one station was located in the Kilarc Forebay (KF1).

Cow Creek Development Area

Eight temperature monitoring stations were evaluated within the Cow Creek Development during the time period from May through September, 2003. Two stations were located in Mill Creek (MC1 and MC2), four stations were located in South Cow Creek (SC1, SC3, SC4, and SC5), one station was located in Cow Creek Forebay (CCF1), and one station was located in Hooten Gulch above the Abbott Diversion (HG1).

Evaluation of Results

Daily mean, maximum, minimum, and number of days the mean daily temperature exceeded 18°C and the maximum daily temperature exceeded 24°C at each monitoring station are provided in Tables E.2.4-13 and E.2.4-14.

A mean daily temperature of 18°C (65°F) was selected for evaluation as it is the management temperature for steelhead in the Feather and American rivers during the summer months (NMFS, 2001; SWRI, 2004). It is more conservative than the 19°C (66°F) criterion being considered by CDFG for trout statewide. The USEPA (1976) also identified 19°C as the maximum weekly temperature for growth for rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*).

A daily maximum temperature of 24°C (75°F) was selected as a temperature evaluation criterion for short-term high temperature exposure. The number of days in which the daily maximum temperature exceeded 24°C at any time is presented for each temperature recorder site. The use of 24°C for short-term exposure may be considered conservative (overly protective) based on available information. Based on available literature drawn largely from laboratory studies (Cherry et al., 1977; Coutant, 1977; Raleigh et al., 1984; Currie et al., 1998) the upper incipient lethal temperature for rainbow trout is within the range of 25 to 30°C (86°F); brown trout have been characterized as being tolerant of temperatures of up to 27°C (81°F). USEPA (1976) identified maximum weekly temperatures for survival for rainbow and brook trout as 24°C. Eaton et al. (1995) identified upper temperature criteria for rainbow and brown trout as 24.0 and 24.1°C, respectively. These studies indicate the temperatures trout can tolerate for periods ranging from 24 to 168 hours. Tables E.2.4-13 and E.2.4-14 report the number of days monitored temperatures exceeded 24°C for even 20 minutes; therefore, this application is very conservative.

Kilarc Development

Temperature monitoring data collected in May through September, 2003 as part of the relicensing studies show that mean daily temperatures remained below 18°C throughout the bypass reach, even during the warmest part of the year (late July) at all stations except OC3. Maximum daily temperatures did not exceed 24ºC. In general, stream temperatures were coolest at the upstream end of the Project Area and warmer with distance downstream in the bypass reach.

A Basin Plan objective states that water temperatures should not be increased by more than 5°F above natural receiving water temperature. To determine Project effects on water temperature warming in the bypass reach, water temperature recorded at station OC1 (upstream of the Kilarc Diversion Dam, representing “natural” water temperature) was compared to the water temperature recorded at station OC3 (Old Cow Creek bypass reach immediately above the Kilarc Powerhouse) (see Figures E.2.4-1 and E.2.4-2). It is important to recognize that even under natural conditions, Old Cow Creek would be expected to warm between these two points, but there is insufficient information to determine how much warming would have occurred in 2003 without the Project. The difference in the increase of the mean daily temperatures ranged from 1.8°C (3.3°F) in May to 4.4°C (7.9°F) in July, and exceeded 5°F during portions of the months of July, August and September. Mean daily temperatures can warm by 4 to 5°C (7 to 9°F) in the bypass reach relative to the water temperature immediately upstream of the Kilarc Diversion Dam. The return water from the tailrace reduces stream temperature by up to 2°C (4°F) relative to the water temperature immediately above the Kilarc Powerhouse, depending on the day and time of year.

Mean daily temperatures in North Canyon Creek ranged from 8.1 to 11.7 ^{o}C (46.6 to 53.1°F) over the duration of the monitoring period (Table E.2.4-13). Mean daily temperatures in South Canyon Creek ranged from 7.7 to 9.7^{o}C (45.9 to 49.5°F) over the duration of the monitoring period. Maximum daily temperatures did not exceed 24ºC. Temperatures in South Canyon Creek were the lowest observed in the Kilarc Development over the duration of the monitoring period.

Cow Creek Development Area

Mean daily water temperatures in South Cow Creek ranged from 11.9 to 21.7°C (53.4 to 71.6°F). All eight stations exceeded a mean daily temperature of 18^{o}C (64°F) at least once during the monitoring period (Table E.2.4-14 and Figure 2.4-3). Mean daily water temperatures in South Cow Creek were warmest just above the confluence with Hooten Gulch (SC5). Mean daily temperatures commonly exceeded 18°C from mid-June until the end of August.

Maximum daily temperatures exceeded 24°C during the month of July and in early August at numerous stations (Figure E.2.4-4 and Table 2.4-14). Notably, the maximum daily temperature exceeded 24°C for at least 20 minutes at Station SC1 (located near the South Cow Creek Diversion Dam) on 13 days, at Station SC4 on 12 days, and at SC5 on 19 days. Other stations recorded less frequent exceedances of this temperature. The significance of these results in relation to aquatic resources is discussed in Sections E.2.5 and E.3.5 (Impacts to Aquatic Resources).

Monitoring stations SC1 and SC4 were used to evaluate Project effects on water temperature warming in the bypass reach (Figure 2.4-3). SC1 is located above the Cow Creek Diversion and SC4 is located in Cow Creek above the Hooten Gulch confluence. As on Old Cow Creek, some warming would occur between these two points, even without the Project, but how much warming cannot be determined from the existing information. The increase in mean daily temperature ranged from 0.8°C (1.4°F) to 1.4°C (2.6°F), which is less than the Basin Plan criterion of >5ºF.

E.2.5 Aquatic Resources

Aquatic resources are described in this section relative to the Project Area. This section describes the species of fish present in the Project Area, fish stocking practices, and aquatic habitat in the Project Area and Project-affected bypass reaches. Anadromous salmonids are discussed in more detail due to their special-status designations.

E.2.5.1 Background

The Cow Creek Watershed supports populations of anadromous salmonids, as well as native and introduced resident species (SHN, 2001). The species present in the Project Area are shown in Table E.2.5-1. Resident species common to Old Cow and South Cow creeks are rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and riffle sculpin (*Cottus gulosus*). South Cow Creek below Wagoner Canyon also supports numerous other native and introduced resident species. In addition, South Cow Creek supports several species of anadromous fish including fall-run Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and lamprey (species unknown, but likely Pacific lamprey [*Lampetra tridentata*]). Life history descriptions and timing for the species identified are described in the Aquatic Habitat and Fisheries Resources Report (Appendix J-2) (PG&E, 2007a).

Historically, the Cow Creek watershed was stocked extensively. CDFG planted a variety of species since at least the 1930's (SHN, 2001), including Chinook salmon, steelhead, rainbow trout (of various strains), brown trout (of various strains), and Eastern brook trout. In the 1990s, rainbow trout and steelhead were planted in the streams and rainbow trout have been planted in Kilarc Forebay (SHN, 2001). CDFG has adopted a policy of not stocking fish in waters supporting anadromous fish. At this time, rainbow trout are stocked into Kilarc Forebay, but no other stocking occurs in the Project Area (S. Baumgartner, pers. comm., 2008; M. Myers, pers. comm., 2009).

Three runs of anadromous salmonids that may occur within the Project Area are either listed or have been considered for listing under the federal Endangered Species Act (ESA). These are steelhead, fall- and late fall-run Chinook salmon (Bailey, 1965; Healey, 1965; Moock and Steitz, 1984; TRPA, 1985; TRPA, 1986; Mills and Fisher, 1994; SHN, 2001; PG&E, 2007a; Killiam, 2007), and spring-run Chinook salmon (Parkinson, pers. comm., 2003; Harvey, 1997) (Table E.2.5-2).

The Central Valley Steelhead population unit (Distinct Population Segment [DPS]), which is listed as threatened under the ESA, includes all naturally spawned populations of steelhead within the Sacramento and San Joaquin River Basins (71 FR 834). Critical habitat for Central Valley Steelhead was designated September 2, 2005 and includes portions of Cow Creek and its tributaries (70 FR 52488). This critical habitat extends through the Project Area on South Cow Creek about 7 miles upstream of the Cow Creek Diversion Dam to the mouth of Hagaman Gulch. Critical habitat on Old Cow Creek for steelhead extends upstream to near the Whitmore Radio Range Station and Whitmore Falls (CDFG, 2009; Brown, pers. comm., 2008), which is downstream of the Kilarc Development.

The Central Valley fall- and late fall-run Chinook salmon population unit is designated as a species of concern by NMFS and includes all naturally spawned populations of fall- and late fall-run Chinook salmon in the Sacramento and San Joaquin rivers and their tributaries. Fall- and late fall-run Chinook salmon have been reported to occur in South Cow Creek (SHN, 2001).

The Central Valley spring-run Chinook salmon population unit, which is listed as threatened under the ESA, includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries (70 FR 37160). Critical habitat for Central Valley spring-run Chinook salmon was designated on September 2, 2005 (70 FR 52488), but does not include Cow Creek or its tributaries. A few individual fish that may have been spring-run Chinook salmon were observed in the vicinity of the Project. These fish were believed to be strays from other systems (Harvey, 1997; PG&E, 2007a).

E.2.5.2 Kilarc Development

Old Cow Creek

Historically, CDFG managed Old Cow Creek for resident salmonids above Whitmore Falls (including the Project Area), and for anadromous salmonids below Whitmore Falls. Whitmore Falls had long been considered an impassable barrier to anadromous salmonids. CDFG and NMFS re-evaluated the barrier at Whitmore Falls in 2003 and now believe that this barrier may be passable under unspecified high flow conditions (A. Manji, pers. comm., 2002, confirmed December 17, 2008). The reclassification of the barrier at Whitmore Falls led CDFG and NMFS to revise their management objectives for the Project Area to include anadromous salmonids.

The timing of migration for the different species (PG&E, 2007a) and runoff patterns may allow steelhead and spring-run Chinook salmon to move past Whitmore Falls and utilize upstream habitat within the Project Area. The NOAA Fisheries status report (Myers et al., 1998) did not report spring-run Chinook salmon in Cow Creek and its tributaries, when the species was being considered for listing under the ESA, but the timing of sightings in Old Cow Creek below Whitmore Falls (Harvey, 1997) and in South Cow Creek during relicensing studies (PG&E, 2007a) coincide with the migration timing of spring-run Chinook. It is not believed, however, that spring-run Chinook are consistently using the Cow Creek watershed for spawning and rearing, but that these fish are strays from other streams. Fall-run Chinook salmon spawners migrate upstream in August through December, when flows are likely too low for them to pass over Whitmore Falls; however, it may be possible for them to pass over the falls during early storms. The frequency with which steelhead or fall-run Chinook might pass over Whitmore Falls is unknown, as there have been no studies to assess this (M. Myers, pers. comm., 2008).

CDFG identified a waterfall located 2.7 miles upstream of the Kilarc Powerhouse as a barrier to upstream migration (A. Manji, pers. comm., 2002). Surveys conducted by PG&E's relicensing consultant indicated that this barrier likely precludes the use of the upper portion of the Project Area by anadromous salmonids. Survey results determined that this 12-foot-high falls was likely to be impassable at any flow. This opinion was shared by CDFG (M. Myers, pers. comm., 2008) and NMFS (D. White, pers. comm., 2008). The PG&E surveys also identified a boulder cascade located 3 miles upstream of Kilarc Powerhouse (between these 12-foot falls and the Kilarc Main Canal Diversion Dam) that was assessed as a barrier at most flows. Eleven other barriers were also identified within the Old Cow Creek bypass reach. These barriers were assessed as passable at some flows (PG&E, 2007a).

Habitat data collected during relicensing studies in 2002 to 2003 indicate that the bypass reach generally provided suitable habitat for salmonids, with a good mix of habitats (riffle, run pool) with good structure and abundant cover (PG&E, 2007a). Dominant substrate in Old Cow Creek was boulder and cobble. The spawning gravel available ranged from fair to good in quality for rainbow trout and steelhead, and ranged from poor to fair for Chinook salmon. The stream was shaded by riparian vegetation and the canyon walls. As discussed in Section E.2.4.7 (2003 Water Water Temperature Conditions) temperature monitoring data collected in May through September, 2003 showed that mean daily temperatures were cool, generally remaining below 18°C, throughout the bypass reach, even during the warmest portion of the year (late July). The cool temperatures provide desirable conditions for rearing salmonids.

Rainbow trout were the most abundant species in the Kilarc Development area during the relicensing surveys. This species made up over 90 percent of the total number of fish at all sites sampled (PG&E, 2007a). Other species present included riffle sculpin and brown trout. Additionally, a few Sacramento pikeminnow (*Ptychocheilus grandis*) were observed. These results were consistent with those of previous studies conducted in Old Cow Creek drainage including a CDFG study near Kilarc Powerhouse (SHN, 2001), and a TRPA (2002) study completed for the Olson Power Plant located downstream of the Kilarc Development.

North and South Canyon Creeks

Limited information is available for North and South Canyon creeks. North and South Canyon creeks are small, shallow creeks that may support resident trout species. North Canyon Creek is a small, ephemeral stream, and supports limited or no flow during the summer months, depending on water year type. South Canyon Creek is somewhat larger and perennial, although still much smaller than Old Cow Creek.

Kilarc Main Canal

Kilarc Main Canal conveys water from the Kilarc Main Canal Diversion Dam to Kilarc Forebay. The canal is approximately 3.65 miles long. Data collected in 2002 to 2003 indicate that the unlined sections of the canal provided some habitat for smaller fish, as these portions of the canal had some cover in the form of cobbles and smaller boulders, as well as aquatic and overhanging terrestrial vegetation (PG&E, 2007a). Substrate in Kilarc Main Canal was dominated by sand and cobbles. This habitat appeared to be more favorable at the upstream end of the canal than at the downstream end. The Kilarc Main Canal is unscreened and fish could enter the canal from upstream of the diversion or from the Kilarc Forebay. Fish densities within the canal were generally low and populations consisted of rainbow and brown trout. Brown trout in the canal may be the offspring of fish from the Kilarc Forebay given that the area upstream of the diversion supported very low densities of brown trout, whereas the forebay had relatively high densities of adult brown trout. The actual origin of these brown trout and the rainbow trout observed is unknown.

Kilarc Forebay

Kilarc Forebay has a surface area of 4 acres (PG&E, 2007b). The forebay was observed to be generally shallow with abundant rooted algae and plants (PG&E, 2007a). Kilarc Forebay provides a local recreational fishing opportunity (Refer to Section E.2.10 Recreation). The forebay supported large numbers of naturally-produced brown trout. There are no inflows to the impoundment other than the Kilarc Canal. Rainbow trout also were sampled in the forebay, but only a small proportion appeared to be of wild origin; most of these fish are planted by CDFG. Golden shiners, an introduced species, also were found in Kilarc Forebay.

E.2.5.3 Cow Creek Development

South Cow Creek

South Cow Creek is managed for anadromous and resident fish, with a focus on anadromous salmonids. In the 1980s and 1990s mostly steelhead were planted with some rainbow trout (SHN, 2001), while prior to that rainbow trout were planted in the greatest numbers, with smaller plantings of eastern brook trout and Chinook salmon. CDFG has adopted a policy of not stocking fish in waters supporting anadromous fish, and no stocking currently occurs in the vicinity of South Cow Creek (Baumgartner, pers. comm., 2008; M. Myers, pers. comm., 2008).

Steelhead have been observed in South Cow Creek both within and upstream of the Project-affected bypass reach (Healey, 1974; Moock and Steitz, 1984; TRPA, 1986; SHN, 2001). Chinook salmon have been observed in areas of the bypass reach, but generally appear to be restricted by natural barriers within Wagoner Canyon (Healey, 1965; CDFG, unpublished data).

Data collected in 2002 to 2003 indicate that habitat in South Cow Creek was predominantly pool (65 to 70 percent) in all reaches, with the remaining habitat divided equally between riffles and runs (PG&E, 2007a). The proportions of shallow and deep pools (with 3 feet being the dividing point) were similar. Below Wagoner Canyon the level of confinement of the stream channel decreased and the stream was wider and shallower. Within, and upstream of Wagoner Canyon, the stream was narrower and deeper. Cover was generally abundant throughout the bypass reach, but was more limited below Wagoner Canyon. Substrate in the bypass reach was dominated by boulders, with cobble and gravel. Spawning gravel tended to be concentrated toward the top of Wagoner Canyon. Spawning gravel was located primarily within pool habitat, especially shallow pool habitat. Run habitat also provided a high proportion of good to excellent spawning gravel for each species.

Mean daily temperatures in South Cow Creek were warmer than optimal for steelhead from June through September, 2003, both above and throughout the bypass reach (Section E.2.4.7). Maximum daily temperature exceeded 24°C about half the time in July, but generally remained less than this the rest of the year. These temperatures could result in sub-lethal effects, and potentially some mortality, for rearing steelhead. This is based on the very conservative use of instantaneous maximum daily temperatures, whereas most of the laboratory studies used in defining this limit are based on exposures of one to seven days. These water temperatures would not provide optimal growing conditions for rearing steelhead and rainbow trout.

Passage within the bypass reach is impeded at low flows by several natural barriers, mostly located near the upstream end of Wagoner Canyon (PG&E, 2007a). A total of nine barriers to fish migration were noted within the bypass reach, including the South Cow Creek Diversion Dam, which is made passable by a fish ladder. The remaining barriers were natural falls that were 3 to 6 feet tall or cascades that could present difficulties under low flow conditions, but likely would be passable at higher flows. Flows of 20 to 25 cfs would likely allow passage at all of these barriers.

The South Cow Creek Diversion Dam is equipped with fish protection facilities including fish screens to prevent entrainment of young fish to the canal and a ladder to pass adult fish upstream. Adult steelhead have been observed using the ladder to access upstream habitat (Moock and Steitz, 1984).

South Cow Creek supports various species of fish (PG&E, 2007a; TRPA, 1985). The fish community structure changed substantially at the downstream end of Wagoner Canyon (PG&E, 2007a). In the sites within and upstream of Wagoner Canyon, the fish community consisted of California roach and rainbow trout or steelhead, with roach being more numerous than rainbow trout. Lamprey were also observed in the South Cow Creek Main Canal and so presumably are present in South Cow Creek, although none were observed there. In the area downstream of Wagoner Canyon, the fish community consisted of seven to nine species (several of which are introduced) typical of the "pikeminnow-hardhead-sucker assemblage" (Moyle, 2002, previously referred to as the transition zone community).[10] The fish community below Wagoner Canyon consisted of (in order of numerical abundance) California roach, speckled dace, rainbow trout, Sacramento pikeminnow, Sacramento sucker, riffle sculpin, and smallmouth bass. Low numbers of Chinook salmon and largemouth bass were also observed. Different studies have reported

[10] The "pikeminnow-hardhead-sucker assemblage" generally lies between the coldwater communities of mountain streams and the valley floor communities, and often contains species from both communities. The species composition in these areas often varies seasonally, depending on flow and water temperature.

Chinook salmon spawning between the confluence with Cow Creek to the base of Wagoner Canyon (Healey, 1974; CDFG, unpublished data). Steelhead activity within the Cow Creek Development area ranges from the confluence with Hooten Gulch to the South Cow Creek campground (Moock and Steitz, 1984; CDFG, 2001; Healey, 1974; TRPA, 1986), which is upstream of the Cow Creek Development. Lamprey (species unknown) also use this area to an unknown extent. While they were not observed in South Cow Creek sampling, a few lamprey ammocetes were captured in the South Cow Creek Main Canal (PG&E, 2007a).

Mill Creek

Mill Creek was generally a low gradient stream with thick riparian growth along the banks. Substrate was predominantly bedrock with a few cobbles interspersed (PG&E, 2007a). Cover in Mill Creek consisted mostly of overhanging vegetation, as well as turbidity above the Mill Creek Diversion Dam.

It is unkown which fish species occur in Mill Creek with the exception of rainbow trout that are found above the Mill Creek Diversion Dam (Table E.2.5-1, PG&E, 2007a). Species found in South Cow Creek above Wagoner Canyon (steelhead/rainbow trout, roach, and lamprey) are also likely to be present in Mill Creek below the diversion, and that non-anadromous species could also be found above it.

Hooten Gulch

Hooten Gulch is a low gradient, U-shaped stream channel with 10-foot-high banks (PG&E, 2007a). This stream is ephemeral above the Cow Creek Powerhouse even early in the year. Cow Creek Tailrace water from the Cow Creek Powerhouse flows down Hooten Gulch. A small diversion takes water from Hooten Gulch into the Wild Oak Powerhouse (not part of the Kilarc-Cow Project) just downstream of the Cow Creek Tailrace. A second diversion near the confluence of Hooten Gulch and South Cow Creek takes water from Hooten Gulch into Abbott Ditch, an irrigation canal (not part of the Project). The Abbott Diversion prevents fish from moving upstream into Hooten Gulch from South Cow Creek. The banks along Hooten Gulch are eroded. Data collected in 2002 to 2003 indicate that the primary habitat types within Hooten Gulch were pool and riffle (PG&E, 2007a). Substrate consisted mainly of cobble, with lesser components of gravel and boulder. Spawning habitat was poor due to high embeddedness of potential spawning substrates. Hooten Gulch supported California roach, riffle sculpin, and rainbow trout.

South Cow Creek Main Canal

South Cow Creek Main Canal conveys water from the South Cow Creek Diversion Dam to Cow Creek Forebay. The canal is 2.1 miles long. Cover within the South Cow Creek Main Canal consisted primarily of aquatic macrophytes and cobbles (observations during relicensing studies). The canal had little riparian vegetation along the banks. Substrate was primarily sand with a few cobbles.

The South Cow Creek Main Canal is screened to prevent fish from being entrained into the canal. Two sampling surveys in the canal in 2003 found relatively few fish and only three species. In order of decreasing abundance, these were California roach, rainbow trout, and lamprey.

Cow Creek Forebay

Cow Creek Forebay is a small forebay (1 acre) in a relatively open area (PG&E, 2007b). Cover within the forebay consisted of submerged aquatic vegetation, algae, and sedges (PG&E, 2007a). Cow Creek Forebay primarily supported populations of golden shiner and green sunfish. A few Sacramento sucker and rainbow trout were also observed (PG&E, 2007a).

E.2.6 Wildlife Resources

The following discussion of wildlife resources within the Project Area includes a description of general wildlife, game species, raptors, and special-status species. Detailed descriptions of the studies, including methods and results are described in the following sections, and presented in Appendices J-1 (Botanical, and Terrestrial and Aquatic Wildlife Resources Report), and K (California Red-legged Frog Report).

E.2.6.1 Methods

The assessment of wildlife resources is based on a review of existing information for the Project Area, agency consultations, and field surveys. The nomenclature of habitats used in this report is based on *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer, 1988). The nomenclature of animals is based on *A Checklist of the Amphibians, Reptiles, Birds, and Mammals of California* (Laudenslayer et al., 1991).

Literature Review

Information on the special-status wildlife of the Kilarc and Cow Creek developments was obtained through a search of the California Natural Diversity Database (CNDDB: CDFG, 2003); the U.S. Fish and Wildlife Service (USFWS), Sacramento Office, Endangered Species Division's species list (USFWS, 2003); Cow Creek Watershed Assessment (SHN, 2001); Kilarc-Cow Creek Hydroelectric FERC No. 606 First Stage Consultation Package (PG&E, 2002a); and other biological studies completed in the vicinity of the Project. Additional CNDDB and USFWS list searches were performed in 2008 (CDFG, 2008a; USFWS, 2008a) to provide updated information on species occurrences and listing status. Relevant technical information from these documents is incorporated into this document and referenced as appropriate.

Field Surveys

Field surveys for wildlife resources were conducted in the Kilarc and Cow Creek developments in the spring, summer, and fall of 2003. This included a reconnaissance-level wildlife survey, a California red-legged frog site assessment and foothill yellow-legged frog surveys. Vegetation mapping (i.e., habitat mapping) was conducted in the summer and fall of 2003. A detailed description of vegetation mapping study methods is provided in Section E.2.7.1 Botanical Resources. No additional wildlife studies were performed in 2008 because additional areas that will be disturbed during decommissioning activities (e.g. improvements to roads needed for access to construction sites) will be limited, and contain habitat types similar to areas assessed in 2003. Furthermore, pre-construction surveys will be implemented prior to implementation of decommissioning activities. The methods for conducting the Project wildlife surveys are described below.

Reconnaissance-Level Wildlife Survey

Reconnaissance-level surveys for terrestrial wildlife habitats were conducted in the Kilarc and Cow Creek developments from April 22 to 24, 2003, and June 17 to 18, 2003. The objective of these surveys was to identify and evaluate the wildlife habitats present in the Kilarc and Cow Creek developments and record wildlife observations. The study area consisted of: (1) intake areas at the North Canyon Creek, South Canyon Creek, Kilarc Main Canal, Mill Creek, and South Cow Creek diversion dams; (2) Kilarc Forebay, Kilarc Penstock, Kilarc Powerhouse, Cow Creek Forebay, Cow Creek Penstock, and Cow Creek Powerhouse; (3) North Canyon Creek Canal, South Canyon Creek Canal, Kilarc Main Canal, Mill Creek-South Cow Creek Canal, and South Cow Creek Main Canal; and (4) bypass reaches of Old Cow and South Cow creeks.

Wildlife habitats were identified, and all wildlife observed or detected through diagnostic sign (i.e., track, scat, feather, carcass, etc.) were identified to species and recorded. Incidental wildlife sightings made during 2003 field surveys are provided in Table E.2.6-1. Any special-status plants or wildlife observed or detected were recorded and locations were mapped (see Figure E.2.6-2, Maps 1, 2, and 3).

Surveys were conducted in representative habitat for special-status wildlife species. Areas potentially supporting special-status species (i.e., California red-legged frog [*Rana aurora draytonii*], foothill yellow-legged frog [*Rana boylii*], northwestern pond turtle [*Actinemys marmorata marmorata*], bald eagle [*Haliaeetus leucocephalus*], California spotted owl [*Strix occidentalis occidentalis*], American peregrine falcon [*Falco peregrinus anatum*], little willow flycatcher [*Empidonax traillii brewsteri*], California thrasher [*Toxostoma redivivum*], ringtail [*Bassariscus astutus*]) and several species of bats were specifically targeted.

Valley Elderberry Longhorn Beetle Habitat Surveys

Focused valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*; VELB) habitat surveys were conducted in the Kilarc and Cow Creek developments in conjunction with the special-status plant species surveys in May and June 2003, and riparian surveys in July and August 2003. The focused surveys followed established guidelines (USFWS, 1999) and were performed in all accessible areas within 25 feet of bypass reaches and 100 feet of Project facilities. The locations of elderberry shrubs were mapped and are shown on Figure E.2.6-1 (Maps 1 and 2). The number of stems in each of the following categories was recorded: less than 1 inch, 1 to 3 inches, 3 to 5 inches, and greater than 5 inches in diameter. Stem diameters were estimated for shrubs that were inaccessible. Observations of the presence or absence of stem holes and beetles were recorded.

California Red-Legged Frog Site Habitat Assessment

A site assessment for California red-legged frog was conducted according to guidance published by USFWS (1997). The following is a summary of the site aseessment methods used. The site assessment report is provided in Appendix K.

Information was obtained from all available resources including literature on habitat requirements and life history of California red-legged frogs, a CNDDB search (CDFG, 2003), a search of the catalogs of the two major western museum collections (Museum of Vertebrate Zoology, U.C. Berkeley; and California Academy of Sciences, San Francisco), topographic maps, aerial photographs, and preliminary information obtained during habitat mapping surveys and vegetation surveys conducted as part of other Project relicensing studies. Habitat information was also collected during helicopter surveys and ground surveys in representative sites in Project-affected reaches, and photographs were taken to document representative habitat.

A preliminary California red-legged frog habitat assessment was conducted within the Site Assessment Area (detailed below) from a preliminary helicopter survey, and from topographic maps, aerial photographs, and preliminary information obtained during habitat mapping surveys and vegetation surveys conducted as part of other Project relicensing studies. The Site Assessment Area was comprised of reaches in the Kilarc and Cow Creek developments or Project-affected reaches in Old Cow Creek, South Cow Creek, diverted tributaries, Hooten Gulch, and diversion canals. These reaches were divided into half-mile reaches on a topographic map and each half-mile reach was numbered. Half-mile reaches were used because they were short enough to document photographically yet long enough to detect potential habitat changes along the streams. Springs and ponds within the Site Assessment Area that could potentially support California red-legged frogs, but not affected by the Project, were also identified and numbered.

A helicopter reconnaissance survey was conducted on July 8, 2003, to document potential California red-legged frog habitat within the Site Assessment Area during early summer, when seasonal waterways still contained sufficient water for tadpoles and potential rearing sites could be identified. Photographs of habitat were taken and waypoints of these areas were recorded during the flight. Three representative reaches of Old Cow Creek and two reaches of South Cow Creek were selected for ground site assessments. These three reaches were selected based on their similarity to the remaining portions of the creeks, as determined from the helicopter surveys. Ground habitat assessments for potential California red-legged frog spawning or summer habitat were conducted concurrently with daytime ground surveys for foothill yellow-legged frogs and habitat in Project-affected reaches.

Ground surveys were conducted on July 7 and 8, 2003, July 9 to 12, 2003, and September 5 to 6, 2003. During ground surveys, habitat factors that may affect California red-legged frog were recorded in field notebooks. These factors included: general habitat characteristics; the presence of pools and backwater areas; vegetation; cover; the presence of other aquatic species such as fish, aquatic garter snakes, and bullfrogs (*Rana catesbeiana*); and the availability of insects that may provide forage for frogs or algae that may contribute to primary productivity, and water temperatures. The start and end points of the surveys were documented with photographs and GPS coordinates (where signal strength was sufficient). Additional photographs were taken of representative habitats and sites that contained habitat characteristics favorable for California red-legged frogs.

Foothill Yellow-Legged Frog Survey and Habitat Assessment

PG&E's protocol (PG&E, 2002b) was used to survey for foothill yellow-legged frogs and their habitat. This approach included preliminary field planning, visual encounter surveys, and habitat assessments.

Preliminary Field Planning

Preliminary field planning was conducted to identify survey sites with potentially suitable foothill yellow-legged frog habitat and to select the timing of surveys. Survey sites were selected based on existing data on foothill yellow-legged frogs in the study area, identification of potentially suitable habitat in the study area, and the results of preliminary habitat assessments. Additional resources relied upon to select survey sites included information obtained from the literature on habitat requirements and life history of foothill yellow-legged frogs, a CNDDB (CDFG, 2003) search, topographic maps, aerial photographs, historical records from the two major western museum collections (Museum of Vertebrate Zoology, U.C. Berkeley; and California Academy of Sciences, San Francisco), preliminary information obtained during habitat mapping surveys and vegetation surveys, and a helicopter survey. Kilarc Main Canal, North and South Canyon Creek canals, South Cow Creek Main Canal, Mill Creek-South Cow Creek Canal, and bypass reaches in Old Cow Creek, South Cow Creek, and diverted tributaries were divided into numbered half-mile sections on topographic maps. Topographic and aerial maps were examined to identify potential habitat. A helicopter survey was conducted on July 8, 2003, to assess potential foothill yellow-legged frog habitat. Streams were photographed and GPS waypoints for potential habitat were recorded during the flight.

Survey sites were selected in representative sections of the study area that contained moderate- to high-value habitats for foothill yellow-legged frogs, based on species-specific criteria. All Project-affected reaches occur at elevations below 4,000 feet. The downstream and upstream ends of South Cow and Old Cow creek bypass reaches were surveyed to include a range of elevations within the Project Area. A short reach, 427 feet upstream of Hooten Gulch and the Wild Oak Powerhouse, a private hydroelectric facility, was surveyed in September 2003. North Canyon Creek was not surveyed because most of it was dry during the aerial survey and the wetted downstream portion was very shaded. Egg masses are usually located in open areas with little shade, and tadpoles generally occur in the same habitat as egg masses (PG&E, 2002b). Mill Creek (which also goes dry in some years) was surveyed for tadpoles downstream of the Mill Creek Diversion Dam, but was not surveyed further because it is small and densely vegetated. The Kilarc Main Canal, North and South Canyon Creek canals, South Cow Creek

Main Canal, and Mill Creek-South Cow Creek Canal are relatively straight, concrete-lined, or earthen channels with swiftly flowing water and no habitat complexity. Therefore, they do not contain primary foothill yellow-legged frog habitat. The survey team walked along three short segments of these canals, including segments downstream of the Mill Creek Diversion Dam, downstream of the South Cow Creek Diversion Dam, and directly upstream of the Kilarc Forebay.

Visual Encounter Surveys

Two sets of visual encounter surveys were conducted from July 7 through July 12, 2003 and from September 2 through September 6, 2003, as specified in protocols developed by PG&E (PG&E, 2002b). A tadpole survey was conducted in July 2003, after late spring flows had subsided. A second survey for juveniles, subadults, and adults was conducted in the first week of September. Teams searched for eggs, tadpoles, and frogs between 9:00 am and 4:00 pm (10:00 am and 4:00 pm in September when days were shorter) when frogs were expected to be basking. Adjacent aquatic habitat and suitable aquatic habitat was searched. All observations were recorded on visual encounter survey data sheets (PG&E, 2002b). GPS coordinates and photographs were obtained to document the start and end points of visual encounter surveys, and photographs were taken of representative habitats. Factors were noted that may affect foothill yellow-legged frogs, such as the presence of cobble bars and side channels, tributary or spring inputs, the presence of other aquatic species such as fish, turtles, aquatic garter snakes and bullfrogs, the availability of insects that may provide forage for frogs, and algae that may contribute to primary productivity.

Habitat Assessment

Habitat was assessed immediately following the initial visual encounter surveys. If foothill yellow-legged frogs were not found, habitat assessments were conducted in the most suitable, representative habitat in one or more subsites. Habitat was also assessed wherever foothill yellow-legged frogs were observed. Data were recorded on habitat assessment data sheets and included information on riparian vegetation, aquatic and terrestrial cover, substrate, water quality, aquatic habitat, and upland habitat (PG&E, 2002b).

Raptor Surveys

Two surveys were conducted in 2003 for bald eagle (*Haliaeetus leucocephalus*), American peregrine falcon (*Falco peregrinus anatum*), and other raptors in the early morning hours (dawn) during the raptor-nesting season (April to June) to detect raptors or the presence of nests. Surveys were concentrated near the Kilarc Forebay, as the area was identified as a known perching and suspected foraging location. Two biologists walked the perimeter of Kilarc Forebay and performed a binocular survey of the surrounding area for at least 30 minutes for each survey period. Any raptors detected were identified, and the following information was recorded: date, time, location, sex, age, species, and behavior. Incidental sightings of raptors were also made by biologists during the course of other surveys for the Project. In addition, treetops, cliffs, and other potential nest sites were scanned for active nests during the helicopter survey completed on July 8, 2003.

Habitat Mapping

Surveys were conducted during 2003 to map the extent and location of vegetation communities and wildlife habitats in the Kilarc and Cow Creek developments (Figures E.2.6-3 and E.2.6-4). The habitat information was incorporated into a GIS database. Habitat for common and special-status wildlife species within these vegetation communities was determined based on a comparison of the mapped plant communities with habitat types in *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer, 1988).

E.2.6.2 General Wildlife Resources

The following description of the general wildlife resources occurring in different plant communities within the Kilarc and Cow Creek developments includes common, resident, and migratory species. This discussion is based on species observation and diagnostic sign (i.e., scat, feather, track, etc.) observed during field surveys and on species expected to occur in the Kilarc and Cow Creek developments based on habitats present (Figures E.2.6-3 and E.2.6-4). These habitat types are further discussed in Section E.2.7, Botanical Resources.

Sierran Mixed Conifer

This habitat type (Sierran Mixed Conifer in Figures E.2.6-3 and E.2.6-4) occurs in southern Oregon and California, dominating mid-elevation slopes in the western Sierra Nevada. This forest habitat generally forms a vegetation band ranging from 2,500 feet to 4,000 feet in the north to 4,000 to 10,000 feet in the southern Sierra Nevada (Mayer and Laudenslayer, 1988). This habitat is an assemblage of conifer and hardwood species and is composed of white fir (*Abies concolor*), Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), incense-cedar (*Calocedrus decurrens*), and California black oak (*Quercus kelloggii*). Sierran mixed conifer forest is the most common forest type in the Kilarc Development and is widely distributed from 3,000 to 6,000 feet in elevation. This habitat also occurs in the Cow Creek Development.

These forests provide habitat for small mammals, such as chipmunks (*Tamius* spp.), western gray squirrel (*Sciurus griseus*), deer mouse (*Peromyscus maniculatus*), and bats (*Myotis* spp.). Larger mammals typically found in these communities include gray fox (*Urocyon cinereoargenteus),* black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*). Large trees and snags can also provide nesting sites for raptors, such as red-tailed hawks (*Buteo jamaicensis*). Reptiles, such as the western fence lizard (*Sceloporus occidentalis*), may also be present. Typical birds of coniferous forests in the Kilarc and Cow Creek developments include dark-eyed junco (*Junco hyemalis*), mountain chickadee (*Parus gambeli*), Steller's jay (*Cyanocitta stelleri*), western wood-pewee (*Contopus sordidulus*), and northern flicker (*Colaptes auratus*).

Ponderosa Pine

This habitat type (Ponderosa plantation in Figure E.2.6-4) occurs at an elevational range from 2,000 to 5,000 feet in the north, to 4,500 to 6,500 feet in southern California (Mayer and Laudenslayer, 1988). This is the lowest-occurring montane forest type over most of its range and intergrades with Sierran mixed conifer habitat on moist sites (often north-facing slopes) and Jeffrey pine forest habitat on dry sites. The community is dominated by ponderosa pine and may also include white fir, incense cedar, and Coulter pine (*Pinus coulteri*). Ponderosa pine habitat occurs as a plantation (rows) versus forest of trees within the Old Cow Creek vicinity of the Kilarc Development.

This habitat sometimes serves as a wildlife corridor for deer and can be extremely important to deer nutrition in migration holding areas (Mayer and Laudenslayer, 1988). Early and late successional stages of this forest type provide habitat for several wildlife species. Wildlife species observed or expected to occur in this habitat include mountain quail (*Oreortyx pictus*), western scrub jay (*Aphelocoma californica*), and western gray squirrel. Large trees and snags can also provide nesting areas for raptors, such as red-tailed hawk.

Montane Hardwood

This habitat type (Interior Live Oak Woodland in Figure E.2.6-3) occurs throughout California, mostly west of the Cascade-Sierra Nevada crest, and east of the crest in localized areas of Placer, El Dorado, Alpine, and San Bernardino counties (Mayer and Laudenslayer, 1988). Elevations range from 300 to 9,000 feet. Dominant plant species include interior live oak (*Quercus wislizenii*), canyon live oak (*Q. chrysolepis*), and Douglas fir. Interior live oak and canyon live oak trees are well represented in this woodland community where it occurs along South Cow Creek within the Cow Creek Development.

Common wildlife species that may be present in this habitat include acorn disseminators and species that utilize acorns as a major food source, similar to blue oak-foothill pine described below. Deer forage on hardwood foliage and several species of reptiles, birds, and mammals utilize the forest floor of this habitat including racer (*Coluber constrictor*), gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis getula*), raptors, owls, yellow-pine chipmunk (*Tamias amoenus*), and Allen's chipmunk (*T. senex*).

Blue Oak-Foothill Pine

This habitat type (Blue Oak Woodland Foothill Pine in Figures E.2.6-3 and E.2.6-4) forms a nearly continuous belt around the Central Valley, between lower elevational grassland and lower montane mixed conifer forest, except for a gap in Tulare County where foothill pine (*Pinus sabiniana*) does not occur. This community is generally found on rocky or exposed shallow soil. Dominant plant species include blue oak (*Quercus douglasii*), live oak (*Quercus* spp.), and valley oak (*Quercus lobata*) (Mayer and Laudenslayer, 1988). The community is dominated by two overstory species (blue oak and foothill pine) within the Kilarc and Cow Creek developments, while the third primary species varies among whiteleaf manzanita (*Arctostaphylos viscida*), interior live oak, and buckbrush (*Ceanothus cuneatus*). The understory is characterized by non-native annual grasses and forbs. This plant community occurs on foothill slopes in the watershed from the valley floor to over 3,500 feet in elevation depending on aspect. Blue Oak-Foothill Pine occurs primarily in the South Cow Creek vicinity adjacent to Interior Live Oak Woodland.

This woodland provides breeding habitats for a large variety of species. For example, in the western Sierra Nevada, 29 species of amphibians and reptiles, 79 species of birds, and 22 species of mammals utilize this habitat for breeding. Wildlife species that enhance oak habitats through acorn dissemination include western scrub-jay, yellow-billed magpie (*Pica nuttalli*), western gray squirrel, and California ground squirrel (*Spermophilus beecheyi*).

Montane Riparian

This habitat type (White alder riparian in Figures E.2.6-3 and E.2.6-4) occurs in the Klamath, Coast, and Cascade ranges and in the Sierra Nevada south to about Kern and northern Santa Barbara counties. Elevation of this habitat is usually below 8,000 feet (Mayer and Laudenslayer, 1988). Dominant plant species typically found in this community include white alder (*Alnus rhombifolia*), black cottonwood (*Populus trichocarpa*), and bigleaf maple (*Acer macrophyllum*). Common species found in the Kilarc and Cow Creek developments include white alder, willow (*Salix* spp.), and valley oak. Secondary vegetation consists of blue oak, non-native annual grass, and buckbrush. The Hooten Gulch and lower South Cow Creek area also contain limited elements of Valley Foothill Riparian habitat, with occurrences of California black walnut (*Juglans californica*) and valley oak. Montane riparian is the primary riparian forest community found in the Cow Creek Watershed. The community is found along sub-drainages and riparian vegetation is common along the edges of streams and creeks. The riparian corridor of this community is much narrower than other riparian communities common to the Sacramento Valley, due to the steep canyons, bedrock channels, and fast-flowing water common in the upper limits of the watershed.

Montane riparian communities associated with the drainages provide foraging and nesting habitats for birds such as yellow warbler (*Dendroica petechia*), American dipper (*Cinclus mexicanus*), solitary vireo (*Vireo solitarius*), and song sparrow (*Melospiza melodia*). Mammals in this habitat include gray fox, long-tailed weasel (*Mustela frenata*), long-tailed vole (*Microtis longicaudus*), and western harvest mouse (*Reithrodontomys megalotis*). Amphibians found in this habitat include Pacific treefrog (*Hyla regilla*) and California newt (*Taricha torosa*).

Mixed Chaparral

This habitat type (Northern Mixed Chaparral in Figure E.2.6-3) occurs in the Klamath Mountains and North Coast Ranges on interior slopes, coastal and interior slopes of the South Coast Range, western foothills of the Sierra Nevada, and Transverse and Peninsular ranges of southern California on slopes away from the deserts (Mayer and Laudenslayer, 1988). This habitat type generally becomes more abundant from north to south, usually below 3,000 feet in northern California and 5,000 feet in southern California. Dominant plant species include oaks, ceanothus, and manzanita. Mixed chaparral occurs primarily in the South Cow Creek vicinity adjacent to oak woodlands.

A wide variety of wildlife utilize mixed chaparral habitat. Wildlife that may be found in this habitat type include northern alligator lizard (*Gerrhonotus coeruleus*), mountain quail, calliope hummingbird (*Stellula calliope*), and dusky flycatcher (*Empidonax oberholseri*). Belding's ground squirrel (*Smermophilus beldingi*) may also occur in this habitat.

Annual Grassland

This habitat type (Non-native annual grassland or Annual Grassland in Figures E.2.6-3 and E.2.6-4) occurs throughout the Central Valley of California, in the coastal mountains as far north as Mendocino County, and in scattered locations in southern California from sea level to about 3,900 feet (Mayer and Laudenslayer, 1988). Dominant plant species include introduced annual grasses such as wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*), barley (*Hordeum* spp.), and fescue (*Vulpia* spp.). Annual and perennial forbs are common associates. Non-native annual grassland is characteristically invaded by exotic species such as yellow starthistle (*Centaurea solstitialis*), medusahead grass (*Taeniatherum caput-medusae*), Klamath weed (*Hypericum perforatum*), Dalmation toadflax (*Linaria dalmatica*), and bull thistle (*Cirsium vulgare*). Non-native grassland occurs in the vicinity of both the Cow Creek and the Kilarc developments and extends into openings within oak woodlands and Sierran Mixed Conifer forest.

Common wildlife species that are typical of this habitat include western fence lizard, western rattlesnake (*Crotalus viridis*), turkey vulture (*Cathartes aura*), American kestrel (*Falco sparverius*), California ground squirrel, Botta's pocket gopher (*Thomomys bottae*), western harvest mouse, California vole (*Microtus californicus*), black-tailed jackrabbit (*Lepus californicus*), and coyote (*Canis latrans*).

Fresh Emergent Wetland

This habitat type (Water in Figures E.2.6-3 and E.2.6-4) occurs throughout California at nearly all elevations below 7,500 feet (Mayer and Laudenslayer, 1988). Saturated or periodically flooded soils support mesic plant species, including sedges (*Carex* spp.) and rushes (*Juncus* spp.). Wetter sites support cattail (*Typha* spp.) and bulrush (*Scirpus* spp.). Seeps or springs often occur in wet areas within non-native grasslands or meadows. There is a small area of fresh emergent wetland along the edge of the Cow Creek Forebay. Freshwater marshes occur along the edges of lakes, ponds, and creeks located at lower elevations of the Kilarc and Cow Creek forebays where the water becomes slow flowing, warm, and shallow. The water often contains a low level of dissolved oxygen. This zone supports emergent vegetation and algae.

Fresh emergent wetlands are among the most productive wildlife habitats in California and are important to wildlife for water and food. Common wildlife species in this habitat include Pacific treefrog, western aquatic garter snake (*Thamnophis couchii*), great egret (*Ardea alba*), great blue heron (*Ardea herodias*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), red-winged blackbird (*Agelaius phoeniceus*), ornate shrew (*Sorex ornatus*), deer mouse, and muskrat (*Ondatra zibethicus*).

Riverine

This habitat occurs up to 8,000 feet throughout California (Mayer and Laudenslayer, 1988). The riverine habitat in the Kilarc and Cow Creek developments consists of Old Cow and South Cow creeks from their respective diversions at the Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam downstream to the Kilarc and Cow Creek powerhouses.

Riverine habitat can provide resting and escape cover for waterfowl. Several gulls and terns forage in open water. Near-shore waters provide food for waterfowl, herons, shorebirds, and belted kingfisher (*Ceryle alcyon*). Many species of insectivores (e.g., swallows, swifts, and flycatchers) forage over the water.

Lacustrine

This habitat type (Water in Figures E.2.6-3 and E.2.6-4) occurs throughout California at virtually all elevations and in all regions, although less abundant in arid regions. Lacustrine habitats are inland depressions or dammed riverine channels containing standing water, including both the near-shore (limnetic) and deepwater habitat (littoral). Lacustrine habitat in the Kilarc and Cow Creek developments consists of the Kilarc and Cow Creek forebays.

Lacustrine habitat is used by 18 mammal, 101 bird, 9 reptile, and 22 amphibian species. Open water habitat provides resting and foraging habitat for several waterbirds, including the American coot (*Fulica americana*), common merganser (*Mergus merganser*), and great blue heron. The forebays may provide foraging habitat for osprey (*Pandion haliaetus*), bald eagle, and peregrine falcon. The perimeter of the Kilarc and Cow Creek forebays may provide basking areas for amphibians and aquatic reptiles. Other characteristic species found in open water habitats include the eared grebe (*Podiceps nigricollis*), pied-billed grebe (*Podilymbus podiceps*), common goldeneye (*Bucephala clangula*), cliff swallow (*Petrochelidon pyrrhonota*), tree swallow (*Tachycineta bicolor*), and several bat species (*Myotis* spp.) (Mayer and Laudenslayer, 1988). Open water also provides a water source for many common mammal species.

Urban

Urban habitat (Developed in Figure E.2.6-4) occurs throughout California and is the result of modifying pre-settlement vegetation and the introduction of new species. This habitat includes areas with horticultural vegetation, as well as human-made structures such as residential, commercial, and industrial buildings (Mayer and Laudenslayer, 1988). Urban habitat occurs around facilities onsite, such as the Kilarc Powerhouse.

Several species of wildlife have adapted to this habitat. These species include rock dove (*Columba livia*), western scrub-jay, northern mockingbird (*Mimus ployglottos*), house finch (*Carpodacus mexicanus*), house sparrow (*Passer domesticus*), opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*).

E.2.6.3 Special-Status Wildlife Species

Figures E.2.6-5 and E.2.6-6 depict locations of special-status wildlife occurrences within a 5-mile radius of the Kilarc and Cow Creek developments based on the CNDDB (CDFG, 2008b). Table E.2.6-2 includes a list of special-status wildlife species, including common and scientific names, state and/or federal status, habitat requirements, and potential for occurrence in the Kilarc and Cow Creek developments based on the CNDDB (CDFG, 2003, 2008a) and USFWS species list (USFWS, 2003, 2008a). Special-status wildlife species that were determined not to be present, and/or for which appropriate habitat is not present in the Kilarc and Cow Creek developments, are not discussed further in this document. Special-status species that are known to occur or for which appropriate habitat is present in the Kilarc and Cow Creek developments are discussed in this section. Information on distribution and habitat requirements included in this report is adapted from *California's Wildlife Volumes I-III* (Zeiner et al., 1988, 1990a, and 1990b) unless otherwise noted.

Special-status wildlife species include species federally listed as endangered or threatened (FE/FT), federal candidate species for listing (FC), species protected by the state of California as endangered or threatened (SE/ST), California species of special concern (CSC), California fully protected species (CFP), species identified as Watch List (WL) by CDFG, and other species identified as special animals (SA) by CDFG. Species recently delisted (FD) from federal special-status listing are also included.

Invertebrates

A search of the CNDDB (CDFG, 2003, 2008a) and USFWS species list (USFWS, 2003, 2008a) indicated that five special-status invertebrate species could potentially occur in the Kilarc and Cow Creek developments if suitable habitat were present. Based on the habitats detected in the Kilarc and Cow Creek developments during the reconnaissance-level wildlife survey, the VELB is the only special-status invertebrate for which habitat is present and verified in the Kilarc and Cow Creek developments.

<u>Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) (VELB)-FT</u>

This species is associated with various species of elderberry (*Sambucus* spp.) throughout the Central Valley and foothills below 3,000 feet in elevation. Shasta County is one of 31 counties all or portions of which are included in the beetle's range (USFWS, 1999). Critical habitat has been designated for this species (45 FR 52,803-52,807), but there is none in Shasta County. The VELB generally occurs along waterways and in floodplains that support remnant stands of riparian vegetation. Both larvae and adult VELB feed exclusively on elderberry plants. Larvae feed internally on the pith of the trunk and larger branches, and it appears that the shrubs must have stems that are 1 inch or greater in diameter at ground level. Adult beetles appear to feed externally on elderberry flowers and foliage. Prior to metamorphosing into the adult life stage, VELB larvae chew an exit hole in the elderberry trunk, through which the adult beetle later exits the plant (CDFG, 2003, 2008a).

Occurrence in the Kilarc and Cow Creek Developments

Elderberry surveys were conducted in 2003 to determine the extent of potential habitat for the VELB within the Kilarc and Cow Creek developments. Elderberry shrubs with stems greater than 1 inch in diameter are considered potential habitat for the VELB (USFWS, 1999). Elderberry shrubs were found at two locations in the Cow Creek Development (Figure E.2.6-1, Maps 1 and 2). One elderberry was observed on the south side of the South Cow Creek Main Canal, opposite the canal trail. This elderberry had three stems: one less than 1 inch in diameter, one that was approximately 1 inch in diameter, and one that was approximately 1.5 inches in diameter. A second elderberry was observed near the trail on the steep, inaccessible slope between the South Cow Creek Main Canal and South Cow Creek. This elderberry had one stem, less than 1 inch in diameter. No holes were observed on either plant in the stem parts that were visible from the trail. Appropriate habitat could be provided by the two elderberry shrubs observed within or adjacent to the Kilarc and Cow Creek developments although no beetles were observed on these plants. There are no reported occurrences of VELB within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008).

Amphibian and Reptile Species

A recent review of the CNDDB (CDFG, 2008a) and USFWS species list (USFWS, 2008a) indicated that six special-status amphibian and two reptile species could potentially occur in the Kilarc and Cow Creek developments. These species are listed in Table E.2.6-2. Based on habitats present in the Kilarc and Cow Creek developments, only two of the amphibian and one of the reptile species have the potential to occur in the Kilarc and Cow Creek developments. These are California red-legged frog, foothill yellow-legged frog, and northwestern pond turtle. Each of these species is described briefly below.

California Red-Legged Frog (*Rana aurora draytonii*)—FT

California red-legged frogs spend most of their time in or near water. However, they can move considerable distances (up to a mile) within a drainage and move through terrestrial habitats. Most documented California red-legged frog sightings have occurred at elevations below 3,500 feet, although historical sightings were noted up to 5,200 feet (USFWS, 2002).

California red-legged frogs breed during the winter and early spring between late November and April. Eggs are laid in a loose, baseball-sized mass (500 to 2,000 eggs) attached to submerged vegetation in ponds or backwater pools in creeks. Breeding occurs in coastal lagoons, marshes, springs, permanent and semi-permanent ponds, ponded and backwater portions of streams, as well as artificial impoundments (such as dammed sites and stock ponds). Suitable spawning pools are almost always 2.3 to 3.3 feet in depth for at least 6.6 feet from the wetted edge, with dense bordering marshland/riparian vegetation (cattails [*Typha* spp.], sedges, tules [*Scirpus* spp.], and willows [*Salix* spp.]). Floating vegetation (*Potamogeton* spp., *Ludwigia* spp.) is often present, and it provides especially favorable basking habitat for adult frogs and foraging cover for tadpoles. Eggs hatch in 6 to 14 days. Tadpoles remain in these habitats until metamorphosis, which generally occurs within 3.5 to 7 months. Juveniles are found in slow moving, shallow riffles in creeks or along margins of ponds.

In the summer, larger frogs are found close to spawning ponds or along deep, quiet pools in creeks with vegetative or other cover such as emergent vegetation, undercut banks, or rootwads, as well as in burrows in or above the banks. Bordering vegetation may be completely absent from such "summer habitat," but secure shelters such as root masses are always available. California red-legged frogs are presumed to disperse along waterways such as streams and lake borders, but little information is available on the timing or extent of that activity. California red-legged frogs may spawn in ephemeral ponds, an advantage because such waterways do not generally support predatory fish. Springs and seeps that may not provide breeding habitat may provide habitat for foraging or refugia.

Occurrence in the Kilarc and Cow Creek Developments

The historical range of the California red-legged frog included Shasta County. Shasta County is not included in the current range of the frog, although Shasta County occurs within the boundaries of the California red-legged frog Recovery Unit 1, Sierra Nevada Foothills and Central Valley, and Recovery Unit 2, North Coast Range Foothills and Western Sacramento River Valley (USFWS, 2002). The Kilarc and Cow Creek developments are located approximately 30 miles northeast of USFWS-designated Core Area No. 8, Cottonwood Creek, for this species. Critical habitat has been designated for this species (45 FR 52,803-52,807), but there is none in Shasta County. The CNDDB search yielded no records of California red-legged frogs within 5 miles of the Kilarc and Cow Creek developments (CDFG, 2008a). The nearest records are museum specimens collected about 18 miles south or west of the Project Area (CAS, 2003; UCB, 2003). The nearest CNDDB record is about 50 miles southwest of the Project, in Tehama County (CDFG, 2008a). No records were found of California red-legged frog surveys conducted within the Project boundaries.

No habitat capable of supporting California red-legged frog spawning activity was found within the Kilarc and Cow Creek developments during the site assessment, but several ponds on private land within the Site Assessment Area may be suitable. Potential "summer habitat" exists along Hooten Gulch within 328 feet of its confluence with South Cow Creek, but only if confirmed spawning habitat exists within 1 mile of Hooten Gulch. The complete report of the site habitat assessment is provided in Appendix J-1.

<u>Foothill Yellow-Legged Frog (*Rana boylii*)—CSC</u>

Foothill yellow-legged frogs inhabit foothill and mountain streams from sea level to about 6,000 feet elevation in the Coast Ranges from the Oregon border south to the Transverse Mountains in Los Angeles County, in most of northern California west of the Cascade crest, and along the western flank of the Sierra Nevada south to Kern County. Most occurrence records of foothill yellow-legged frogs are below 3,500 feet. The foothill yellow-legged frog is found in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types (Zeiner et al., 1988).

Home ranges are small, but these frogs may move several hundred meters to spawning habitat. Adult frogs congregate at suitable spawning sites as spring runoff declines, when water temperatures reach 12 to 15°C, usually anytime from mid-March to May, depending on local water conditions. The breeding season at any locality is usually about two weeks for most populations. Spawning frogs favor low to moderately steep gradient streams (0 to 8°C). Females deposit eggs in shallow edgewater areas with water velocities less than 10 centimeters per second (PG&E, 2002b). Egg masses are often attached to the downstream sides of cobbles and boulders, or to gravel, wood, or other materials. Eggs hatch in approximately five days. Tadpoles transform in three to four months and stay for a time in spawning habitat, but eventually disperse. They feed on diatoms or algae on the surface of the substrate (Stebbins, 1951). Tadpoles favor calm, shallow water. Juvenile and adult frogs bask on midstream boulders or in terrestrial sites along riffles, cascades, main channel pools, and plunge-pools, often in dappled sunlight near low overhanging vegetation. They are relatively strong swimmers and prefer faster water habitat than do other foothill frog species such as the bullfrog or the California red-legged frog. Adults generally avoid deep shade.

Occurrence in the Kilarc and Cow Creek Developments

Preliminary habitat mapping data and ground surveys suggest that Old Cow Creek contains little suitable spawning habitat. Frog colonization could be limited further by insufficient forage or basking sites. It is possible that Old Cow Creek contains only small, isolated spots with sufficient sunlight and forage for foothill yellow-legged frogs. Although a foothill yellow-legged frog was reported upstream of the Kilarc Powerhouse in 2001 (CDFG, 2008a), no foothill yellow-legged frogs were found in the Old Cow Creek bypass within the 16,919 feet surveyed in the lower, middle, and upper reaches in 2003. During the 2003 habitat assessment, water temperature ranged from 12ºC to 18ºC downstream of North Canyon Creek to 13ºC and 14ºC downstream of the Kilarc Main Canal Diversion Dam.

Foothill yellow-legged frog adults and juveniles were found in South Cow Creek at the downstream end of the bypass reach. Water temperature ranged from 16 to 21ºC in this portion of South Cow Creek. They were also found in the downstream portion of Hooten Gulch where the Cow Creek Powerhouse tailrace augments summer flow, and upstream of the Cow Creek Powerhouse during general wildlife surveys. Water temperature ranged from 20 to 22ºC in this portion of Hooten Gulch. Bullfrog tadpoles were also observed in the downstream portion of the South Cow Creek bypass reach. Upstream of the bypass reaches where foothill yellow-legged frogs were found was a steeper, boulder/cobble dominated creek, with mostly fast water and little edgewater. Suitable breeding habitat was not observed in this area. Water temperature ranged from 14 to 23ºC downstream of the South Cow Creek Diversion Dam during the 2003 habitat assessment. Foothill yellow-legged frogs have also been reported in South Cow Creek, downstream of the confluence with Hooten Gulch (CDFG, 2008a).

The foothill yellow-legged frog is not likely to occur in other sections within the Kilarc and Cow Creek developments. Mill Creek is a small, heavily vegetated stream that offers little or no foothill yellow-legged frog basking, spawning, or tadpole habitat. Most of North Canyon Creek was dry, and the downstream portion that enters Old Cow Creek was also smaller and heavily shaded. The diversion canals had swiftly flowing water and no habitat complexity. These canals are not likely to provide primary habitat.

Northwestern Pond Turtle (*Actinemys marmorata marmorata*)—CSC

The western pond turtle is uncommon to common in suitable aquatic habitat throughout California, west of the Sierra-Cascade crest, from sea level to 6,000 feet. The northwestern pond turtle occupies the area north of San Francisco Bay and the American River, although there is overlap with the range of the southwestern pond turtle in central California. The northwestern pond turtle requires basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. Three to 11 eggs are laid from March to August depending on local conditions. The incubation period for eggs ranges from 73 to 80 days. Sexual maturity is attained in about eight years (Zeiner et al., 1988).

Occurrence in the Kilarc and Cow Creek Developments

A northwestern pond turtle was observed in Hooten Gulch during the focused amphibian surveys (Figure E.2.6-1, Map 1). Appropriate habitat is also present in the Kilarc and Cow Creek forebays, upstream from the diversion on South Cow Creek, and in Old Cow Creek. There are four CNDDB occurrences of northwestern pond turtle within 5 miles of the Kilarc and Cow Creek developments (CDFG, 2008a).

Bird Species

A review of the CNDDB (CDFG, 2003, 2008a) and USFWS species list (USFWS, 2003, 2008) indicated that 26 special-status avian species could potentially occur in the Kilarc and Cow Creek developments. These species are listed in Table E.2.6-2. Based on reconnaissance-level wildlife surveys and habitats present within the Kilarc and Cow Creek developments, only 16 of these species are known to occur or could potentially occur within the Kilarc and Cow Creek developments. These include osprey, white-tailed kite (*Elanus leucurus*), bald eagle, sharp-shinned hawk (*Accipiter striatus*), northern goshawk (*A. gentilis*), Swainson's hawk (*Buteo swainsoni*), golden eagle (*Aquila chrysaetos*), American peregrine falcon, western burrowing owl (*Athene cunicularia hypugaea*), California spotted owl (*Strix occidentalis occidentalis*[11]), Vaux's swift (*Chaetura vauxi*), rufous hummingbird (*Selasphorus rufus*), little willow flycatcher, loggerhead shrike (*Lanius ludovicianus*), hermit warbler (*Dendroica occidentalis*), and Lawrence's goldfinch (*Carduelis lawrencei*). An additional species, Lewis' woodpecker (*Melanerpes lewis*), was not on these lists, but was observed during the surveys in 2003.

11 Northern spotted owl (*Strix occidentalis caurina*) was added to the discussion during development of the 2003 wildlife report, but spotted owls south of the Pit River are considered to belong to the California subspecies.

Osprey (*Pandion haliaetus*)—WL

The osprey occurs along seacoasts, lakes, and rivers, primarily in ponderosa pine and mixed conifer habitats. It preys mostly on fish at or below the water surface, but will also take small mammals, birds, reptiles, amphibians, and invertebrates. Large snags, open trees, or surrogate man-made structures (e.g., electric power poles) near large, clear, open waters are required for foraging. The osprey typically swoops from flight, hovers, or perches to catch prey. The breeding season is from March to September. A nest may be as much as 250 feet above ground and is usually within 1,000 feet of fish-producing water. Typically, this species migrates in October south along the coast and the western slope of the Sierra Nevada to Central and South America.

Occurrence in the Kilarc and Cow Creek Developments

No osprey or osprey nests were observed in the Kilarc and Cow Creek developments during focused raptor surveys in 2003. Osprey were observed during other surveys for the Project on two occasions: an adult was observed foraging at the Kilarc Forebay in June 2003, and an adult was observed in flight over the Kilarc Forebay in September 2003. Suitable foraging habitat also occurs at the Cow Creek Forebay and suitable nesting habitat occurs at the Kilarc Forebay. There are no other reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

White-Tailed Kite (*Elanus leucurus*)—CFP

This is a common to uncommon, yearlong resident in coastal and valley lowlands, and is rarely found away from agricultural areas. This species inhabits herbaceous and open stages of most habitats in cismontane California. Substantial groves of dense, broad-leaved deciduous trees are used for nesting and roosting. The white-tailed kite forages in undisturbed, open grasslands, meadows, farmlands, and emergent wetlands. The white-tailed kite eats small rodents, especially the California vole, as well as birds, snakes, lizards, frogs and large insects. Nests are built of twigs and sticks with an inner layer of grass or leaves in trees that are usually located on habitat edges. Nest-building occurs January through August (Dunk, 1995). Egg-laying begins in February and probably peaks in March and April. Peak fledging probably occurs in May and June with most fledging complete by October (Erichsen, 1995). Clutch size is most commonly four (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may use the riparian trees in the Kilarc and Cow Creek developments as nest sites, and may forage on the uplands within the Kilarc and Cow Creek developments. No white-tailed kites were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Bald Eagle (*Haliaeetus leucocephalus*)—FD (2007), SE, CFP

Formerly listed as FT under the ESA, the bald eagle was delisted in 2007 (72 FR 37,345-37,372). However, this species continues to be federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and federal Migratory Bird Treaty Act (16 U.S.C. 703-712). This eagle also continues to be protected as endangered under the California Endangered Species Act. This species is a permanent resident and uncommon winter migrant in California. By the late 1970's, California breeding populations of the bald eagle were restricted mostly to Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity counties. Subsequently, the breeding range in California has expanded to 28 counties (CDFG, 2008c). About half of the wintering population is in the Klamath Basin. The bald eagle is fairly common as a local winter migrant at a few favored inland waters in southern California. The largest numbers occur at Big Bear Lake, Cachuma Lake, Lake Matthews, Nacimiento Reservoir, San Antonio Reservoir, and along the Colorado River. The bald eagle is typically found in coniferous forest habitats with large, old growth trees near permanent water sources such as lakes, rivers, or ocean shorelines. It requires large bodies of water with abundant fish and adjacent snags or other perches for foraging. The bald eagle preys mainly on fish and occasionally on small mammals or birds, by swooping from a perch or from mid-flight. Nests are found in large, old growth, or dominant trees, especially ponderosa pine with an open branchwork, usually 50 to 200 feet above the ground. It breeds February through July, with peak activity from March to June. Clutch size is usually two. Incubation usually lasts 34 to 36 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

No bald eagles or eagle nests were observed in the Kilarc and Cow Creek developments during focused raptor surveys. There is an historical, anecdotal report of adult bald eagles observed roosting on a snag adjacent to Kilarc Forebay and juveniles observed nearby. There are no reported occurrences in the CNDDB within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a), although there are 18 resident pairs at Lake Shasta, 15 miles to the northwest (USDA-FS, 2008).

Sharp-Shinned Hawk (*Accipiter striatus*)—WL

The sharp-shinned hawk is a fairly common migrant and winter resident throughout California, and is found in a variety of habitats, but prefers riparian habitats and north-facing slopes. This hawk eats mostly small birds, but also small mammals, insects, reptiles, and amphibians. It usually nests in dense, small-tree coniferous stands that are cool, moist, well shaded, with little ground cover, and near water. Nests are built on a platform or cup in dense foliage against the trunk or in the main crotch of a tree. It breeds from April through August with a peak from late May to July. Clutch size averages four to five eggs. Incubation lasts 34 to 35 days. Fledging occurs at about 60 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage or nest in riparian or mixed conifer forest in the Kilarc and Cow Creek developments. No sharp-shinned hawks were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Northern Goshawk (*Accipiter gentilis*)—CSC

Northern goshawk inhabits middle to high elevation, mature, dense coniferous forests. During winter, it occurs in the foothills, in northern deserts in pinyon-juniper woodland, and in low elevation riparian habitats. This species breeds in the North Coast Ranges through the Sierra Nevada, Klamath, Cascade, and Warner mountains and possibly in the Mount Pinos, San Jacinto, San Bernardino, and White mountains. It remains yearlong in breeding areas as a scarce to uncommon resident. Optimal habitat contains trees for nesting, a closed canopy of greater than 50 percent for protection and thermal cover, and open spaces allowing maneuverability. It prefers middle and higher elevations and mature, dense conifer forests. The northern goshawk feeds mostly on birds, using snags and dead treetops as observation platforms. Northern goshawks usually nest on north slopes, near water, and in the densest parts of stands, but close to openings. Breeding occurs from April to June. Average clutch size is three eggs. Incubation lasts 36 to 41 days. Young usually fledge by 45 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage in riparian, blue oak-foothill pine woodland, or mixed conifer habitat in the Kilarc and Cow Creek developments and may also breed in forest habitats in the Kilarc and Cow Creek developments. No northern goshawks were observed during Project surveys. There are two CNDDB records for this species approximately 5 miles east of the Kilarc and Cow Creek developments (CDFG, 2008a).

Swainson’s Hawk (*Buteo swainsoni*)—ST

Swainson’s hawk is restricted to portions of the Central Valley and Great Basin regions where suitable nesting and foraging habitat is still available. Central Valley populations are centered in Sacramento, San Joaquin, and Yolo counties. Over 85 percent of Swainson’s hawk territories in the Central Valley are in riparian systems adjacent to suitable foraging habitats. Swainson’s hawk often nests peripherally to riparian systems of the valley as well as utilizing lone trees or groves of trees in agricultural fields. Valley oak, Fremont cottonwood, walnut, and large willow with an average height of about 58 feet, and ranging from 41 to 82 feet, are the most commonly used nest trees in the Central Valley. Swainson’s hawk requires large, open grasslands with abundant prey and suitable nest trees. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands. This species may use the riparian trees in the Kilarc and Cow Creek developments as nest sites, and may forage on the uplands. Breeding occurs late March to late August, with peak activity late May through July. Clutch size is two to four eggs (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

Suitable foraging and nesting habitat for this species occurs within grassland (foraging) and woodland (nesting) habitats of the Kilarc and Cow Creek developments, particularly in the southern portion of South Cow Creek. No Swainson's hawks were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

<u>Golden Eagle (*Aquila chrysaetos*)—WL, CFP</u>

This species is federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and federal Migratory Bird Treaty Act (16 U.S.C. 703-712). This eagle is an uncommon permanent resident and migrant throughout California up to 11,500 feet, except the center of the Central Valley. It is more common in southern than in northern California. Typical habitat includes rolling foothills, mountain areas, sage-juniper flats, and desert. It nests on cliffs of all heights and in large trees in open areas in rugged, open habitats with canyons and escarpments. Large platform nests are built of sticks, twigs, and greenery. The golden eagle eats mostly rabbits and rodents, but also takes other mammals, birds, reptiles, and some carrion. Breeding occurs from late January through August with a peak from March through July. Clutch size averages two eggs, which are laid early February to mid-May. Incubation lasts 43 to 45 days, and the nestling period usually lasts 65 to 70 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

No golden eagle or golden eagle nests were observed in the Kilarc and Cow Creek developments during focused raptor surveys. Golden eagles were observed during other surveys for the Project on two occasions: an adult was observed in flight over the Cow Creek Forebay on June 17, 2003, and on June 18, 2003, two adults were observed at the same location. This species may breed or forage in oak woodland, or mixed conifer forest and additionally forage in grasslands in the Kilarc and Cow Creek developments. There are no other reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

<u>American Peregrine Falcon (*Falco peregrinus americana*)—FD (1999), SE[12], CFP</u>

This species is a very uncommon breeding resident and uncommon migrant. Active nesting sites are known along the coast north of Santa Barbara, in the Sierra Nevada, and in other mountains of northern California. In winter, it is found inland throughout the Central Valley and occasionally on the Channel Islands. Migrants occur along the coast and in the western Sierra Nevada in spring and fall. Breeding mostly occurs in woodland, forest, and coastal habitats near wetlands, lakes, rivers, or other water or on high cliffs, banks, dunes, and mounds. Riparian areas and coastal and inland wetlands are important habitats yearlong, especially in non-breeding seasons. The nest is a scrape on a depression or ledge in an open site. The American peregrine

[12] The Fish and Game Commission decided to delist the American peregrine falcon on December 12, 2008. The regulation will likely be amended in early 2009. The video of the December 12, 2008 meeting is available online at: http://www.cal-span.org/cgi-bin/archive.php?owner=CFG&date=2008-12-12

falcon will also nest on human-made structures and occasionally uses tree or snag cavities or old nests of other raptors. It feeds on a variety of birds and occasionally takes mammals, insects, and fish. Breeding occurs from early March to late August. Clutch size averages three to four eggs. Incubation lasts about 32 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

No American peregrine falcon or falcon nests were observed in the Kilarc and Cow Creek developments during focused raptor surveys. Nesting has been documented in the Cow Creek watershed (SHN, 2001). This species may forage in or near Kilarc or Cow Creek forebays and in stream habitat in the Kilarc and Cow Creek developments. There are no other reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Western Burrowing Owl (*Athene cunicularia hypugaea*)—CSC

This species is a yearlong resident of open, dry grassland and desert habitats and in grass, forb, and open shrub stages of pinyon-juniper and ponderosa pine habitats up to 5,300 feet. It was formerly common in appropriate habitats throughout the state, excluding the humid northwest coastal forests and high mountains. It usually nests in old burrows of ground squirrels or other small mammals, but may dig its own burrow in soft soil. The nest chamber is lined with excrement, pellets, debris, grass, and feathers. Pipes, culverts, and nest boxes are used where burrows are scarce. Breeding occurs from March through August, with peak activity in April and May. Clutch size averages five to six eggs. Young emerge from the burrow at about two weeks and fledge by about four weeks. Burrowing owls are semi-colonial (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

Suitable nesting, burrowing, and foraging habitats exist within grasslands in the Kilarc and Cow Creek developments. No burrowing owls were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Northern Spotted Owl (*Strix occidentalis caurina*)—FT, CSC

The northern spotted owl occurs in dense, old growth, multi-layered mixed conifer, redwood, Douglas fir, and oak woodland habitats, from sea level up to approximately 7,600 feet. The norhtern spotted owl prefers large trees and high canopy cover for nesting and foraging areas. Nesting habitat contains a dense canopy cover of greater than 70 percent with medium to large trees and a multi-storied structure. Nests are located in cavities or broken treetops. This species breeds from early March through June, with a peak in April and May. It generally has one brood per year, with a clutch size of one to four, with an average of two (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

While the northern spotted owl was included on a list of species potentially present at the Kilarc and Cow Creek developments, spotted owls in this area would be California spotted owls (*Strix* *occidentalis occidentalis*). The Pit River is the accepted boundary between the ranges of these two subspecies (55 FR 26,114-26,195; USFWS, 2008b). The Cow Creek watershed, including Old Cow and South Cow creeks, is south of the Pit River watershed. Spotted owls may forage and breed in mixed conifer forest in the Kilarc and Cow Creek developments. No spotted owls were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008d). Critical habitat has been designated for the northern spotted owl (57 FR 1,796-1,838), but there is none in the Project Area.

Vaux's Swift (*Chaetura vauxi*)—CSC

Vaux's swift is a summer resident of northern California, breeding fairly commonly in the Coast Range, in the Sierra Nevada, and possibly in the Cascade Range. It prefers redwood and Douglas fir habitats with nest-sites in large hollow trees and snags, especially tall, burned-out stubs. It is a fairly common migrant throughout most of California in April, May, August, and September. Vaux's swift feeds high in the air over most terrain and habitats and also commonly feeds at lower levels in forest openings, above burns, and especially above rivers and lakes. It nests in redwood, Douglas fir, and occasionally other coniferous forests. The nest is typically built on the vertical inner wall of a large, hollow tree or snag, especially tall stubs charred by fire. This species enters the nesting tree from the top or through cracks in the side, and almost always builds the nest near the bottom of a cavity, regardless of the height of the entrance. The Vaux's swift occasionally nests in chimneys and buildings. Breeding occurs from early May to mid-August. Clutch size is three to seven eggs, and incubation lasts 18 to 20 days. The altricial young are tended by both parents and leave the nesting tree at about 28 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage and breed in mixed conifer forest near streams and the Kilarc and Cow Creek forebays in the Kilarc and Cow Creek developments. No Vaux's swifts were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Rufous Hummingbird (*Selasphorus rufus*)—SA

The rufous hummingbird uses a wide variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, riparian areas, open woodlands, chaparral, mountain meadows, and various chaparral habitats during migration. This species arrives in California in February and migrates north through lowlands and foothills until mid-April and early May. In California, breeding only occurs in the Trinity Alps, in Humboldt County. Breeding season extends from late April through July, with an average of two eggs laid. Incubation period is unknown, but probably close to other *Selasphorus* species (16 to 22 days for Allen's hummingbird [*Selasphorus sasin*]). After breeding, males begin to migrate south in late June and early July, and most individuals have left the breeding grounds by mid-September. However, a few regularly overwinter, particularly in southern California. Young are altricial and are tended by females until fledging occurs at 22 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage or breed in oak woodland and mixed conifer habitats in the Kilarc and Cow Creek developments. No rufous hummingbirds were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Lewis' Woodpecker (*Melanerpes lewis*)—SA

The Lewis' woodpecker is an uncommon, local winter resident occurring in open oak savannahs, broken deciduous, and coniferous habitats. It is found along the eastern slopes of the Coast Ranges south to San Luis Obispo County and also winters in the Central Valley, Modoc Plateau, and the Transverse and other ranges in southern California. It breeds locally along eastern slopes of the Coast Ranges and in the Sierra Nevada, Warner Mountains, Klamath Mountains, and in the Cascade Range. It excavates a nest cavity in a snag or dead part of a live tree, usually five to 80 feet above ground. It usually nests in sycamore, cottonwood, oak, or conifer trees. It may nest near other pairs. Breeding occurs from early May through July, with a peak in late May and early June. Clutch size is four to nine, incubation lasts 13 to 14 days, and fledging occurs at 28 to 34 days. The male incubates and broods at night, while the female continues these duties during the day. The pair bond may be permanent (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species was observed downstream from the Cow Creek Development along South Cow Creek and may forage or breed in oak woodland and mixed conifer habitats in the Kilarc and Cow Creek developments. There are no other reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Little Willow Flycatcher (*Empidonax traillii brewsteri*)—SE (Nesting; All Subspecies)

The little willow flycatcher is a rare to locally uncommon, summer resident in wet meadow and montane riparian habitats from an elevation of 2,000 to 8,000 feet in the Sierra Nevada and Cascade Range. It most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. It is a common spring (mid-May to early June) and fall (mid-August to early September) migrant at lower elevations, primarily in riparian habitats throughout California exclusive of the North Coast. Nests are an open-cup shape, placed in an upright fork of a willow or other shrub, or occasionally on a horizontal limb, at a height of 1 to 10 feet. Peak egg-laying occurs in June. Incubation lasts 12 to 13 days, and clutch size averages three to four eggs. It is probably single-brooded. Both sexes care for altricial young. Fledging age is 13 to 14 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This subspecies may forage in riparian habitats in the Kilarc and Cow Creek developments. Nesting and marginal breeding habitat occurs within reaches of South Cow Creek. No willow flycatchers were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Loggerhead Shrike (*Lanius ludovicianus*)—CSC

The loggerhead shrike is a common resident and winter visitor in lowlands and foothills throughout California. It prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches. Its highest density occurs in open-canopied valley foothill hardwood, valley foothill hardwood-conifer, valley foothill riparian, pinyon-juniper, juniper, desert riparian, and Joshua tree habitats. It occurs only rarely in heavily urbanized areas, but is often found in open cropland. It builds its nest on a stable branch in a densely-foliaged shrub or tree, usually well-concealed. Nest height is 1 to 50 feet above ground. It lays eggs from March into May, and young become independent in July or August. The loggerhead shrike is a monogamous, solitary nester with a clutch size of four to eight. Incubation lasts 14 to 15 days. Altricial young are tended by both parents and leave the nest at 18 to 19 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage in oak woodlands or riparian habitat in the Kilarc and Cow Creek developments. This species may also breed in oak woodlands in the Kilarc and Cow Creek developments. No loggerhead shrikes were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Hermit Warbler (*Dendroica occidentalis*)—SA

The hermit warbler is a fairly common to common, summer visitor and migrant and a rare, but regular, visitor in winter. It breeds in major mountain ranges from the San Gabriel and San Bernardino mountains northward, excluding coastal ranges south of Santa Cruz County. It is a common spring and fall migrant in mountains, an uncommon to fairly common visitor in lowlands in spring, and a rare to uncommon migrant in the fall. It breeds in mature ponderosa pine, montane hardwood-conifer, mixed conifer, Douglas fir, redwood, red fir, and Jeffrey pine habitats. In migration and winter, it also occurs in valley foothill hardwood habitat and in stands of planted pines. It builds its nest 25 to 125 feet above ground in a conifer. The nest is often placed out on a horizontal branch. It breeds from late April into early July with peak activity in June, and lays three to five eggs (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may breed in mixed conifer forests and may forage in mixed conifer and oak-pine woodland in the Kilarc and Cow Creek developments. No hermit warblers were observed during

Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Lawrence's Goldfinch (*Carduelis lawrencei*)—SA

The Lawrence's goldfinch is highly erratic and localized in occurrence. It is rather common along the western edge of southern deserts; fairly common, but erratic from year to year in Santa Clara County and on the coastal slope from Monterey County south; and uncommon in foothills surrounding the Central Valley. Because this species is migratory, it is present mostly from April through September in the Project vicinity. It breeds near water in open oak or other arid woodlands and chaparral. It rarely breeds along the immediate coast. Typical habitats include valley foothill hardwood, valley foothill hardwood-conifer, and, in southern California, desert riparian, palm oasis, pinyon-juniper, and lower montane habitats. Nearby herbaceous habitats are often used for feeding. It winters erratically in southern coastal lowlands and along the Colorado River Valley. A small number also winter in northern California. It builds its nest in dense foliage of a tree or shrub and prefers to nest in an oak, but also uses cypress or cedar, riparian thickets, and other species. The breeding season begins in late March or early April. Lawrence's goldfinch is a monogamous breeder and lays three to six eggs per clutch. Incubation lasts 12 to 13 days. Altricial young are tended by both parents and leave the nest at about 11 days (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may forage and breed in oak woodland or blue oak-foothill pine woodlands near streams or the Kilarc and Cow Creek forebays in the Kilarc and Cow Creek developments. No Lawrence's goldfinches were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Mammals

A review of the CNDDB (CDFG, 2003, 2008a) and USFWS species list (USFWS 2003, 2008a) suggest that 12 special-status mammal species could potentially occur in the Kilarc and Cow Creek developments. These species, together with another species observed during Project surveys, are listed in Table E.2.6-2. Only 10 of these species, spotted bat (*Euderma maculatum*) pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), silver-haired bat (*Lasionycteris noctivagans*), Yuma myotis (*Myotis yumanensis*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*Myotis volans*), small-footed myotis (*Myotis ciliolabrum*), Pacific fisher (*Martes pennanti pacifica*), and ringtail (*Bassariscus astutus*) could potentially occur in the Kilarc and Cow Creek developments based on the habitats present. These species are discussed further below.

Silver-Haired Bat (*Lasionycteris noctivagans*)—SA

Silver-haired bat occurs along most of coastal California, in the Sierra Nevada, in the Great Basin region, and in parts of southern California and the Central Valley. Although this species may be found almost anywhere in California during migration, summer ranges are usually at elevations below 9,000 feet. Some silver-haired bats that summer in California may winter in Mexico. This species is found primarily in coastal and montane forests, but also occupies valley foothill woodlands, pinyon-juniper woodlands, valley foothill riparian habitats, and montane riparian habitats. Foraging occurs over streams and ponds, as well as open brushy areas. Roost sites are primarily hollow trees and under bark, but this bat sometimes roosts under rocks. Females may form nursery colonies or may be solitary. The silver-haired bat feeds primarily on soft-bodied insects, including moths (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur anywhere in the Kilarc and Cow Creek developments, although it is unlikely to be found in Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. No silver-haired bats were observed during Project surveys, but this species has been reported from one location within 5 miles of the Kilarc and Cow Creek developments (CDFG, 2008a).

Yuma Myotis (*Myotis yumanensis*)—SA

Yuma myotis is a year-round resident in most of California at lower elevations in a wide variety of habitats from coast to mid-elevation. It is very tolerant of human habitation and survives in urbanized environments. Day roosts are in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are in buildings, bridges, and other man-made structures. It is presumed to be non-migratory and hibernates in winter, but no large winter aggregations have been reported. A single young is born per year between June and July. Females form large maternity colonies of 200 to several thousand individuals. Males roost singly or in small groups. The Yuma myotis feeds on emergent aquatic insects, such as caddisflies and midges. Foraging occurs directly over the surface of still water ponds, reservoirs, or pools in streams and rivers (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in open forests and woodlands and in Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. No Yuma myotis were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Long-Eared Myotis (*Myotis evotis*)—SA

The long-eared myotis is a year-round resident in California, occurring in mixed hardwood/conifer forest and montane conifer forest in northern California, and in pinyon-juniper, mesquite scrub, and pine/oak woodland in southern California. Its distribution is broad, but it is not usually found in large numbers. It typically roosts singly or in small groups in hollow trees, under exfoliating bark, crevices in rock outcrops, and occasionally in mines, caves, and buildings during the day. Roost sites in these structures tend to be cryptic (i.e., in crevices and fissures). Night roosts are in caves, mines, bridges, building, and rock crevices. It is presumed to be non-migratory, and to hibernate locally in caves. A single young is born per year between June and July. Females may form small maternity colonies with less than 40 individuals. The long-eared myotis feeds on moths, flies, and small beetles. It forages along rivers and streams, over ponds, and within cluttered forests (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in mixed hardwood/conifer and montane conifer forests and on Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. It may also occur in snags, tree hollows, or beneath tree bark. No long-eared myotis were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Fringed Myotis (*Myotis thysanodes*)—SA

The fringed myotis is found in western North America from British Columbia to Veracruz and Chiapas. Over most of its range, this species occurs at mid-elevations, but it has been found at high elevations in New Mexico and the Sequoia National Forest above 6,000 feet. This bat occurs in most habitats within its elevation range in California, except for the Central Valley and the Mohave Desert. Along the west coast, this bat is found at low elevations and is associated with redwood forests. Maternity colonies are large, up to 300 individuals, and occur in caves, mines, and buildings. Males roost separate from the maternity colonies. Night roosts are in similar features. Only one young per year is commonly born. Little is known of the reproductive cycle of this species. The fringed myotis primarily eats beetles (73 percent of its diet), moths, flies, leafhoppers, lacewings, crickets, and harvestmen (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in valley-foothill woodland and mixed conifer forests and at Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. No fringed myotis were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Long-Legged Myotis (*Myotis volans*)—SA

Long-legged myotis inhabits western North America from southeast Alaska to Central Mexico, and is found at an elevational range from sea level to 12,000 meters (39,370 feet). It is primarily a coniferous forest bat although it may also occur in riparian and desert habitats. Maternity colonies can include up to 300 individuals. Maternity roosts are found in buildings, rock crevices, and under exfoliating bark. Males roost singly or in small numbers in rock crevices, buildings, and under tree bark. Night roosts are under bridges, in caves and mines, and in buildings. The species commonly hibernates in the northern portion of their range. It is unknown whether this bat migrates in the portion of its range where winters are less severe. Mating takes place in the fall and sperm is stored over winter. Ovulation and fertilization takes place from March to May and parturition occurs from May to August. There is extensive variation in the timing of reproductive activity in this species. The long-legged myotis feeds primarily on moths (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in mixed-conifer forests and at Project facilities, including the Kilarc and Cow Creek powerhouses and tunnels. It may also utilize tree bark for roosting. No long-legged myotis were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Small-Footed Myotis (*Myotis ciliolabrum*)—SA

The small-footed myotis ranges from British Columbia and Saskatchewan to the Southwestern United States and prefers areas where it associates with cliffs, talus fields, and steep riverbanks. Roosts tend to be in rock crevices, cliff faces, and in talus formations. Maternity roosts are found in similar sites and have been observed in buildings. Mating takes place in the fall. Usually one young is born in the summer (June to July), although twins are known to occur. Lactating females have been observed from June through August. The small-footed myotis forages over water, rock formations and along cliffs. The diet of this species consists of moths, flies, beetles, and bugs (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in uplands and at Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. No small-footed myotis were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Spotted Bat (*Euderma maculatum*)—CSC

The spotted bat has been found at a small number of localities, mostly in foothills, mountains, and desert regions of southern California. Although this species was earlier thought to be extremely rare, it is now known to occupy a rather large range throughout western North America from southern British Columbia to northern Mexico. Little is known about the species in California. Occupied habitats range from arid deserts and grasslands through mixed conifer forests. The highest recorded elevation is 10,600 feet in New Mexico. Apparently the spotted bat prefers to roost in rock crevices and on cliffs, but is occasionally found in caves and buildings as well. Mating occurs in autumn, and most births occur before mid-June. One young is produced per year and is tended until August. It feeds over water and along marshes. Moths are their principal food (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in mixed-conifer forest and at Project facilities including the Kilarc and Cow Creek powerhouses and tunnels. No spotted bats were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Pale Townsend's Big-Eared Bat (*Corynorhinus townsendii pallescens*)—CSC

The pale Townsend's big-eared bat is found throughout California, but the details of its distribution are not well known. It is found in all except subalpine and alpine habitats and may be found at any season throughout its range. It is most abundant in mesic habitats and requires caves, mines, tunnels, buildings, or other human-made structures for roosting. Most mating occurs from November to February, but many females are inseminated before hibernation begins. Sperm is stored until ovulation occurs in spring. Gestation lasts 56 to 100 days, depending on temperature, size of the hibernating cluster, and time in hibernation. Births occur in May and June, peaking in late May. A single litter of one is produced annually. Young are weaned in 6 weeks and fly in two and a half to three weeks after birth. The maternity group begins to break up in August (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species may occur in the Kilarc and Cow Creek developments in mesic habitats and at Project facilities including Kilarc and Cow Creek powerhouses and tunnels. No pale Townsend's big-eared bats were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Pacific Fisher (*Martes pennanti pacifica*)—FC, CSC

The Pacific fisher is an uncommon permanent resident of the Sierra Nevada, Cascades, and Klamath Mountains, and is also found in a few areas in the North Coast Ranges. Suitable habitat for fishers consists of large areas of mature, dense forest stands with snags and a canopy closure greater than 50 percent. Females breed a few days after parturition and the implantation of the embryo is delayed until the following winter. Post-implantation active growth lasts approximately 30 days, and young are born February through May. Litter size ranges from one to four. The young remain with the female until late autumn. Males and females become sexually mature in the first or second year (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

This species was not observed during 2003 surveys although fishers are potentially present in the Kilarc and Cow Creek developments in mature, dense forest stands with snags; however, fishers are likely to avoid Project facilities and other areas with human activity. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Ringtail (*Bassariscus astutus*)—CFP

The ringtail is a widely distributed, common to uncommon permanent resident. It occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Little additional information is available on distribution and relative abundance among habitats. It nests in rock recesses, hollow trees, logs, snags, abandoned burrows, or woodrat nests. Young are born in May and June, with one litter per year. A litter averages three young and ranges from one to five. Gestation lasts 40 to 50 days. Females may drive males away three to four days prior to giving birth (Zeiner et al., 1990a).

Occurrence in the Kilarc and Cow Creek Developments

The ringtail may occur in forested areas in the Kilarc and Cow Creek developments. No ringtails were observed during Project surveys, and there are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments (CDFG, 2008a).

Game Species

The Kilarc and Cow Creek developments support a variety of local game species throughout the year. These species include mule deer; game birds, such as chukar (*Alectoris chukar*), California quail, and mourning dove; and mammals, such as western gray squirrel, black-tailed jackrabbit, brush rabbit (*Sylvilagus bachmani*), and desert cottontail rabbit (*S. auduboni*). Mule deer require cover in the form of dense timber and brush stands. This species forages in open, brushy areas or within relatively open timber stands on shrubs, grasses, forbs, and sometimes conifers. In general, upland game bird hunting season is from late summer to the end of winter. Mourning doves and several species of waterfowl are occasional in the Kilarc and Cow Creek developments, but their occurrence is far too limited to provide a significant hunting resource.

E.2.7 Botanical Resources

This section provides a description of existing botanical resources in the vicinity of the Kilarc and Cow Creek developments. The information presented here represents a combination of historical material from a literature review, material from field studies conducted in 2003 in support of Project relicensing, and data from additional field studies conducted in 2008. An additional review of the literature was performed in 2008 to augment 2003 field studies, and to provide information on additional areas that may be affected by decommissioning activities. The results of these studies are summarized in the following discussion. Detailed descriptions of the studies, including methods and results, are described in the following sections and presented in Appendix L (2008 Botanical Technical Report).

E.2.7.1 Methods

Methods for each 2003 study were described in the Kilarc-Cow Creek Project Relicensing Final Study Plans (PG&E, 2003). The methods for each 2003 and 2008 study and any modifications are summarized in the following sections.

Vegetation Mapping

During 2003, all occurrences of major plant communities within the immediate vicinity of the Kilarc and Cow Creek developments were mapped using available aerial photographs. Visual coverage by foot and vehicle was used to field-check the vegetation/cover type map. Corrections were mapped on prints of aerial photographs during the field surveys. Plant community polygons were digitized as GIS layers. Acreages were derived from these layers. Community descriptions follow the Cow Creek Watershed Assessment (SHN, 2001). Any additional vegetation types mapped in the Kilarc and Cow Creek developments are described from Holland (1986).

Additional mapping efforts in 2008 included the margins of non-project roads that may be used for decommissioning activities and new temporary access roads. Mapping was also conducted as part of wetland delineation studies on Hooten Gulch below the tailrace from the Cow Creek Powerhouse, and with a more general wetland delineation.

Special-Status Plant Study

Literature reviews were conducted to determine what special-status plant species could potentially occur within the existing FERC Project Boundary. An initial review was performed in 2003, and an identical query was performed in 2008 to update any findings. Species lists reviewed included those provided by the USFWS (2003, 2008a), CDFG (2003a, 2008a), and California Native Plant Society (CNPS, 2000, 2008). For the purposes of this review, special-status plant species were defined as those species either listed, proposed, or under review as rare, threatened, or endangered by the federal government or the state of California, and those listed as rare or endangered by the CNPS. Special-status plant taxa potentially present in the Kilarc-Cow Creek Hydroelectric Project Vicinity are presented in Table E.2.7-1.

Surveys were conducted within the entire extent of the Kilarc and Cow Creek developments where safely accessible. Most of the steep banks of Old Cow and South Cow creeks, including most of the siphon areas between the Kilarc Main Canal and Old Cow Creek, were not accessible and were viewed only from above or below.

The survey protocol followed *Guidelines for Assessing Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities* (CDFG, 2000). All surveys were floristic. Multiple surveys were required to search for all potentially present special-status plant species during appropriate seasons. A list of species observed during the 2003 and 2008 botanical resource studies is provided in Table E.2.7-2.

Initial special-status species surveys were scheduled for early May in 2003. Vegetation in the Cow Creek Development was at peak bloom during the May 5 to 10, 2003 survey period, and early season plants were flowering profusely in the lower elevations of the Kilarc Development. Areas surveyed within the Cow Creek Development included the Project access roads, Mill Creek Diversion Dam, South Cow Creek Diversion Dam, Mill Creek-South Cow Creek Canal, South Cow Creek Main Canal, Cow Creek Penstock, and Cow Creek Powerhouse. Areas surveyed within the Kilarc Development included the Kilarc Forebay, Kilarc Penstock, Kilarc Powerhouse, Kilarc Main Canal Diversion Dam, and parts of the Kilarc Main Canal. However, cold, late storms dropped snow along much of the Kilarc Main Canal and the higher elevation areas of the Kilarc Development during the course of the May surveys, including the reaches of North and South Canyon creeks and the respective diversion dams. Plant growth in these areas was just beginning, and walking along much of the Kilarc Main Canal trail was unsafe. These areas were surveyed for the first time between June 16 and 20, 2003. Both the Cow Creek and Kilarc developments were surveyed between June 16 and 20, 2003, as well as in July and August 2003. Most of the special-status species potentially present in the Kilarc and Cow Creek developments are identifiable during the summer. The two annual species that might not be identifiable in the summer occur around vernal pools and moist swales, and are not expected to occur in the forest and riparian habitats found along the bypass reaches of Old Cow and South Cow creeks.

The location of the only special-status plant species observed within the Kilarc and Cow Creek developments during the 2003 surveys was mapped on a print of an aerial photo. Photographs were taken showing diagnostic characteristics of this species. Voucher specimens were to be collected in accordance with government collecting regulations; however, no specimens were taken because the only special-status plant population found in 2003 consisted of two plants.

An additional special-status plant survey was conducted at the Cow Creek Development on April 18 and 22, 2008. Areas included in this survey were roads outside the FERC project boundary that may need upgrading for use during decommissioning, as well as the slopes adjacent to Cow Creek Main Canal that may be disturbed during decommissing. This survey resulted in the identification of a second special-status plant species at one of the temporary access road sites within the Cow Creek Development. This population was mapped using GPS data.

Riparian Study

Riparian vegetation in the Kilarc and Cow Creek developments was surveyed in July and August, 2003 (see Table E.2.7-3). Riparian vegetation in the bypass reaches of Old Cow Creek and South Cow Creek was described, and the distribution and width were mapped. Data collected included the species composition, an estimate of the percent cover, the height of the vegetation, and mortality, if any. Map polygons were a minimum of 0.25 acre in size. Additionally, the surveyors recorded the presence of seedlings and young saplings. Additional field efforts in 2008 included a wetland delineation on Hooten Gulch between the Cow Creek Powerhouse and the confluence with South Cow Creek. Riparian vegetation along that reach was mapped as part of the delineation.

Wetland Delineation Study

A wetlands delineation study was conducted in support of permitting for the decommissioning activities. The Kilarc Development study area for the wetlands delineation was limited to lands within the boundary established by FERC for the Kilarc Development. The Cow Creek Development study area included lands within the boundary established by FERC for the Cow Creek Development and lands outside the FERC Project boundary that may be encroached upon during decommissioning.

An on-site routine delineation of wetlands was conducted in April, 2008, within the study area, based on field observations of positive indicators for wetland vegetation, hydrology, and soils. This method is consistent with the approach outlined in the United States Army Corps of

Engineers (USACE) Wetlands Delineation Manual (USACE, 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE, 2006). Taxonomic nomenclature for plant species is in accordance with The Jepson Manual (Hickman, 1993). Wetland indicator status for plant species was confirmed using Reed (1988).

Positive indicators of hydric soils were recorded in the field in accordance with the criteria outlined in Field Indicators of Hydric Soils in the United States (Hurt and Vasilas, 2006). Soil colors were determined using a Munsell® soil color chart (Munsell, 1994). The hydric status of each soil map unit occurring within the study area was reviewed using the Web Soil Service (USDA, 2007).

The boundaries of delineated features were mapped using a Trimble Pathfinder Pro XH GPS capable of sub-foot accuracy. Where use of the GPS was not practicable, the features were delineated by hand onto ortho-rectified color aerial photographs. All data points and several location monuments were also located using the Trimble GPS unit. The final wetland delineation report will be submitted to the USACE for verification during the permitting process.

E.2.7.2 Plant Communities

The Kilarc and Cow Creek developments have a diverse flora and a variety of vegetation communities, which are a result of the varied topography, substrate, and elevations found in the watershed. Elevations range from approximately 820 feet at the Cow Creek Powerhouse to 3,900 feet at the North Canyon Creek Diversion Dam. Vegetation communities present within the Kilarc and Cow Creek developments include:

- Sierran mixed coniferous forest
- Ponderosa pine plantation
- Interior live oak woodland
- Blue oak-foothill pine woodland
- White alder riparian forest
- Northern mixed chaparral
- Annual grassland
- Wetlands (freshwater marsh and seeps)
- Developed/disturbed

The following descriptions of vegetation cover types within the Kilarc and Cow Creek developments have been derived primarily from the Cow Creek Watershed Assessment (SHN, 2001), and supplemented with descriptions from Holland (1986) for cover types not included in the Cow Creek Watershed Assessment. These vegetation cover types are also partly described in Section E.2.6, in relation to habitat for wildlife resources. The higher elevations support coniferous forests and the middle elevations support blue oak-foothill pine woodland and interior live oak forest. The lower elevations support non-native grassland and blue oak-foothill pine woodland.

Ponderosa Pine Plantation

Areas within the Old Cow Creek vegetation study area were burned in a 1988 fire called the Fern fire. These areas were re-planted with ponderosa pine seedlings, which are now young trees. Part of the replanted area and adjacent areas were burned in the Squirrel fire of 2002. At the time of the 2003 surveys, these recently burned areas were varied mixes of unaffected and burned vegetation.

Sierran Mixed Conifer Forest

Sierran mixed conifer forest is widely distributed within the watershed from 3,000 to 6,000 feet in elevation (SHN, 2001). This mixed conifer forest has replaced much of the area once dominated by ponderosa pine forest. Historically, this vegetation type was confined to moist sites having north-facing or east-facing slopes and well-drained soils. More recently, exclusion of fire has resulted in the conversion of ponderosa pine forests to mixed conifer forests in much of the region. Ponderosa pine, incense cedar, Douglas fir, and white fir are the dominant species in the tree overstory. Associated species include black oak.

Sierran mixed conifer forest provides most of the vegetative cover in Old Cow Creek and is also present at the upper end of South Cow Creek. Part of the vegetation in Old Cow Creek and adjacent areas was burned in the Squirrel fire in 2002. At the time of the 2003 surveys, these areas were varying mixtures of unaffected and burned vegetation. Vegetation at the northeast side of the Kilarc Forebay and along the Kilarc Penstock was also affected by this fire.

Interior Live Oak Woodland

Interior live oak woodland is broad-leafed woodland that is usually found on north-facing hillsides below 8,500 feet in elevation (Holland, 1986). This woodland is dominated by interior live oak. Associated species include California bay (*Umbellularia californica*), blue oak, buckeye, and poison oak (*Toxicodendron diversilobum*). Interior live oak woodland was the most extensive cover type in the South Cow Creek vegetation study area, but was not extensive enough to be mapped in the Old Cow Creek vegetation study area.

Blue Oak-Foothill Pine Woodland

Blue Oak-Foothill Pine Woodland occurs on foothill slopes in the vicinity of the Kilarc and Cow Creek developments from the valley floor to over 3,500 feet in elevation, depending on aspect. This cover type is dominated by blue oak and foothill pine, but may include various co-dominants (SHN, 2001). Co-dominants include whiteleaf manzanita, interior live oak, and buckbrush.

The understory is characterized by species typical of non-native annual grassland. In the absence of fire, a dense shrub community may develop including interior live oak, California buckeye (*Aesculus californica*), whiteleaf manzanita, poison oak, and California (western) redbud (*Cercis occidentalis*). Drier, harsher sites tend to support chaparral and grass understory, and mesic sites are characterized by locally abundant occurrences of black oak and poison oak.

White Alder Riparian Forest

White alder riparian forest is the primary riparian forest community found in the vicinity of the Kilarc and Cow Creek developments (SHN, 2001). This riparian forest is found along the mainstem and tributaries of Old Cow and South Cow creeks. Tree and shrub species are generally deciduous. White alder riparian is typically found along the edges of streams and creeks from the valley floor into the lower coniferous forest at elevations from 500 to 4,000 feet. The riparian corridor of this community is narrower than other riparian communities of the Sacramento Valley, due to the steep canyons, bedrock channels, and fast-flowing water common in the upper limits of the watershed. Common species include white alder, willow, bigleaf maple, and valley oak. Associated species include Oregon ash (*Fraxinus latifolia*), blue oak, non-native annual grasses, and buckbrush. Individuals or small stands of Fremont cottonwood (*Populus fremontii* ssp. *fremontii*) are found scattered throughout the bypass reaches of the Kilarc and Cow Creek developments. Western sycamore (*Platanus racemosa*) and California black walnut are present in a small area downstream of the Cow Creek Powerhouse.

Northern Mixed Chaparral

Northern mixed chaparral is dominated by tall shrubs, forming dense, often nearly impenetrable vegetation at elevations below 3,000 feet where it occurs in northern California (Holland, 1986). In the vicinity of the Kilarc and Cow Creek developments, this chaparral is dominated by manzanitas (*Arctostaphylos* spp.) and various ceanothus species (*Ceanothus* spp.). A dense cover of annual herbs may appear during the first growing season after a fire, followed in subsequent years by perennial herbs and short-lived shrubs until the original shrub species re-establish dominance by stump-sprouting. Small areas of chaparral are found at scattered locations in both Old Cow and South Cow vegetation study areas.

Non-Native Annual Grassland

Non-native annual grassland occurs at lower elevations and extends into openings within blue oak-foothill pine woodland in the foothill zone of the watershed (SHN, 2001). The foothill zone generally occurs below 2,500 feet in elevation. All tree-less grazing lands within the vegetation study area have been included in this cover type. Annual grassland is present in both Old Cow and South Cow creeks.

Non-native annual grassland supports a variety of annual grasses and associated forbs. Dominant species include wild oats (*Avena* spp.), foxtail chess (*Bromus madritensis* ssp. *rubens*), soft chess (*Bromus hordeaceus*), dogtail grass (*Cynosurus echinatus*), and ripgut brome. Annual and perennial forbs are common associates and include native species such as California poppy (*Eschscholzia californica*), butter n' eggs (*Triphysaria eriantha* ssp. *eriantha*), Sierra foothill silverpuffs (*Microseris acuminata*), and non-native species such as several filarees (*Erodium* spp.). Non-native annual grassland is frequently infested with noxious weeds such as yellow starthistle, medusahead grass, Klamath weed, and bull thistle.

Wetland Communities

Wetland communities include freshwater marsh and seeps that occur adjacent to Old Cow and South Cow creeks (SHN, 2001). In addition, seeps may also be seen adjacent to other facilities in the Kilarc and Cow Creek developments (e.g., Kilarc Powerhouse, Cow Creek Powerhouse, etc). Open water areas, such as the Kilarc and Cow Creek forebays, are also present in the Kilarc and Cow Creek developments.

Fresh Water Marsh

Freshwater marsh occurs along the edges of ponds and creeks located at lower elevations, including the Kilarc and Cow Creek forebays (SHN, 2001). This zone supports emergent vegetation and algae. Common freshwater marsh species include broad-leaved cattail (*Typha latifolia*), tules, rushes, and sedges.

Seeps

Seeps or springs often occur in wet areas within non-native grasslands or meadows. These are usually associated with changes in geologic material, fractures, or faults (SHN, 2001). This wetland vegetation type is characterized by perennial herbaceous plant species associated with permanently moist or wet soil (Holland, 1986), and consists of sedges, rushes, and a variety of grass species. Seeps are present at a few locations in the Kilarc Development and access roads in the Cow Creek Development.

Vernal Swale

A single vernal swale occurs on the terrace along an access road to the Cow Creek Development. The vernal swale is hydrologically connected to an intermittent stream that drains the terrace. Plant species observed in the vernal swale include slender popcorn flower (*Plagiobothrys stipitatus*), wooly marbles (*Psilocarphus brevissimus*), water star-wort (*Callitriche heterophylla*), bicolor lupine (*Lupinus bicolor*), and Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*).

Developed/Disturbed

Developed land in the vicinity of the Kilarc and Cow Creek developments includes residential areas and the area around the Kilarc Powerhouse. Disturbed land includes areas where slides have occurred on steep slopes and areas disturbed by human activities, particularly logging. Any vegetation present consists either of species from the surrounding vegetation or weedy species typical of disturbed areas. Areas in these categories that were large enough to map were all found along Old Cow Creek and were primarily related to logging activities.

E.2.7.3 Special-Status Plant Species

Based on the literature review, a list of special-status species with potential to occur in the Kilarc and Cow Creek developments was prepared (Table E.2.7-1). None of the species identified from the literature review was observed within the FERC Project boundary during the botanical surveys. While Bogg's Lake hedge-hyssop (*Gratiola heterosepala*) and Ahart's paronychia (*Paronychia ahartii*) are annual species that might not be identifiable by July (when the first botanical surveys along the bypass reaches were conducted), neither of these species was expected to occur in the forest and riparian habitats found along the reaches surveyed. Neither species was observed during the botanical surveys in 2003 and 2008. However, two additional special-status species were observed during 2003 and 2008 surveys.

A common species, scarlet fritillary (*Fritillaria recurva*), was observed in several locations both within the Kilarc Development and the Cow Creek Development during the May 2003 and 2008 surveys. Fritillaries were observed along Kilarc Penstock and at several locations along the South Cow Creek Main Canal and the slopes above South Fork Cow Creek. Many similar plants were not identifiable to species due to inaccessibility or undeveloped flowers in 2003. By June in 2003, most of these plants were no longer visible or had lost their flowers and fruit. Fritillaries in fruit were also observed on the steep slopes above the diverted reaches when the July and August botanical surveys were conducted on these reaches. It was considered possible that some of the fritillaries could be the CNPS List 3 species, Butte County fritillary (*Fritillaria eastwoodiae*), which is similar to scarlet fritillary. However, studies in 2008 found only scarlet fritillary in the Cow Creek Development. Fritillaries along the Kilarc Penstock would not be affected by deconstruction activities.

Butte County Fritillary

Butte County fritillary is included on CNPS List 3. List 3 species are plants that need more information to determine their rarity. Butte County fritillary is a bulbiferous perennial herbaceous species that grows in chaparral, cismontane woodland, and lower montane coniferous forest at elevations from 130 to 4,925 feet (CDFG, 2008a). Although this fritillary usually grows on dry slopes, it is also found in wet places. This species occupies a variety of soils, including serpentine, red clay, and sandy loam. Butte County fritillary flowers from March to May. No individuals of this species were identified during surveys in 2003 and 2008.

Mountain Lady's Slipper

Mountain lady's slipper (*Cypripedium montanum*) is included on CNPS List 4. List 4 species are limited in distribution and may become rarer. Mountain lady's slipper is a rhizomatous perennial herbaceous species that grows in broadleafed and coniferous woodlands and forests at elevations from 600 to 7,300 feet (CNPS, 2000). This species is widely distributed, but most occurrences are small. Mountain lady's slipper flowers from March to August. Two stems of this species were growing at the base of an above-ground reach of the Kilarc Main Canal in 2003, at the top of a steep, bare slope failure (Figure E.2.6-2, Maps 2 and 3). The surrounding vegetation was Sierran mixed coniferous forest.

Big-scale Balsamroot

Big-scale balsamroot (*Balsamorhiza macrolepis* var. *macrolepis*) is included on CNPS List 1B. List 1B species are rare, threatened, or endangered in California and elsewhere. Big-scale balsamroot is a rhizomatous perennial herbaceous species that grows in cismontane woodland and in valley and foothill grassland at elevations from 115 to 3,280 feet (CDFG, 2008a). This species may occur on serpentine soils. This balsamroot flowers from March to June. A population of big-scale balsamroot was found at a proposed temporary access road site (Figure E.2.6-1, Map 2). The surrounding vegetation was blue oak-foothill pine woodland.

E.2.7.4 Riparian Study

Riparian vegetation surveys were conducted to determine the type, extent, and condition of riparian vegetation in the Kilarc and Cow Creek developments and in the bypass and artifically augmented flow (Hooten Gulch) reaches. Observations for each vegetation reach are summarized below, and the locations of these reaches are shown in Figures E.2.7-1 and E.2.7-2. With the exception of Hooten Gulch and parts of Old Cow Creek, these stream reaches are in steep, narrow canyons. White alder riparian forest occurs along South Cow, Mill, Old Cow, North Canyon, and South Canyon creeks. Along Hooten Gulch, species more typical of mixed riparian forest, such as western sycamore and California walnut also occur. However, these types are not distinct entities along Hooten Gulch, and dominant species intermingle along the creek corridor. Young saplings were observed in most of the reaches.

Kilarc Development

Areas with riparian vegetation in the Kilarc Development include the bypass reaches of Old Cow, North Canyon, and South Canyon creeks. These areas are discussed below.

Dominant species in the riparian vegetation along Old Cow Creek include white alder, Fremont cottonwood, bigleaf maple, and mountain dogwood (*Cornus nuttallii*). Fremont cottonwood is present as individual trees or small pockets in several locations along Old Cow Creek, but does not form stands. White alder and bigleaf maple are the common species along the reach, which is also interspersed with mountain dogwood. Understory species in the riparian vegetation typically present include willows, vine maple (*Acer circinatum*), and Himalayan blackberry (*Rubus discolor*) interspersed with creek dogwood (*Cornus sericea*). The common herbaceous species present include Indian rhubarb (*Darmera peltata*), brickellbush (*Brickellia* sp.), arrow butterweed (*Senecio triangularis*), sedges and grasses, as well as the exotic Klamath weed. Upland tree species such as live oak, ponderosa pine, incense cedar, white fir, Douglas fir, and Pacific yew (*Taxus brevifolia*) are located upslope of the riparian zone and in some reaches adjacent to the stream.

The riparian vegetation along Old Cow Creek generally consists of a narrow strip found along both banks of the creek. The tree canopy ranged from 10 to 100 percent in cover. The width of the riparian zone ranged from 15 to 500 feet. The average height of the tree canopy within the riparian vegetation ranged from 8 to 35 feet. There were a few areas identified in 2003 where white alder trees had died or had a large percent of decadence.[13] These areas were located at the base of a slide upslope from the creek. Seedlings of the various riparian species along the channel were found on the banks and more often occupied mid-channel islands or bars. The herbaceous component of the riparian zone along the Old Cow Creek bypass reach for the Kilarc Development was fairly sparse along the banks. Cover was approximately 20 percent of this reach.

North and South Canyon Creeks

Dominant species in the riparian vegetation along North and South Canyon creeks include white alder, mountain dogwood, and bigleaf maple. Understory species in the riparian vegetation typically present include vine maple, Indian rhubarb, bracken fern (*Pteridium aquilinum* var. *pubescens*), and trail plant (*Adenocaulon bicolor*). Upland tree species such as live oak, ponderosa pine, incense cedar, white fir, and Douglas fir are found upslope from the riparian zone.

The riparian vegetation along South Canyon Creek was comprised of a narrow strip found along both banks of the creek. The tree canopy ranged from 90 to 100 percent in cover. The width of the riparian zone ranged from 5 to 10 feet. The average height of the tree canopy within the riparian vegetation ranged from 50 to 70 feet. No unusual mortality was recorded along South Canyon Creek.

Cow Creek Development Area

Areas with riparian vegetation in the Cow Creek Development include the bypass reaches of South Cow and Mill creeks and the artificially augmented flow reach of Hooten Gulch. These areas are discussed below.

South Cow Creek

Dominant species in the riparian vegetation along South Cow Creek include white alder, bigleaf maple, Oregon ash, and California bay. Fremont cottonwood is present as individual trees or small clusters in several locations along South Cow Creek, but do not form stands. Understory species typically include willows, Himalayan blackberry, poison oak, Indian rhubarb, California wild grape (*Vitis californica*), sedges, and grasses. Upland tree species such as ponderosa pine, canyon live oak (*Quercus chrysolepis*), interior live oak, and black oak are located upslope of the riparian zone and adjacent to the stream in some reaches.

The riparian vegetation along South Cow Creek consisted generally of a narrow strip along both banks of the creek. The tree canopy of the riparian vegetation along South Cow Creek ranged from 60 to 99 percent cover and the shrub layer ranged from 50 to 80 percent cover. The width of the riparian zone[14] ranged from 10 to 60 feet. The average height of the tree canopy within the

[13] Die-back of current year's growth or dead branches in excess of those on healthy trees.
[14] The width of the riparian zone represents an average total of both banks of the creek and also includes riparian vegetation on mid-channel islands or bars when these features are present.

riparian vegetation ranged from 10 to 40 feet. No unusual mortality was observed along South Cow Creek. Seedlings of the various riparian species along the channel were found on the banks and were more often occupying mid-channel islands or bars.

The herbaceous component of the riparian zone along the South Cow Creek bypass reach was fairly sparse along the banks. Indian rhubarb and sedges were the dominant herbs found within this reach. These species grow between boulders or on the edges of banks and bars within the channel. Herbaceous cover was approximately 10 to 20 percent of the bypass reach.

Mill Creek

White alder is the dominant species along the Mill Creek bypass reach. It is interspersed with the co-dominant species, California bay, and Oregon ash. Understory species typically present include willows, Himalayan blackberry, California wild grape, Indian rhubarb, sedges, and grasses. Upland tree species such as ponderosa pine and black oak are located upslope of the riparian zone.

The riparian vegetation along Mill Creek generally consisted of a narrow strip found along both banks of the creek. The tree canopy ranged from 50 to 90 percent in cover. The width of the riparian zone ranged from 20 to 30 feet. The average height of the tree canopy within the riparian vegetation ranged from 5 to 20 feet. There was a dense shrub and herbaceous understory along the channel. No unusual mortality was observed along Mill Creek.

Hooten Gulch

Dominant species in the riparian vegetation along Hooten Gulch include white alder, Fremont cottonwood, valley oak, and California black walnut. White alder and valley oak are more common along the reach, while cottonwood is found as scattered individuals. A few western sycamores were identified at the Cow Creek Powerhouse. Understory species in the riparian vegetation typically present include willows, Himalayan blackberry, California wild grape, and California redbud. There are a few scattered California buckeyes present within the riparian zone. Tree species such as foothill pine and valley oak are located upslope of the riparian zone.

The riparian vegetation along Hooten Gulch generally consisted of a narrow strip found along both banks of the creek. The tree canopy ranged from 70 to 85 percent in cover. The width of the riparian zone ranged from 15 to 35 feet. The average height of the tree canopy within the riparian vegetation ranged from 30 to 60 feet. No unusual mortality was observed along Hooten Gulch. The riparian vegetation along the channel was comprised primarily of trees and shrubs. The herbaceous component was sparse.

E.2.8 Historical Resources

The purpose of this section is to describe the historical resources present in the Project Area. This section identifies the important architectural and historical resources in the Area of Potential Effect (APE). The architectural APE includes the entire built environment and is defined as the area within the FERC Project Boundary and a 100-foot buffer zone outside the boundary (see Figures E.2.8-1 and E.2.8-2). The Kilarc and Cow Creek powerhouses are in the APE as well as the associated Project facilities, such as the penstocks, water conveyance canals, diversion dams, flumes, siphons, tunnels and forebays, and all access roads.

The Project is considered a federal undertaking under Section 106 of the National Historic Preservation Act (NHPA), and 36 CFR 800, the implementing regulations. FERC is the federal lead agency and PG&E is the Project sponsor and the permit applicant. This LSA also follows NEPA and CEQA guidelines for inventoring and documenting historic properties.[15]

E.2.8.1 Historical Context

The earliest European exploration of California occurred in 1542, when Spanish explorer Juan Sebastian Cabrillo traveled along the California coast and made contact with the native inhabitants. During the next 125 years, the Native Americans of California had sporadic contact with European explorers. The earliest documented accounts of explorations of California did not indicate excursions into the Project Area.

Mission and Mexican Period (1769 - 1848)

The Spanish established the first European foothold in California with the establishment of a network of missions. The mission system was initiated, in part, as a way for Spain to manage the indigenous populations of Alta California and to convert the native people of California into Catholic citizens of Spain. The northernmost missions in California established during this era were all located at least 200 miles from the Project Area (Milliken, 1995; Silliman, 2001; Lightfoot, 2005).

California was Spanish territory until Mexican independence in 1822. During this time, the Spanish and later the Mexican governments did not have a significant presence in northern California or in the vicinity of the Project Area. French and American explorers traveled through the lands surrounding the Project Area. In addition, the Sacramento River Valley was briefly occupied by fur trappers from as early as 1820 (Lewis Publishing Company, 1891). These early explorations made inroads into the region that would later be followed by Euro-American fur traders, settlers, and gold seekers alike.

Early Euro-American explorers and fur trappers were known to have been in the vicinity of the Project. Alexander McLeod traveled along Cow Creek between 1829 and 1830, and in 1836; and John Work in 1833 (Miesse, 2008). John Work was probably the first explorer in the Whitmore area. The Work party camped at Hat Creek, reached the headwaters of Cow Creek, which Work named Canoe River. The Work party then followed the divide between Old Cow and South Cow creeks and continued down Cow Creek (Thielemann, 2000).

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15 The LSA will support the Project's NEPA and CEQA compliance, because FERC will prepare a NEPA document based on it.

California Gold Rush and American Period (1848 – Present)

The American settlement and eventual acquisition of California was the result of two important and concurrent events: the Mexican-American War (1846 to 1848) and the California Gold Rush (1848 to 1850), which brought thousands of American miners and settlers to the region. The American victory over Mexico resulted in the Treaty of Guadalupe Hidalgo (1848), which awarded the United States control of California.

The California Gold Rush began with the discovery of gold in early 1848 at Sutter's Mill in Coloma. It is estimated that within a year (1849) roughly 90,000 people came to California, and by 1855 almost 300,000 had arrived from around the United States and abroad, including Mexico, South America, and Hawaii. The discovery of gold in the Sierra Nevada by Euro-Americans ignited a major population increase in the northern half of California, specifically throughout the Sacramento River Valley, as immigrants poured into the territory seeking gold or the opportunities it presented. Mining camps were established all over the region surrounding the Kilarc and Cow Creek developments.

Gold was first discovered in Shasta County near Reading at Clear Creek in 1848. One area was Horsetown, one of the three major areas for gold mining in Shasta County, along with Shasta and Lower Springs. There were also gold mining operations in the Keswick area. Other notable mines in the county included the Gladstone, Washington, Walker, and the Mad Mule mines (Smith, 1991). Gold mining peaked in the 1880s, but a resurgence in gold mining occurred in the 1930s, at which point dredging techniques were the primary method used.

Statehood and Local Government

California was admitted to the Union on September 9, 1850. Shasta County, one of the original 27 counties in 1850, initially included present-day Modoc, Lassen, Siskiyou, Plumas, and Tehama counties. The county seat was originally located at Reading's Ranch until 1851, when it was transferred to the town of Shasta, and thereafter to Redding in 1888. The following towns were established near the Kilarc and Cow Creek development areas: Shingletown, Millville, and Fall City in the 1850s, and Whitmore and Palo Cedro in the 1860s (Smith, 1991).

There were two military forts in the Project Area set up to protect the mining camps and new American settlements. Fort Reading was located a few miles from confluence of the Cow Creek and Sacramento rivers. Fort Crook was located a little further away in the Burney area to the north, near Fall River Mills and Fall City (Hart, 2008).

The town of Redding was founded in 1872 and named in honor of Benjamin Redding, who was a land agent for the Central Pacific Railroad Company. The town was the railroad's terminal point until 1883 when the railroad was extended further up the Sacramento River canyon. The town incorporated in 1887 and was the first municipality in Shasta County (Smith, 1991).

Transportation and Settlements

The earliest transportation corridors in the Project Vicinity consisted of trails and rough, dirt roads. One of the first roads was the Basin Hollow Road created in 1857. This road extended from Webb & Stevenson's mill on the south fork of Cow Creek to Stroud's ranch at Clover Creek. In 1872, the railroad arrived in Shasta County. Cottonwood was the first Shasta County railroad depot (Smith, 1991).

In 1885, several German families were persuaded to settle in the Whitmore area, near the Project Area. Once they established themselves in the area, they engaged in farming and ranching, activities which are still predominant in the area. Settlers primarily raised sheep, hogs, and cattle and grew hops, dry beans, and fruit. The local dry red soil was difficult to farm without large amounts of water. Water was provided to settlements for irrigation through ditches. The South Cow Creek Irrigation Company constructed the German Ditch, which was one of the largest irrigation ditches in the area. Many of these irrigation ditches were later adapted for use in hydroelectric power generation (Thielemann, 2000).

Copper Mining

In the mid-1860s, when copper was discovered in Shasta County, copper mining became the predominant replacement material as gold deposits were exhausted, and Shasta County was established as one of the leading copper mining and smelting regions of the United States. The discovery of copper led to another spurt of population growth in Shasta County. By 1906, there were five copper smelters in Shasta County, including Keswick, Coram, Kennett, Bully Hill and Ingot (Smith, 1991). The first mines were built in Copper City in 1862. The West Shasta Copper-Zinc District included Iron Mountain, Keystone, Balakalala, Mountain Copper, Shasta King, Sutro, and Mammoth mines. The East Shasta Copper Zinc District included Bully Hill and Afterthought mines (Hart, 1979). The Afterthought, Donkey Mine, and Ingot Smelter were located within the Cow Creek Watershed upstream of the Cow Creek Development. All the smelters closed by 1920, due to litigation by the United States Forest Service (USFS) and area farmers as copper refining was an extremely toxic process. There was also a lack of commercial viability for the copper and the poor quality of the ore (Smith, 1991).

Hydroelectric Power

Before hydropower was introduced, California depended on coal, wood, kerosene, and petroleum gas for energy. These were expensive resources and not always available. By the 1870s, several municipalities and industries were using steam plants to generate electricity. An increasing population (1.5 million in the 1890s) and a shift towards mechanization of industry led to a power shortage and it became necessary to develop a cheap and reliable source of energy to fuel the energy needs of the population (JRP and DOT, 2000).

In order to meet these needs, California turned to hydroelectric power. California features high mountains with abundant watersheds and hydroelectric power generation exploits these topographical advantages. Additionally, the landscape was covered with leftover canals and other water conveyance systems from hydraulic mining and irrigation projects that were suitable for adaptation for use in hydroelectric power generation. An estimated 6,000 to 8,000 linear miles of canals existed in the 1880s after the Sawyer Act put an end to hydraulic gold mining methods (JRP and DOT, 2000).

In 1892, Herman Scherer installed the Sacramento River hydroelectric facility which generated electricity for lighting purposes in Dunsmuir. Another facility was the Fall River plant constructed by Zummalt in 1890, located where the Fall River cascades 75 feet to the Pit River (Hart, 1979).

By 1902, hydroelectric power was well established (JRP and DOT, 2000). The scale and price of generating hydroelectric power had increased dramatically and was generally beyond the reach of a single or group of entrepreneurs, requiring the resources of larger entities. Larger scale consolidations of resources and companies can be seen in the large-scale mining and agricultural industries of California during the early twentieth century. The development of hydroelectric power, for an ever-increasing population (5 million in 1930) in the midst of the Great Depression, was adopted by public agencies, whether municipal, state, or federal. One example was the New Deal Central Valley Project of which the Shasta Dam was a focal point. The 1930s construction of Shasta Dam had a significant impact on Shasta County. Shasta Dam was completed in 1944 and is the second largest dam in the United States after the Hoover Dam (JRP and DOT, 2000).

Kilarc and Cow Creek Development Areas

Kilarc Development Area

At the turn of the twentieth century, Hamden Holmes Noble, a prominent San Francisco mining stockbroker and financier, started the Keswick Electric Power Company (1897 to 1899). The purpose of the company was to supply hydroelectric power to the new copper mining industry in Shasta County (Siskin et al., 2008).

In response, the Keswick Power Company began construction of a hydroelectric plant on North Battle Creek, a stream around 20 to 30 miles southeast of the copper mining district. This plant, called Volta, began operation in 1901 with lines leading directly to the Mountain Copper Company's smelters at Keswick. At the same time, Noble, along with Edward Coleman and Antoine Borrel, incorporated and the Keswick Electric Company became the Northern California Power Company (Reynolds, 1995; Siskin et al., 2008).

Over the next decade, the NCPC increased its generating capacity by expanding its first plant, Volta, and building three more plants: South, Inskip, and Kilarc (Reynolds, 1995). The NCPC became the fourth largest utility in all of California and second only to California Gas and Electric (the predecessor to PG&E) in Northern California (Reynolds, 1982).

Kilarc was NCPC's second powerhouse. The term "kilarc" designated the high-voltage switch oil used in the power plants (Gudde, 2004). Other power plants built by NCPC are part of the Battle Creek system. The first was the Volta facility near Manton and Shingletown in 1901. Work at the Volta facility employed thousands of people. Kilarc was simply a back-up plant, 20 miles north of Volta, with a direct transmission line that connected Kilarc to the Bully Hill smelter. After Kilarc Powerhouse went online in 1904, NCPC contracted in 1905 with PG&E to access PG&E's transmission grid, which entailed easier access to obtaining local business. The South and Inskip hydroelectric power plants were built in 1910 and the Coleman facility was constructed in 1911 (Hart, 1979).

When the Kilarc Powerhouse began producing electricity in 1904, the electrical needs of the region took a sudden downturn caused by the Mountain Copper Company's cutting electricity use by one-third due to fires at the mines, the Horsetown diggings closing, and the Balakalala Copper Company opting not to construct its new smelter. This reduction in energy demands forced NCPC to search for new markets as more than half of the generating capacity was unutilized. In the 1910s, NCPC faltered, and PG&E purchased the company in 1919. PG&E continued to operate NCPC's Battle Creek hydroelectric system as part of its grid through the 1970s. In the 1970s and 1980s, PG&E decided to replace some of the original plants, including Volta, Inskip, and South (Reynolds, 1995, 1982).

Cow Creek Development Area

The Northern Light & Power Company constructed the Cow Creek hydroelectric facility in 1907 and it was operational by 1908 (PG&E, 1962). The fluctuations in the economy at the time, and the need for constant improvements in hydroelectric generation and transmission, forced the two companies operating the Kilarc and Cow Creek facilities into direct competition. NCPC consolidated in 1908. In 1912, after a short price war, NCPC Consolidated purchased the Northern Light & Power Company after it became part of the Sacramento Valley Power Company. PG&E acquired control over NCPC Consolidated in 1919 and the Kilarc and Cow Creek systems were jointly operated after this point.

E.2.8.2 Methods and Results

Below are the methods and results of the records search, historic research, and field survey.

Records Search and Historical Research

Cultural resources specialists requested records searches from the Northeast Information Center (NEIC) of the California Historic Resources Information System at California State University, Chico to compile data regarding previously conducted surveys and recorded cultural resources within a 0.5-mile radius of the APE. The following sources were consulted for the records searches:

- NEIC base maps: USGS 7.5-minute series topographic quadrangles: Miller Mountain, Whitmore, Inwood, and Clough Gulch, and USGS 15-minute topographic quadrangles of Whitmore and Millville (NEIC, 2008).
- Previous survey reports and archaeological site records on file were examined to identify recorded archaeological sites and historic-period built environment resources (e.g., buildings, structures, and objects) within or immediately adjacent to the APE.

- The California Department of Parks and Recreation's *California Inventory of Historic Resources* (1976) and the State Office of Historic Preservation's (SHPO) *Historic Properties Directory* (2006), which combines cultural resources listed on the California Historical Landmarks, California Points of Historic Interest, and those that are listed in or determined eligible for listing in the NRHP or the California Register of Historical Resources (CRHR).

In addition, architectural historians conducted archival research at the following locations:

- San Francisco Public Library, San Francisco, California
- PG&E Records Center, Brisbane, California
- PG&E Photographic Archives at Beale Street, San Francisco, California
- Shasta Historical Society, Redding, California
- Redding Public Library, Redding, California
- California State Archives, Sacramento, California
- California State Library, Sacramento, California

<u>Records Search Results</u>

The record search resulted in the identification of two previously recorded architectural and historical resources located within a 0.5-mile radius of the APE and six new and updated resources within the Project APE. Results of the records search are listed in Tables E.2.8-1 and E.2.8-2.

Field Survey Methods

Cultural resource specialists conducted an intensive cultural resources pedestrian survey for architectural and historical resources within the APE and all associated access roads between April 1 and May 2, 2008.

The APE consisted of two separate locations corresponding to the two distinct watersheds of the Kilarc and Cow Creek powerhouses (Old Cow Creek and South Cow Creek), both located in Shasta County. An additional survey was conducted on the South Canyon Creek Canal and Siphon, and the proposed access roads that would be used and improved during decommissioning.

All resources identified within the APE were photographed and mapped with GPS equipment. All combined survey areas represented a total of approximately 164 acres, most of which consisted of a single linear pedestrian transect following the canals, and totaling approximately 16.3 miles, with larger areas around the Kilarc and Cow Creek powerhouses; the former caretaker and foreman's cottages at the Kilarc and Cow Creek powerhouses, the Kilarc and Cow Creek forebays, the Kilarc Day Use Area, and the main diversion sites.

Field Survey Results

A total of six architectural and historical resources were identified within or adjacent to the APE. All were recorded on Department of Parks and Recreation (DPR) standard forms, mapped and photographed. The two previously recorded sites were re-visited, and updated site records were prepared for the North and South Canyon Creek ditch (P-45-003241), and the the South Cow Creek Diversion (CA-SHA-1764H). Tables E.2.8-1 and E.2.8-2 summarize the architectural and historical resources described in this LSA.

E.2.9 Archaeological Resources

The purpose of this section is to describe the archaeological resources present in the Project Area. This section identifies the important archaeological resources in the APE. The archaeological APE is the entire Project Area within the FERC Project boundary where actual ground disturbing activities may occur.

E.2.9.1 Prehistoric Context

Archaeological evidence indicated that the prehistory of northeast California extends at least as far back as 12,000 to 13,000 years ago (McGuire, 2007). Archaeologists recognize six general patterns of cultural adaptation (primarily based on materials remains) throughout northeast California during the period between 5000 years Before Christianity (B.C.) to Anno Domini (A.D.) and, the Contact Period.

Northeast California Cultural Chronology

The six primary time periods are as follows: the Early Holocene (5000 B.C.), the Post-Mazama (5000 to 3000 B.C.), the Early Archaic (3000 to 1500 B.C.), the Middle Archaic (1500 B.C. to A.D. 700), the Late Archaic (A.D. 700 to 1400) and the Terminal Prehistoric (A.D. 1400 to Contact).

<u>Early Holocene (5000+ B.C.)</u>

Numerous diagnostic projectile points are represented in this period and include large lanceolate points and a range of stemmed points. Clovis points, evidence of Paleo-Indian populations, have also been documented along lakes and rivers in the region and may reflect a date range of circa 11,500 to 9,500 years B.C.

In general, the Early Holocene is thought to have been composed of a highly mobile population with habitation sites located near freshwater sources.

<u>Post-Mazama (5000 B.C. to 3000 B.C.)</u>

The best-known representation of the Post-Mazama period dates between 4,500 and 2,500 cal B.C. in Surprise Valley in Modoc County. Artifacts identified from this site include Northern Side-notched (NSN) projectile points, antler wedges, mortars with V-shaped bowls and pointed pestles, T-shaped drills, tanged blades, and flaked stone pendants. Northern Side-notched points found in Surprise Valley generally appear to postdate the Mount Mazama ash fall which occurred circa 5000 B.C.

Early Archaic (3000 B.C. to 1500 B.C.)

Projectile points are commonly used to mark the regional and temporal variability of the northeast region during the Early Archaic. The point assemblages of the Early Archaic contain Elko and Siskiyou Side-notched forms and Gatecliff and Martis-like series, which can date to as early as 2500 cal B.C.

Middle Archaic (1500 B.C. to A.D. 700)

The Middle Archaic resembles archaeological components of the Early Archaic but shifts to larger settlement sites. The presence of projectile points during the Middle Archaic continued in the archaeological record which indicates that hunting was still an important activity.

Late Archaic (A.D. 700 to 1400)

The Late Archaic period can be divided into two parts dating from circa A.D. 200 to 1000, and circa A.D. 1000 to 1400. The early part, (circa A.D. 200 to 1000) closely resembles the Middle Archaic period, whereas the latter part (circa A.D. 1000 to 1400) reflects substantial changes in settlement, assemblages, and subsistence patterns. Archaeological deposits in this region reflect adaptations to habitation sites, which include features such as hearths, caches, and storage pits.

Terminal Prehistoric (A.D. 1400 to Contact)

The Terminal Prehistoric period reflects a change in subsistence and land use patterns to those of the prehistoric populations that inhabited the area prior to and throughout the Contact Period. This pattern exhibits elaborate ceremonial and social organization, trade and the development of social stratification. Exchange became well developed, and an even more intensive emphasis was placed on the use of acorns, as evidenced by the presence in the archaeological record of shaped mortars and pestles, and numerous hopper mortars.

Prehistory of the Project Area

Very few early sites (over 10,000 years old) are known to exist in the Southern Cascades. Most of the evidence for early occupation in this region comes from sites dating between 7,500 to 5,000 Before Present (B.P.) (Chartkoff and Chartkoff, 1984). The artifact assemblages for this period reflect a subsistence pattern that utilized a variety of tool types.

Approximately 2,000 years B.P., along the Pit River near the Project Vicinity, a shift occurred in the apparent use of different obsidian sources—from obsidian obtained at Medicine Lake to lower quality Tuscan and Buck Mountain obsidians. This shift could indicate an expansion in reliance on local resources and reduced mobility. In addition, during A.D. 1600 to the Contact Period, an established trade network surfaced linking central and northern California. Various artifacts, such as clam shell disk beads, pebble pendants and narrow drills, to name a few, represent the incorporation of cultural material from numerous trading groups (Dunn et al., 1992).

E.2.9.2 Ethnographic Context

Archival and ethnographic resources (Riddell, 1978; Heizer and Whipple, 1971; Kroeber, 1925) suggest that the Yana groups occupied the territory within and surrounding much of the Project Area with influences from their immediate neighbors, the Wintu to the west and the Pit River tribes, Achumawi to the north and Atsugewi just to the east. The Yana tribe was part of the Hokan language group. Much of this information was gathered by ethnographers during the later nineteenth and early twentieth centuries (Powers, 1877; Merriam, 1905; Kroeber, 1925).

The Project Area lies within the territory occupied at the time of European contact with the Central Yana people. The Yana tribe is comprised of four separate subgroups including the Northern Yana, the Central Yana, the Southern Yana, and the Yahi. Yana territory encompassed the upper regions of the Sacramento River valley and foothills (Kroeber, 1925; Heizer and Whipple, 1971).

Unlike the Southern Yana, the Northern and Central Yana had substantial earth-covered multi-family dwellings and assembly houses (Johnson, 1978). Conical bark houses were made of cedar or pine bark and the smaller houses had a shallow oval depression 10 to 12 feet in diameter with dirt banked up 3 or 4 feet on the outside.

The most important food source in the Yana diet was acorns, which were gathered in late September and October (Johnson, 1978). Deer was the most important game animal, along with rabbits and quail. Fishing was a seondary food-procuring activity. Salmon, trout, and other fish were caught by spears, harpoons, traps, and nets. Roots, tubers, and bulbs were also gathered. The Yana had a relative abundance of food in the fall; however, in the summer months, few food items were available below 2,500 feet (Johnson, 1978). The food quest and the summer heat in the foothills likely explain the seasonal migration of people to the higher elevations in search for deer, berries, and seed plants (Johnson, 1978).

The Yana society was centered around tribelets, comprising a few family groups led by a hereditary chief. The membership of the tribelets was probably based on marriages, deaths, and inter-tribal conflicts rather than allegiance to a particular chief. Central Yana villages were primarily located in the lower reaches of the foothills. Kroeber (1925) reports that the largest and most permanent villages were situated along the major western draining creeks in the territory, including Battle, Deer, and Cow creeks. The upland areas were utilized during the late spring and early fall for acorn gathering and collecting spring bulbs and tender roots.

The relatively isolated area in which the Yana people lived did not attract much mining or non-native settlement up until the early 1840s when the foothills began to be utilized for livestock grazing.

According to Kroeber (1925), there were an estimated 1,100 to 1,800 Yana in pre-Contact times (Johnson, 1978). Initially, many of the Yana lived far up the creeks and drainages and were not as affected as other groups in the Sacramento River Valley by the plague of 1831 to 1833. Cook had estimated that there were 1,900 Yana in 1848, and that, decimated by Euro-American diseases, by 1884 the Yana population had been reduced to 35 people (Johnson, 1978).

The Yana peoples, specifically the Central Yana, have long held important ties to the land in the Project Area. Traces of their past activities and ancestors are embedded in the landscape.

E.2.9.3 Methods and Results

Below are the methods and results of the records search, archival and historical research, and field survey.

Records Search and Historical Research

Cultural resources specialists requested records searches from the NEIC of the California Historic Resources Information System at California State University, Chico to compile data regarding previously conducted surveys and recorded cultural resources within a 0.5-mile radius of the APE. The following sources were consulted for the records searches:

- NEIC base maps: USGS 7.5-minute series topographic quadrangles: Miller Mountain, Whitmore, Inwood, and Clough Gulch, and USGS 15-minute topographic quadrangles of hitmore and Millville (NEIC, 2008).
- Previous survey reports and archaeological site records on file were examined to identify recorded archaeological sites and resources within or immediately adjacent to the APE.
- The California Department of Parks and Recreation's *California Inventory of Historic Resources* (1976) and the SHPO's *Historic Properties Directory* (2006), which combines cultural resources listed on the California Historical Landmarks, California Points of Historic Interest, and those that are listed in or determined eligible for listing in the NRHP or the CRHP.

In addition, cultural resources specialists conducted archival research at the following locations:

- San Francisco Public Library, San Francisco, California
- PG&E Records Center, Brisbane, California
- PG&E Photographic Archives at Beale Street, San Francisco, California
- Shasta Historical Society, Redding, California
- Redding Public Library, Redding, California
- California State Archives, Sacramento, California
- California State Library, Sacramento, California

Records Search Results

The results of the records searches indicate that 14 previous studies have been completed for portions of the APE. These studies resulted in the identification of five archaeological sites and three unrecorded finds within a 0.5-mile radius of the APE. The five previously recorded prehistoric archaeological sites identified within a 0.5-mile radius of the APE are illustrated in Table E.2.9-1.

The unrecorded historic archaeological sites identified wihin a 0.5-mile radius of the APE and illustrated in Table E.2.9-1 include:

- Obsidian flake scatter (Foster,THP#2-89-97-SHA)
- Rock wall segment (Vaughan, 1989).
- Mano (Vaughan, THP#SH-L-694, 1995)

Native American Consultation

As part of the consultation process with Native American organizations and individuals, cultural resource specialists contacted the Native American Heritage Commission (NAHC) on March 7, 2008 with a request for information about sacred lands that may be located within the APE and a list of interested Native American groups and individuals in or near the APE. A search of the Sacred Lands file housed at the NAHC did not result in the identification of any sacred lands within the APE. On March 13, 2008, the NAHC provided a list of local groups and individuals to contact for further information regarding local knowledge of sacred lands. Follow-up phone calls were placed to each of the Native American groups in March 2008 and letters were sent the following month (April) to each of the groups.

Field Survey Methods

Archaeologists conducted an intensive pedestrian survey within the APE for archeological resources for both the Kilarc Development Area and the Cow Creek Development Area and all associated access roads between April 1 and May 2, 2008.

The APE consisted of two separate locations corresponding to the two distinct watersheds of the Kilarc and Cow Creek powerhouses (Old Cow and South Cow creeks), both located in Shasta County. Additional survey areas included the South Canyon Creek Canal and Siphon, and the proposed access roads that would be used and improved during development activities.

All resources identified within the APE were photographed and mapped with GPS equipment. All combined survey areas represented a total of approximately 164 acres, most of which consisted of a single linear pedestrian transect following the canals, and totaling approximately 16.3 miles, with larger areas around the powerhouses, the former caretaker and foreman's cottages at the Kilarc and Cow Creek powerhouses, the Kilarc and Cow Creek forebays, the Kilarc Day Use Area, and the main diversion sites surveyed with multiple transects.

Field Survey Results

A total of 13 archaeological resources were identified within or adjacent to the APE. All were recorded on DPR standard forms, mapped and photographed. The 13 resources consist of three previously unrecorded resources, 5 previously recorded sites, and 5 newly discovered resources. The newly identified resources include the Cow Creek Powerhouse caretaker's homestead site (482-12-03H), a prehistoric lithic scatter site (482-12-04), a multi-component artifact scatter site (482-12-05/H), a multi-component artifact scatter (482-12-08/H), and a lithic scatter and water systems site (482-12-11H). The DPR site records are provided in Appendix M. Some of these sites extended beyond the parameters of the APE (FERC Project Boundary and major access roads). For these sites, only the features or surface artifacts within a 25-foot corridor outside the APE were recorded in detail.

The five previously recorded sites were re-visited, and updated site records were prepared for these sites (CA-SHA-166, CA-SHA-2540/H, CA-SHA-2541-H, P-45-003242, P-45-004319). A new site record has been prepared for 482-12-11/H, an older discovery of a prehistoric lithic scatter plotted at the NEIC, and for which no formal record existed. Tables E.2.9-1 and E.2.9-2 summarize the archaeological resources described in this LSA, while Tables E.2.8-1 and E.2.8-2 summarize the architectural and historical resources.

E.2.10 Recreation

This section describes existing recreation use for the Project that would potentially be affected by decommissioning. The Project is located approximately 30 miles east of Redding, California. Within the Project Area, the Kilarc Forebay and Day Use Area is the only recreation area where public recreational activity is formalized and facilities are located. The Kilarc Powerhouse has a grassy lawn that the public occasionally uses for informal picnicking and fishing access. Other lands within the Project Area are comprised of private lands, not open to the general public, and PG&E lands that are not easily accessible (e.g., no road access, heavily forested, steep hillsides). These properties do not have recreation facilities (e.g., restrooms, picnic tables) or attributes that draw recreation users (e.g., accessible creeks or reservoirs). The Kilarc Forebay is open to the public via access roads that cross private lands, and has accessible recreation facilities and attributes recreation users seek. During the 2003 relicensing effort, PG&E commissioned a Recreational Resources Report and a visitor survey to determine the existing recreation use for the Kilarc Forebay and Kilarc Powerhouse. This section uses this recreation study, including a Questionnaire Study and Existing Use Study, for the analysis.

E.2.10.1 Regional Recreation Areas

The region in which the Project is located is known for the recreation opportunities similar to those currently provided at Kilarc Forebay, including fishing, sightseeing, picnicking, wildlife viewing, and hiking. The Project is surrounded by millions of acres of public lands that offer both developed and dispersed recreation opportunities. The region offers a wide assortment of water-based recreation opportunities such as fishing, swimming, and boating. Recreation attractions include Shasta Lake, Whiskeytown Lake, Mount Shasta, Whiskeytown–Shasta–

Trinity National Recreation Area, Lassen National Forest, Castle Crags State Park, Pacific Crest Trail, McArthur-Burney Falls Memorial State Park, as well as a variety of streams and rivers, like Hat Creek and the Sacramento River. Also, PG&E-maintained recreational opportunities include: Macumber Reservoir, North Battle Creek Reservoir, Lake Grace, and Lake Nora, all part of PG&E's Battle Creek Project, FERC Project No. 1121 (PG&E Form 80, Project No. 1121).

These facilities are located near Shingletown, between 20 and 47 miles from the Project, and offer a wide range of facilities that collectively support picnicking, motorized and non-motorized boating, camping, scenic viewing, swimming, and fishing. Table E.2.10-1 describes the respective recreational amenities at these PG&E facilities.

Nearby hiking areas include Trinity Divide Country, Pacific Crest Trail, Lassen Volcanic National Park, and the Thousand Lakes Wilderness Area. An estimated two to three million visitors each year come to Shasta County to enjoy these recreation resources (USDA-FS, 2003, 2002, 2000a).

The recreational activities and facilities at these various areas are summarized in Tables E.2.10-2 to E.2.10-4. Figure E.2.10-1 also illustrates the locations of some of these facilities in relation to the Project. Yearly visitation is over 2.2 million people to Shasta-Trinity National Forest (USDA-FS, 2002), approximately 650,000 people to Lassen National Forest (USDA-FS, 2003), and approximately 775,000 people to Whiskeytown-Shasta-Trinity NRA (USDA, 2001).

In terms of regional recreation demand, northern California's growth has been concentrated in the metropolitan areas such as the San Francisco Bay Area. While most of the population is concentrated in urbanized counties, many Californians are moving inland (California State Parks, 2002). Shasta County has shared this inland growth pattern with an 11 percent growth rate from 1990 to 2000 (Economic Research Service, 2003).

Regional recreation use is extremely high due to the large number of recreation resources, unique natural setting, and proximity to urban areas. The demand on recreation resources throughout northern California, and within the vicinity of the Project, will continue to increase over the next 10 to 20 years (PG&E, 2007c).

E.2.10.2 Kilarc Forebay and Day Use Area

The Kilarc Day Use Area is situated on a flat plateau at the west end of an unpaved access road located off Miller Mountain Road. The area around Kilarc Day Use Area provides a wide variety of outdoor recreation opportunities, including sightseeing, hiking, fishing, scenic and wildlife viewing, and nature appreciation. The CDFG stocks Kilarc Forebay with hatchery trout each spring and summer (CDFG, 2008a). Shasta County Ordinance (SCO) bans camping and open fires (SCO Section 12.32.120), as well as motor boating and swimming (SCO Section 12.24.160) at the Kilarc Forebay to maintain water quality and personal safety. In accordance with the Project's current FERC License, the Kilarc Day Use Area was developed as a recreation facility with a group picnic area and fishing access. Access to the Kilarc Day Use Area is across private property, and is allowed in conjunction with the FERC license. The group picnic areas are on the northeastern side of the Forebay. Access to the two vault toilets is afforded from both the day use area and Kilarc Forebay via a short trail. A footbridge located where the Kilarc Main Canal enters the Kilarc Forebay provides public access around the Kilarc Forebay shoreline. PG&E understands that some informal hiking occurs along the Kilarc Main Canal that extends to the east of Kilarc Forebay to the Kilarc Main Canal Diversion Dam. This activity is not a sanctioned public recreational opportunity and is not part of the Kilarc Day Use Area.

The 2003 questionnaire and existing use survey was conducted within the FERC Project Boundary through both observations of the recreation activities made from the Kilarc Forebay shoreline and Kilarc Powerhouse and visitor use questionnaire distribution and collection. Out of 135 questionnaires distributed, 45 responses were received, a 33.3 percent response rate. The survey was conducted Memorial Day through Labor Day, 2003 (including July 4th). The questionnaire confirmed the existing use study in that the most common recreation activities with the highest number of participants included fishing, sightseeing, picnicking, wildlife viewing, hiking, and 'other activities.' Other activities included nature photography, all terrain vehicle riding, scouting, and hunting. The most common primary activities reported were fishing and sightseeing. Out of the 45 visitors who responded, 38 visitors originated from Shasta County in California, two from Colusa County, and one each from the counties of Fresno, Riverside, Lassen, and Alameda.

Over the course of the existing use study, the highest peak number of people-at-one-time (PAOT) of 25 was observed at Kilarc Forebay shoreline with an average of 5.4 PAOT. The highest peak number of vehicles-at-one-time (VAOT) was 9 at Kilarc Day Use Area. The overall peak number of persons observed in the study area was 25 on May 25, 2003 (Memorial Day weekend) with an average of 2.8 observed PAOT, and the overall peak number of vehicles observed in the study area was 9 on September 1, 2003 (Labor Day weekend) with an average of 3.2 observed VAOT.

Approximately 77.9 percent of total visitors were observed at the Kilarc Forebay shoreline. Approximately 13.3 percent of total visitors were observed at the Kilarc Day Use Area. For the entire sampling season, the highest number of vehicles in the study area (130) was observed at Kilarc Day Use Area, followed by Kilarc Inlet Canal Area with 35.

In terms of observed activity participation, the highest number of people was recorded for bank fishing with approximately 62 percent of the total number of visitors. The second-highest number was for general recreation with approximately 19.6 percent of total visitors. General recreation, picnicking and sunning had approximately 20, 12 and 6 percent participation respectively. Although no survey respondents indicated that they boated, 2 visitors (0.4 percent participation) were recorded for general boating (however this activity is not permitted in the Kilarc Forebay). Overall, results indicated that fishing was the primary activity that attracted visitors to the Kilarc Forebay. Although survey respondents indicated that they arrived before 12 p.m. and left the study area by 5 p.m., researcher observations revealed different information. According to researcher observations, most of the observed activity occurred in the morning (Table E.2.10-3). The Kilarc Day Use Area's table use was evenly split between morning and afternoon. The group use was predominantly in the afternoon.

E.2.10.2 Kilarc Powerhouse

The Kilarc Powerhouse is situated on a terrace above the streambed of Old Cow Creek, and is located approximately 1 mile northwest of the Kilarc Forebay. Kilarc Powerhouse does not have any formal recreational facilities such as picnic benches, or restrooms, but the public informally uses the lawn terrace occasionally for picnicking and fishing access (PG&E, 2008). Catch-and-release fishing is permissible along the shore of Old Cow Creek. As described in Section E.2.8, Kilarc Powerhouse is of some historical and architectural interest to visitors traveling along Fern Road East; however, no interpretive panels are present on the site.

Most of the information concerning recreational use of the Kilarc Powerhouse comes from the Existing Use Study rather than the questionnaire. Only one questionnaire was distributed at Kilarc Powerhouse. Kilarc Powerhouse had a peak of 6 PAOT and an average of 2.8 PAOT, and had a VAOT peak of 4 and an average of 2 VAOT. No specific recreational activities at the Powerhouse were recorded by the Existing Use Study.

E.2.11 Aesthetics

This section describes the aesthetic resources of the Project that would be potentially affected by decommissioning. The description provides an assessment of the aesthetics of the Project within the Shasta County General Plan, the character of the landscape and region, and provides a visual sensitivity baseline and analysis of key observation points in the Project.

E.2.11.1 1998 General Plan Guidelines

According to Section 6.8 (Scenic Highways) of the Shasta County General Plan (as amended through September 2004), visual resources within the Project do not fall under the category of scenic highways. Scenic highways are defined as "any freeway, highway, road, street, boulevard, or other vehicular right-of-way, which traverses an area of unusual scenic quality." The visible land area outside the actual right-of-way is generally described as the "viewshed" or the "scenic corridor." The corridor encompasses the land easily visible from a highway. Depending on topography and air quality, the physical dimensions of the corridor may vary considerably. No Project facilities, however, are within the viewshed of officially designated or planned scenic highways.

Undesirable land uses that could impair the visual quality of official scenic highways include construction of large buildings or facilities, various types of large unscreened outdoor storage areas, non-landscaped parking lots, and the siting of billboards or other off-premises signs. The Kilarc Powerhouse and Kilarc Forebay are located in areas that are used by the public and contain visual resources that would be affected by decommissioning. The Cow Creek Powerhouse and associated facilities are not accessible or easily viewed by the public and therefore are not considered aesthetic resources.

E.2.11.2 Landscape Character and Scenic Quality

The area surrounding the Kilarc Powerhouse and its facilities is heavily forested on all sides as the landscape rises steeply upward toward Miller Mountain. Vegetation density and landforms limit long views in the area. The Old Cow Creek channel is lined with light colored granite and moderately vegetated slopes. The Kilarc Powerhouse, constructed of locally quarried stone, is most visible from Fern Road East, which crosses directly over the penstock and passes within 50 feet of the powerhouse structure, thus placing the building in the immediate visual foreground. The topography and vegetation portrays a natural landscape, however evidence of human activity is abundant in this area, especially evidence of timber harvesting activities.

Kilarc Forebay is located on Miller Mountain, approximately 1,200 feet above the powerhouse. A public day-use area associated with the forebay is currently operated and maintained by PG&E, accessible by permit across roads on private lands. The Kilarc Forebay vicinity is characterized by steeply undulating landscapes covered by a green canopy of Jeffrey pine, white fir, and lodgepole pine forests that are broken by outcrops of light-colored granite. Views to the south and east of the Kilarc Forebay provide high-country views of Lassen Peak and Lassen National Forest. To the north and west of the Kilarc Forebay, distant views of the peaks in the Shasta National Forest can be seen, but are in some places partially obscured by vegetation. The colors of the region vary according to season and location. In terms of color, rangelands of the region are typically green in the early spring turning to the characteristic tan during the dryer summer months. While the fall brings a variegated color palette of the region’s oak trees and other deciduous vegetation in the lower portions of the watershed, much of the higher elevation areas tend to have a mixture of interspersed tan grasses, light-brown veined granite outcrops, and green-hued pine forests. The brown colors inherent in Project facilities, such as the stone-constructed Kilarc Powerhouse, tend to diminish the contrast between these man-made facilities and the surrounding natural environment.

Regional Character

The Project is located in the foothills at the southern end of the Cascade Mountain Range. The elevation within the Project Area ranges from about 856 feet above mean sea level (MSL) at the Cow Creek Powerhouse to 3,940 feet above MSL at the North Canyon Creek Diversion Dam. The topography varies from gently rolling low hills near the Cow Creek Powerhouse to steep, narrow canyons in the upper Old Cow Creek drainage. The Project Area epitomizes the foothills of the Cascades as it encompasses a range of scenery, varying from the narrow and steep river canyons and densely vegetated river banks with conifer forest in the upper watershed to open rolling foothills with grasses and oak and pine trees with a sparse and scattered overstory in the lower watershed. These characteristics reflect the impact of livestock grazing and timber harvesting. The lower watershed of the Project Area, for instance, typifies livestock rangelands vegetated with sparsely occurring oak and pine.

Kilarc Development

Kilarc Powerhouse is located at an elevation of 2,580 feet above MSL and sits below Miller Mountain on the western slope below Fern Road East. Kilarc Forebay and the water conveyance system is located on a ridge 1,200 feet above the Kilarc Powerhouse in a southeasterly direction. The visibility of the Kilarc Powerhouse is clear, as the facility is directly adjacent and below Fern Road East. The Kilarc Penstock rises steeply above Fern Road East and is visible as a cleared, 50-foot path to the ridge above. The landscape visibility of the forebay pond is moderate from the adjacent Kilarc Day Use Area, and does not obscure views of the surrounding area. From the access road, views of the Kilarc Forebay and facilities are partially screened from trees along the roadway and are situated higher in elevation as compared to the roadway surface.

The Kilarc Main Canal Diversion Dam and Forebay are relatively small in scale and blend in with their surroundings. While the visual contrast of the forebay and dam is strong in the immediate area of the Kilarc Day Use Area, they do not detract from the near panoramic view of the distinctive landscapes in the background (more than 5 miles away from the forebay) areas.

Kilarc Powerhouse is located on Fern Road East near the crossing of Old Cow Creek. The area surrounding the powerhouse is dominated by forested areas adjacent to the west side of Miller Mountain. Landscape visibility is limited from the roadway due to the presence of trees and a curvilinear roadway. Although Kilarc Powerhouse is a visible element in the landscape, it does not represent a substantial contrast with its surroundings, because of the heavily vegetated travel corridor from which it can be seen and its construction with naturally occurring materials (stone), which softens its contrast.

Cow Creek Development

Cow Creek Powerhouse is located at an elevation of 856 feet above MSL. Cow Creek Powerhouse is located on South Cow Creek Road and is inaccessible to the public because of a locked access gate at the pavement terminus. The area surrounding Cow Creek Powerhouse is dominated by rangeland and forested areas adjacent to South Cow Creek. Landscape visibility is limited from the roadway due to the presence of trees and a non-linear roadway. While Cow Creek Powerhouse is a visible element in the landscape, the view is limited from South Cow Creek Road and the Cow Creek Powerhouse structure does not substantially contrast with its surroundings. Cow Creek Forebay and the water conveyance system is located on a ridge 700 feet above the Cow Creek Powerhouse and is oriented in a northeasterly direction. The landscape visibility of the Cow Creek Forebay is obscured from South Cow Creek Road due to the elevation difference. There is no view of the penstock from the paved terminus of South Cow Creek Road.

E.2.11.3 Visual Sensitivity

Visual sensitivity of the Project is largely determined by the types of users, amount of use, public interest, and adjacent land uses. As noted in the recreation analysis in Section E.2.10, visitation to the Project Area, primarily the Kilarc Forebay, is focused on recreation and occurs primarily in the summer season from late May through early September. Visitation is typically heaviest during holiday weekends with an average daily usage of 5.4 persons. PG&E maintains a picnic area near Kilarc Forebay. Recreation activities are limited to picnicking and fishing at the Kilarc Forebay pond. Swimming and operating a motorboat on the forebay are prohibited. Aside from fishing, sightseeing was the second most popular activity noted by participants, as described in the 2007 Recreational Resources Report.

Key Observation Points Kilarc Development

To determine visual sensitivity for the Project Area, Key Observation Points (KOPs) were identified during field visits in April 2008 and used to incorporate views of existing landscapes and Project facilities from the Project-related recreation areas and public travel routes. All operations of the Project facilities occur on existing creeks and canals, most of which are located away from major roadways, and are not visible from the surrounding area due to the steep landscape and dense vegetation. Additionally, most of the Project facilities are built either on the creeks and canals themselves (dams). Also, the Project Area does not appear in Shasta County's Open Space Inventory (Section 6.9, General Plan, as amended September 2004). Therefore, only the following two KOPs were selected for further analysis:

- KOP 1 (Photograph E.2.11-1) is a point directly north of Kilarc Powerhouse on Fern Road East, a travel corridor to the Project Area. The powerhouse and switchyard is clearly visible from this KOP.
- KOP 2 (Photograph E.2.11-2) overlooks Kilarc Forebay to the northwest from Kilarc Forebay Day Use Area. The Kilarc Forebay Dam is visible from this KOP.

Photograph E.2.11-1. KOP 1

Photograph E.2.11-2. KOP 2

No KOPs were identified for the Cow Creek Development portion of the Project, due to topography, vegetation, and the lack of public viewpoints to Project features. Therefore, the visual impact analysis below focuses on potential impacts from Project decommissioning activities at or near the Kilarc Development.

Visual Sensitivity Analysis of Kilarc Development

The visual impact analysis is based on field observations conducted in April 2008, a review of ground-level photographs of the Project Area from the KOPs listed above, and from information contained in the PDP. A line-of-sight analysis was used to consider the extent to which changes resulting from the decommissioning activities would be visible from these two KOPs. The analysis performed for this section is qualitative in nature and uses the Federal Highway Administration (FHWA) methodology as described below.

Visual Traits Assessment

The FHWA methodology (1988) for assessing visual impacts includes consideration of the following visual traits: vividness, intactness, and unity. *Vividness* is the visual power or memorability of landscape components as they combine in distinctive visual patterns. *Intactness* is the visual integrity of the natural and man-built landscape and its freedom from encroaching elements; intactness can be present in well-kept urban and rural landscapes, as well as in natural settings. *Unity* is the visual coherence and compositional harmony of the landscape considered as a whole; this trait frequently attests to the careful design of individual man-made components in the landscape. These three visual traits describe how the form, line, color and texture of a project interact with surrounding elements of the natural and built landscapes when added to a view.

Using these traits, each viewpoint was analyzed for its visual quality and viewer sensitivity. *Visual quality* is a measure of the overall impression or appeal of an area or existing view as determined by the particular landscape characteristics. *Viewer sensitivity* is defined as the viewer's concern for scenic quality in response to change in the visual resources that compose the view.

Visual quality and viewer sensitivity were assigned a value of high, moderate, or low where:

- "High" defines a landscape with great scenic value – for example, a "picture postcard" scene such as Mount Shasta. People typically go out of the way to visit areas of high visual quality that have high levels of vividness, unity, and intactness, and viewers have substantial concern for the scenic quality of these areas.

- "Moderate" defines landscapes that are common or typical and have average scenic value. They usually lack significant man-made or natural features. Levels of vividness, intactness, and unity are average, and viewers have some concern for scenic quality in response to changes in views.

- "Low" defines landscapes that are below average in scenic value. They often contain visually discordant man-made alterations and provide little of interest in terms of landscape attributes. Views are typically classified as indistinct, unharmonious, and disjunctive. Levels of vividness, intactness, and unity are low, and viewers have little to no concern for views in these areas.

Additionally, viewer exposure was assessed for each viewpoint. *Viewer exposure* is typically assessed by measuring the number of viewers exposed to the resource change, type of viewer activity, duration of their view, speed at which the viewer moves, and position of the viewer.

E.2.12 Land Use

This section describes the land use of the Project that would be potentially affected by its decommissioning. This analysis is based on a review of federal, state, and local governments planning documents.

E.2.12.1 Existing Land Jurisdictions

The Project is located in Shasta County, California, approximately 30 miles east of the city of Redding, near the community of Whitmore (see Figures A.1-1 and A.1-2).

The Project is located in the Cascade Range in eastern Shasta County. The Kilarc Development is located in Township 33 North, Range 1 East, Mount Diablo Base and Meridian (MDB&M) and is shown on the Miller Mountain 7.5' USGS quadrangle. The Cow Creek Development is located in Townships 31 and 32 North, Range 1 West, MDB&M and is shown on the Clough Gulch and the Inwood 7.5' USGS quadrangles. The Project occupies property owned by PG&E (Licensee), or where PG&E has acquired the necessary land rights.

Existing Land Uses

Shasta County categorizes the Project Area land uses as Timber Production, Exclusive Agricultural, and Unclassified (Shasta County, 2003). These designations are intended for lands that are unimproved and are planned to remain open in character. Land uses in the Project Area currently include National Forest, hydroelectric project facilities, transportation systems, recreation, and conservation.

Federal and State Forests

The Lassen National Forest boundary is approximately 2 miles northeast of the Kilarc Development. The USFS manages the Lassen National Forest through its Land and Resource Management Plan (1992), which includes the protection and management of natural resources, conservation of wilderness areas, and enhancement of recreational opportunities.

The LaTour Demonstration State Forest lies approximately 6 miles east of the Kilarc Forebay. The California Department of Forestry and Fire Protection (CAL FIRE) operates the LaTour Demonstration State Forest as an area to demonstrate the productive and economic possibilities of good forest practices toward maintaining forest crop land in a productive condition. The forest land is primarily used to evaluate timber production and management practices while providing public recreation opportunities, fish and wildlife habitat, and watershed protection. The Draft LaTour Demonstration State Forest Management Plan (2008) establishes management goals for this forest, and although the plan has not been adopted as of the writing of this LSA, the draft plan is instructive for reviewing consistency of the Project with management goals.

E.2.12.2 Existing Land Ownership and Interests

A total of 184.32 acres of land are located within the FERC Project boundary. These lands are owned primarily by PG&E (approximately 109.69 acres) and private landowners (approximately 72.76 acres). In addition, 1.87 acres are held in trust by the United States under the jurisdiction of the Bureau of Indian Affairs.[16]

Land ownership is shown in Figures E.2.12-1 and E.2.12-2.

Hydroelectric Facilities

As described in Exhibit A, the Project is located in two separate drainage areas, Old Cow Creek and South Cow Creek. The Project's two powerhouses, Kilarc and Cow Creek, are supplied with water diverted from North and South Canyon Creeks, Old Cow Creek, Mill Creek, and South

[16] Although the land is held in trust by the United States under the jurisdiction of the Bureau of Indian Affairs, the land is considered "patented" and labeled as such on Project maps.

Cow Creek. Water for power generation is diverted from these creeks and delivered into the forebays at the head of the penstocks of the two powerhouses.

Transportation Systems

The Kilarc Development is accessed from Fern Road East via Whitmore Road. A junction connecting to Whitmore Road lies approximately 30 miles east of Redding along SR 44. PG&E uses Miller Mountain Road, an unpaved road off Fern Road East, to access the Kilarc Forebay and Kilarc Day Use Area. Miller Mountain Road also connects with several unpaved roads that provide access to the Kilarc Diversion Dam and Kilarc Main Canal. Access to the North and South Canyon portion of the Kilarc Development from Fern Road is via Oak Run Fern Road to Smith Road.

The Cow Creek Development is accessed from the southwest on SR 44 via South Cow Creek Road. South Cow Creek Road connects with SR 44 approximately 35 miles east of Redding. South Cow Creek Road is gated at the pavement terminus, and the unpaved road continues to the Cow Creek Powerhouse. The unpaved road also leads from the Powerhouse to the Cow Creek Forebay and Cow Creek Diversion Dam via unpaved spur roads. The Cow Creek Diversion Dam and Cow Creek Forebay can also be reached from the northeast through a gate on South Cow Creek Road. South Cow Creek Road intersects Whitmore Road approximately 2 miles east of Whitmore. Since South Cow Creek Road is gated on the southwest and northeast of the Project, the Cow Creek Development is inaccessible to the public.

E.2.12.3 Land Use Plans and Policies

Shasta County General Plan and Zoning Plan

Relevant land use plans for the Project Vicinity are described in the Shasta County General Plan (2004) and Shasta County Zoning Plan (2003). The Project is located within the Sierra-North Regional Plan Area of the General Plan. The General Plan includes objectives for preserving agricultural lands and timberlands, and protection and provision of open space and recreational resources. The Zoning Plan designates the Kilarc Development land as Unclassified and Timber Production lands. The Cow Creek Development land is designated as Timber Production, Exclusive Agricultural, and Unclassified lands.

The Timber Production designation is intended to preserve lands devoted to and used for the growing and harvesting of timber. Permitted uses within the Timber Production district include forest management, grazing, beekeeping, watershed management, and fish and wildlife habitat; hunting, fishing, camping, and similar recreational uses not involving any permanent improvement of the land or interfering materially with the primary use; and Christmas tree farms.

The Exclusive Agricultural designation is intended to preserve lands with agricultural value that have the combination of size and quality to make their use for agriculture economically feasible, and within which agricultural preserves may be created. Permitted uses within the Exclusive Agricultural district include agricultural uses, sale of products grown on the premises, wholesale nursery or greenhouse, forest management, and low-intensity recreational uses that require only minor improvements.

The Unclassified designation is intended to be applied as a holding district until a precise principal zone district has been adopted for the property. Permitted uses within the Unclassified district include agricultural and timber management uses, open space, and limited residential, and mixed uses.

Pacific Gas and Electric Company's Land Conservation Commitment

Consistent with the Settlement Agreement between PG&E and the California Public Utilities Commission, PG&E has committed to preserve approximately 140,000 acres of its watershed lands through the Land Conservation Commitment. In order to achieve this commitment, the Pacific Forest and Watershed Land Stewardship Council (Stewardship Council) was created in 2004 as an independent nonprofit organization that acts as an advisory body to oversee development and implementation of the Land Conservation Plan (LCP). The Stewardship Council Board adopted the LCP in 2007, providing a framework for how the lands will be managed to benefit both the community and the environment consistent with the following six beneficial public values: protection of natural habitat of wildlife, fish and plants; preservation of open space; sustainable forestry; agricultural uses; outdoor recreation by the public; and historical values. PG&E will donate conservation easements and/or fee title to public agencies or qualified non-profit conservation organizations to permanently preserve and enhance these lands.

California Department of Forestry and Fire Protection Fire and Resource Assessment Program

CAL FIRE has designated portions of Shasta County, including the Project Area, a State Responsibility Area. Therefore, CAL FIRE is fiscally responsible for fire response in this area. As required by California Public Resources Code 4201-4204, CAL FIRE has identified and mapped Fire Hazard Severity Zones. The hazard level for the Project Area is Very High (CAL FIRE, 2007).

During wildfire emergencies in the area, Kilarc Forebay is used as a water supply for fire suppression. There are several other water bodies within 15 miles of the Kilarc Forebay, including Buckhorn Lake, Silver Lake, Blue Lake, Woodridge Lake, and Lake Shasta, which can also be used as a water resource for fire suppression. Additionally, wide points along creeks in the area have been successfully used in the past for water collection via helicopter.

E.2 AFFECTED ENVIRONMENT TABLES

E.2.1 Geology and Soils

Table E.2.1-1. Soil Resources in the Vicinity of the Kilarc Development

Soil Type	Soil Name	Kilarc Facilities			
		Penstock	Forebay	Canal	Spillways
AbD	Aiken stony loam				x
ClD	Cohasset loam	x	x	x	x
CmD	Cohasset stony loam			x	
CmE	Cohasset stony loam	x		x	x
CoE	Cohasset very stony loam, moderately deep	x			x
CwF	Cone very stony loam, moderately deep			x	
KlE	Kilarc very stony sandy clay loam	x			x
LgE	Lyonsville-Jiggs complex			x	
TcE	Toomes very rocky loam			x	
WfG	Windy and McCarthy very stony sandy loams			x	x

Table E.2.1-2 Soil Characteristics in the Kilarc Development

Soil Type	Soil Name	Percent Slope			Elevation (ft MSL)		Hydraulic Conductivity
					Min (ft MSL)	Max (ft MSL)	
AbD	Aiken stony loam	8	to	15	1200	1500	Moderately High
ClD	Cohasset loam	0	to	30	2000	5000	Very Low to Moderately Low
CmD	Cohasset stony loam	0	to	30	2000	5000	Low to Moderately Low
CmE	Cohasset stony loam	30	to	50	2000	5000	Very Low to Moderately Low
CoE	Cohasset very stony loam, moderately deep	8	to	50	1000	5500	Very Low to Moderately Low
CwF	Cone very stony loam, moderately deep	15	to	60	2000	4000	High to Very High
KlE	Kilarc very stony sandy clay loam	30	to	50	1000	3600	Moderately Low to Moderately High
LgE	Lyonsville-Jiggs complex	10	to	50	3000	6500	Low to High
TcE	Toomes very rocky loam	0	to	50	600	3500	Moderately High to High
WfG	Windy and McCarthy very stony sandy loam	50	to	75	2000	9000	Low to High

Source: NRCS (2008a,b)
Note: ft MSL = feet mean sea level

Table E.2.1-3. Soil Resources in the Vicinity of the Cow Creek Development

Soil Type	Soil Name	Cow Creek Facilities				
		Penstock	Forebay	Canal	Spillway	Access Road
AbB	Aiken stony loam			x		x
AbD	Aiken stony loam			x		x
CoE	Cohasset very stony loam, moderately deep			x		
GuD	Guenoc very rocky loam	x	x	x	x	
GsD	Guenoc very stony loam	x		x		x
KlD	Kilarc very stony sandy clay loam	x			x	
RxF	Rockland	x		x	x	x
SdD2	Sehorn very stony silty clay, eroded	x				
TcE	Toomes very rocky loam					x

Table E.2.1-4. Cow Creek Development Soil Properties

Soil Type	Soil Name	Percent Slope			Elevation (ft MSL)		Hydraulic Conductivity
					Min (ft MSL)	Max (ft MSL)	
AbB	Aiken stony loam	0	to	8	1200	1500	Moderately High
AbD	Aiken stony loam	8	to	15	1200	1500	Moderately High
CoE	Cohasset very stony loam, moderately deep	8	to	50	2000	5500	Very Low to Moderately Low
GuD	Guenoc very rocky loam	0	to	30	400	3000	Low to Moderately High
GsD	Guenoc very stony loam	0	to	30	400	3000	Low to Moderately High
KlD	Kilarc very stony sandy clay loam	10	to	30	1000	3600	Moderately Low to Moderately High
RxF	Rockland	15	to	70	650	4000	Low to Very High
SdD2	Sehorn very stony silty clay, eroded	8	to	30	300	2000	Very Low to Moderately High
TcE	Toomes very rocky loam	0	to	50	600	3500	Moderately High to High

Source: NRCS (2008a,b)

Note: ft MSL = feet mean sea level

E.2.2 Hydrology and Water Resources

Table E.2.2-1. Gaging Stations in the Cow Creek Watershed

Station Number	Station Name	Latitude	Longitude	Area (mi^2)	Starting Date	Ending Date
	USGS-reported Stations					
11374000	Cow Creek near Millville, CA	40°30'20"	122°13'55"	425	1949	Present
11372200	South Cow Creek near Millville, CA	40°32'55"	122°05'30"	77.3	1956	1972
11372080 (CB133)[1]	South Cow Creek Canal Diversion to South Cow Creek, near Whitmore	40°35'35"	121°58'53"	NA	1984	Present
11372325 (CB132)[1]	Kilarc Canal Diversion to Old Cow Creek, near Whitmore, CA	40°41'13"	121°48'27"	NA	1983	Present
11373200	Oak Run Creek near Oak Run, CA	40°41'25"	122°02'35"	11	1957	1966
11373300	Little Cow Creek near Ingot, CA	40°44'45"	122°03'40"	60.8	1957	1965
11372700	Clover Creek near Oak Run, CA	40°41'35"	121°58'30"	19	1957	1959
	Non-USGS-reported Stations					
CB87	Kilarc Powerhouse[2]	*	*	NA	1975	Present
CB88	Cow Creek Powerhouse[2]	*	*	NA	1974	Present
CB2	Kilarc Main Canal Diversion Dam[2]	*	*	NA	1981	2001
CB4	South Cow Creek Diversion Dam[2]	*	*	NA	1981	1997

1 Station number in parentheses for non-USGS-reported stations is PG&E's station number

2 Data collected by PG&E but not verified or published by USGS

* Data are not known

Table E.2.2-2. Estimated Peak Flow (cfs) for Old Cow Creek and South Cow Creek

	1.5 Year	2-Year	5-Year	10-Year	25-Year	Drainage Area (square-miles)	Drainage Area as Percent of Gage No. 11374000
Cow Creek near Millville (gage No. 11374000), measured flow	18,700	22,600	33,000	37,700	45,000	425	—
Old Cow Creek at Kilarc Main Canal Diversion Dam	1,047	1,256	1,848	2,111	2,520	23.8	5.6%
South Cow Creek at South Cow Creek Diversion Dam	2,057	2,486	3,630	4,147	4,950	47.0	11%

Table E.2.2-3. Summary of Average Monthly Unimpaired Flow (cfs) for Old Cow Creek

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	98	180	270	379	381	361	221	281	181	87	62	37
Minimum	22	17	17	17	18	22	42	41	39	42	42	23
Average	30	45	86	127	123	106	90	93	62	51	47	28
Median	28	32	70	101	101	91	75	80	54	48	46	28
10^{th} Percentile	23	20	20	32	37	45	56	54	44	43	42	24
20^{th} Percentile	24	21	30	51	50	57	61	59	45	44	43	25
80^{th} Percentile	32	60	146	205	176	144	132	127	71	58	51	30
90^{th} Percentile	37	91	183	293	232	194	154	152	102	62	52	33

Table E.2.2-4. Summary of Average Monthly Unimpaired Flow (cfs) for South Cow Creek

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	199	365	550	770	775	734	450	573	369	177	126	76
Minimum	46	34	35	35	36	45	85	84	80	85	85	47
Average	61	91	175	259	250	215	184	190	127	103	95	57
Median	58	66	142	206	205	185	153	164	110	98	94	58
10th Percentile	48	40	40	65	75	91	114	110	89	88	86	50
20th Percentile	49	43	61	104	102	115	124	121	92	89	88	51
80th Percentile	66	122	296	416	358	294	268	259	144	118	103	61
90th Percentile	76	185	373	596	472	395	314	309	207	126	106	67

Table E.2.2-5. Water Rights

		Diversion								
SWDU No.	**Priority/ first use**	**Gage**		**Amount**	**Units**	**Description (Name of Works)**	**Point of Diversion**	**Place of Use**	**Type of Use**	**Water Right Class**
9977	1907	CB	128	2.5	cfs	North Canyon Creek Canal	North Canyon Creek	Kilarc Powerhouse	P	Pre 1914
1020	1906	CB	1	7.5	cfs	South Canyon Creek Canal	South Canyon Creek	Kilarc Powerhouse	P	Pre 1914
828	1903	CB	2	52	cfs	Kilarc Canal below intake	Old Cow Creek	Kilarc Powerhouse	P	Pre 1914
849	1907	CB		20	cfs	Mill Creek Canal	Mill Creek	Cow Creek Powerhouse	P	Pre 1914
829	1904	CB	8	50	cfs	S. Cow Creek Canal, below intake	South Cow Creek	Cow Creek Powerhouse	P	Pre 1914
869	1901			200	gpm	Kilarc domestic supply	Tributary to Cow Creek	Kilarc Powerhouse	D,II	Pre 1914

E.2.3 Geomorphology

Table E.2.3-1. Rosgen Stream Classifications

	Downstream Station (RS)	Upstream Station (RS)[1]	Distance (miles)
Old Cow Creek			
A2/A2a+	0	-0.22	0.22
B2a	0	0.93	0.93
B2a/B4a	0.93	1.13	0.20
A2a+	1.13	1.19	0.06
B2a	1.19	1.4	0.21
B1	1.4	1.65	0.25
B2a	1.65	2.57	0.92
B1	2.57	2.67	0.10
B2a	2.67	4.41	1.74
South Cow Creek			
B4c/B3c	0	-0.5	0.50
B3c	0	0.7	0.7
B4c/B3c	0.7	1.0	0.3
B2c/B3c	1.0	1.7	0.7
B3c	1.7	2.6	0.9
B2a	2.6	3.6	1.0
B2a/B3a	3.6	4.05	.45
Hooten Gulch			
B3	0	-0.28	0.28
B4/B3	0	0.55	0.55

1 RS=River Station is the mid-channel distance upstream or downstream from Kilarc Main Canal or South Cow Creek diversion dam. Negative numbers indicate distance upstream from the Kilarc Main Canal or South Cow Creek diversion dam; diversion is RS=0.

Table E.2.3-2. Diagnostic Features of Montgomery–Buffington Channel Types

	Colluvial	Alluvial					Bedrock
		Dune-Ripple	Pool-Riffle	Plane-Bed	Step-Pool	Cascade	
Bed Material	**Variable**	**Sand**	**Gravel**	**Gravel- cobble**	**Cobble-boulder**	**Boulder**	**Bedrock**
Bedform Pattern	Variable	Multi-layered	Laterally oscillatory	Featureless	Vertically oscillatory	Random	Variable
Dominant Roughness	Grains, LWD	Sinuosity, banks, grains, bedforms (dunes, ripples, bars)	Bedforms (bars, pools), sinuosity, banks, grains	Grains, banks	Grains, banks	Grains, banks	Boundaries (bed and banks) Grains
Sediment Sources	Hillslopes, debris flows	Fluvial, bank failure	Fluvial, bank failure	Fluvial, bank failure, debris flow	Fluvial, hillslope, debris flow	Fluvial, hillslope, debris flows	Fluvial, hillslope, debris flows
Sediment Storage	Bed	Overbank, bedforms	Overbank, bedforms	Overbank	Bedforms	Lee and stoss sides of obstructions	None
Confinement	Confined	Unconfined	Unconfined	Variable	Confined	Confined	Confined
Pool spacing (channel widths)		5 to 7	5 to 7	none	1 to 4	<1	
Typical Slope	>.10	<0.001	<0.015	0.015 - 0.03	0.03 – 0.065	>0.065	Variable
Reach Type	Source	Response transport-limited	Response may have either supply- or transport-limited characteristics	Response may have either supply- or transport-limited characteristics	Transport supply-limited	Transport supply-limited	Transport

Table E.2.3-3. Summary of Bank Stability Ratings for South Cow Creek, Old Cow Creek, and Hooten Gulch

Stability Rating	South Cow Creek				Hooten Gulch				Old Cow Creek			
	Above Diversion		Below Diversion		Above Powerhouse		Below Powerhouse		Above Diversion		Below Diversion	
	(mi)	(%)	(mi)	(%)	(mi)	(%)	(mi)	(%)	(mi)	(%)	(mi)	(%)
Channel Length Surveyed	0.44		3.35		0.28		0.57		0.22		3.02	
High	0.20	45	3.07	92	0	0	0	0	0.12	56	0.54	18
Moderate	0.24	55	0.16	5	0.14	50	0.55	97	0.02	6	1.23	41
Low	0	0	0.12	4	0.14	50	0.02	3	0.08	38	1.25	41

Note: Diversion = South Cow Creek Diversion Dam on South Cow Creek, Kilarc Main Canal Diversion Dam on Old Cow Creek.

Powerhouse = Cow Creek Powerhouse.

Table E.2.3-4. Summary Bar Sediment Storage Data

	Location (RS to RS)	Total # of Bars	Median (D50) Particle Size (mm, in)	Total Bar Length (ft)	Channel-bar Ratio
Old Cow Creek					
Above Diversion	0 to –0.22	0	∞	0	∞
Below Diversion	0 to 3.01	4	22-64, 0.9-2.5	420	38
South Cow Creek					
Above Diversion	0 to –0.44	2	45-90, 1.9-3.5	192	12
Below Diversion	0 to 1.50	7	16-90, 0.6-3.5	532	15
Below Diversion	1.50 to 4.05	1		40	337
Hooten Gulch					
Above Powerhouse	0 to –0.28	0	∞	0	∞
Below Powerhouse	0 to 0.57	0	∞	0	∞

Notes: Diversion = South Cow Creek Diversion Dam on South Cow Creek, Kilarc Main Canal Diversion Dam on Old Cow Creek.

Powerhouse = Cow Creek Powerhouse.

Table E.2.3-5. Pool Fine Sediment Surface Area and Sediment Thickness

	Number of Pools Surveyed	Pool Bed Surface Area With Fines (%)				Average Fines Thickness (inches)			
		Median	Avg	Max	Min	Median	Avg	Max	Min
So. Cow Ck Below Diversion	43	5	11	90	0	0.3	0.4	2.0	0
So. Cow Ck Above Diversion	6	10	6.7	10	0	0.25	0.2	0.25	0
Old Cow Ck Below Diversion	42	5	13	75	0	0.5	0.6	6	0
Old Cow Ck Above Diversion	4	15	14	25	0	.8	0.6	1	0
Hooten Gulch Below Powerhouse	7	63	56	95	0	1	0.8	2	0

Notes: Diversion = South Cow Creek Diversion Dam on South Cow Creek, Kilarc Main Canal Diversion Dam on Old Cow Creek.

Powerhouse = Cow Creek Powerhouse.

Table E.2.3-6. Percentage of Particle Sizes by Class, Kilarc Main Canal Diversion Dam

	Cobble and Coarser (>64mm, >2.52in)	Gravel (64mm-2mm, 2.52in-0.08in)	Sand (2mm-.063mm, 0.08in-0.002in)	Silt (<.063mm, <0.002in)
K-I	5%	71%	24%	1%
K-II	9%	79%	11%	0%
K-III	52%	41%	6%	0%
K-IV	65%	34%	1%	0%

Note: K-I through K-IV indicates the sampling location identifier.

Table E.2.3-7. Summary of Bulk Particle Size Analysis, Kilarc Main Canal Diversion Dam

Sample ID	D 16 mm, in[1] (Class Name)	D50 mm, in[1] (Class Name)	D84 mm, in[1] (Class Name)
K-I	0.9, 0.04 (Sand)	8.7, 0.3 (Gravel)	45.1, 1.7 (Gravel)
K-II	4.3, 0.2 (Gravel)	20.2, 0.8 (Gravel)	52.8, 2.1 (Gravel)
K-III	7.0, 0.3 (Gravel)	70.2, 2.7 (Cobble)	213.7, 8.4 (Cobble)
K-IV	24.4, 1.0 (Gravel)	117.3, 4.6 (Cobble)	160.6, 6.3 (Cobble)

Note: K-I through K-IV indicates the sampling location identifier.

1 Diameter (D) for which given percent (16, 50, or 84) of the cumulative sample is finer than.

Table E.2.3-8. Percentage of Particle Sizes by Class, South Cow Creek Diversion Dam

	Cobble and Coarser (>64mm, >2.52in)	Gravel (64mm-2mm, 2.52in-0.08in)	Sand (2mm-.063mm, 0.08in-0.002in)	Silt (<.063mm, <0.002in)
C-I	15%	63%	21%	0.35%
C-II	66%	29%	5%	0.1%
C-III	74%	26%	0%	0%
C-IV_A	84%	16%	0%	0%
C-V	30%	58%	12%	0.1%
C-VI	17%	65%	18%	0.1%

Note: C-I through C-VI indicates the sampling location identifier.

Table E.2.3-9. Summary of Bulk Particle Size Analysis, South Cow Creek Diversion Dam

Sample ID	D 16 mm, in[1] (Class Name)	D50 mm, in[1] (Class Name)	D84 mm, in[1] (Class Name)
C-I	1.2, 0.05 (Sand)	20.4, 0.8 (Gravel)	62.6, 2.5 (Gravel)
C-II	22.2, 0.9 (Gravel)	87.7, 3.5 (Cobble)	147.6, 5.8 (Cobble)
C-III	52.2, 2.1 (Gravel)	85.7, 3.4 (Cobble)	121.9, 4.8 (Cobble)
C-IV_A	64.1, 2.5 (Cobble)	95.6, 3.8 (Cobble)	143.6, 5.7 (Cobble)
C-V	6.2, 0.2 (Gravel)	46.2, 1.8 (Cobble)	79.2, 3.1 (Cobble)
C-VI	1.7, 0.07 (Sand)	24.7, 1.0 (Gravel)	66.9, 2.6 (Cobble)

Note: C-I through C-VI indicates the sampling location identifier.

1 Diameter (D) for which given percent (16, 50, or 84) of the cumulative sample is finer than.

E.2.4 Water Quality

Table E.2.4-1. Basin Plan Water Quality Objectives Relevant to the Project Area (RWQCB-CRV, 2007)

<table>
<tr><th>Component</th><th>Units</th><th colspan="4">Basin Plan Objective</th></tr>
<tr><td>Fecal Coliform (Bacteria)</td><td>Count (Most Probable Number) per 100 milliliters of sample (MPN/100ml)</td><td colspan="4">For waters designated for contact recreation, the 30-day geometric mean must not exceed 200/100ml, or have greater than 10% of samples in 30 days that exceed 400/100ml, based on not less than five samples for any 30-day period</td></tr>
<tr><td rowspan="5">Trace Elements</td><td rowspan="5">Micrograms per Liter (µg/L)</td><td>Arsenic</td><td>10</td><td>Cyanide</td><td>10</td></tr>
<tr><td>Barium</td><td>100</td><td>Iron</td><td>300</td></tr>
<tr><td>Cadmium</td><td>0.22</td><td>Manganese</td><td>50</td></tr>
<tr><td>Copper</td><td>5.6</td><td>Silver</td><td>10</td></tr>
<tr><td>Lead</td><td>15</td><td>Zinc</td><td>16</td></tr>
<tr><td>Color</td><td></td><td colspan="4">Waters should be free of coloration.</td></tr>
<tr><td rowspan="3">Dissolved Oxygen</td><td rowspan="3">Milligrams per Liter (mg/L)</td><td colspan="2">Warm water Fishery</td><td colspan="2">5.0</td></tr>
<tr><td colspan="2">Cold Water Fishery</td><td colspan="2">7.0</td></tr>
<tr><td colspan="2">Spawning Fishery</td><td colspan="2">7.0</td></tr>
<tr><td>pH</td><td>pH units</td><td colspan="4">6.5 – 8.5</td></tr>
<tr><td>Electrical Conductivity (Specific Conductance)</td><td>Micromhos/centimeter</td><td colspan="4">Shall not exceed 230 micromhos/centimeter (50 percentile) or 235 micromhos/cm (90 percentile) at Knights Landing above Colusa Basin Drain in the Sacramento River. (Although relevant, this objective is not directly applicable to this Project)</td></tr>
<tr><td>Temperature</td><td>Degrees Fahrenheit (ºF)</td><td colspan="4"><5ºF increase over natural receiving water temperature; no increase which impacts beneficial uses</td></tr>
<tr><td>Turbidity</td><td>Nephelometric Turbidity Units (NTUs)</td><td colspan="4">No changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed 1 NTU, where natural turbidity is between 0 and 5 NTUs.</td></tr>
<tr><td>Sediment</td><td></td><td colspan="4">No alteration to cause nuisance of adversely affect beneficial uses.</td></tr>
<tr><td>Suspended and Settleable Material</td><td></td><td colspan="4">No alteration to cause nuisance or adversely affect beneficial uses.</td></tr>
</table>

Notes:

1. The maximum concentrations for copper, cadmium, and zinc were established based on an aqueous solution with 40 mg/L hardness. Calculation of concentrations based on site specific hardness data may be performed using formulas provided in the Basin Plan.

2. Source: RWQCB-CRV (2007).

Table E.2.4-2. Water Quality Sampling Location Stations, Kilarc Development 2003

Station ID	Station Location	Monitoring Activity
NC1	North Canyon Creek above North Canyon Creek Canal	TR[a], IS[b], WQ[c]
NC2	North Canyon Creek above South Canyon Creek	TR, IS
CC1	South Canyon Creek above Toscher Diversion	TR, IS, WQ
CC2	South Canyon Creek above North Canyon Creek	TR, IS, WQ
OC1	Old Cow Creek above Kilarc Main Canal	TR, IS, WQ
OC2	Old Cow Creek above confluence with North Canyon Creek	TR, IS
OC3	Old Cow Creek above Kilarc Powerhouse	TR, IS, WQ
OC4	Old Cow Creek below Kilarc Powerhouse	TR, IS, WQ
KF1	Kilarc Forebay	TR, IS, WQ

Notes:

a TR = Temperature recorder

b IS = *In-situ* parameter monitoring

c WQ = Analytical parameters

Table E.2.4-3. Water Quality Sampling Location Stations, Cow Creek Development and Hooten Gulch 2003

Station ID	Station Location	Monitoring Activity
MC1	Mill Creek above Mill Creek-South Cow Creek Canal	TR[a], IS[b], WQ[c]
MC2	Mill Creek above confluence with South Cow Creek	TR, IS
SC1	South Cow Creek above Mill Creek-South Cow Creek Canal	TR, IS, WQ
SC3	South Cow Creek above confluence with Mill Creek	TR, IS
SC4	South Cow Creek above confluence with Hooten Gulch	TR, IS, WQ
SC5	South Cow Creek below confluence with Hooten Gulch and Cow Creek Powerhouse and Tailrace	TR, IS, WQ
CCF1	Cow Creek Forebay above Cow Creek Powerhouse	TR, IS, WQ
HG1	Hooten Gulch below Cow Creek Powerhouse above Abbott Diversion	TR, IS

Notes:

a TR = Temperature recorder

b IS = *In situ* parameter monitoring

c WQ = Analytical parameters

Table E.2.4-4. Summary of Methods and Purpose for Laboratory Water Quality Analyses in 2003 Sampling

Parameter	EPA Method	Technique	Purpose
Alkalinity			Buffering capacity (acid-neutralizing)
Chloride	300.0	Colorimetric	Typically analyzed – naturally occurring
Fluoride	300.0	Colorimetric	Typically analyzed – naturally occurring
Ortho-phosphate	300.0	Colorimetric	Can indicate nutrient enrichment
Carbonate*	SM 2320 B	Colorimetric	Component of alkalinity
Bicarbonate*	SM 2320 B	Colorimetric	Component of alkalinity
Hydroxide*	SM 2320 B	Colorimetric	Component of alkalinity
Nitrate	300.0	Colorimetric	Can indicate nutrient enrichment
Ammonia*	SM 4500	Colorimetric	Can indicate nutrient enrichment
Sodium	200.7	Flame Atomic Absorption (AA)	Can be increased through the reuse of irrigation water
Magnesium	200.7	ICP	Common, naturally occurring – contributes to hardness
Calcium	200.7	ICP	Common, naturally occurring – contributes to hardness
Copper	200.7	ICP	Potentially associated with mining activity
Lead	200.8	Graphite Furnace AA	Potentially associated with mining activity
Iron	200.7	ICP	Typically analyzed
Manganese	200.7	ICP	Potentially associated with mining activity
Zinc	200.7	ICP	Potentially associated with mining discharges
Mercury	200.8	Cold Vapor AA	Potentially associated with mining activity
Molybdenum	200.8	ICP	Rare element – associated with metal ores
Hardness	130.2	Titrimetric	Typically analyzed – important in solubility of metals
Fecal Coliform	SM 9221-B/E	3X5 Multiple Tube Fermentation	Indicator for the presence of harmful pathogens associated with waste from mammals
Arsenic	200.8	Gaseous Hydride AA	Potentially associated with mining activity
Total Dissolved Solids*	SM 2540 C	Gravimetric	Typically analyzed
Total Suspended Solids*	SM 2540 D	Gravimetric	Indication of sediment transport

* "Standard Methods for the Examination of Water and Wastewater", 20th Ed., 1998.

Table E.2.4-5. Summary of Water Quality Data for Metals, Kilarc Development, May and October 2003

Constituent	Range of Concentrations (µg/L) Minimum - Maximum	CA Primary Drinking Water MCL (µg/L)	CA Secondary Drinking Water MCL (µg/L)	Basin Plan Standards (µg/L)	California Toxics Rule Criteria (µg/L)
Total Metals					
Arsenic	<0.10 – 0.22	50	–	–	–
Barium	0.0015 – 0.079	1,000	–	–	–
Cadmium	<0.002 – <0.01	5	–	–	–
Copper	<0.003 – 0.077	1,300	1,000	–	–
Lead	<0.01 – 0.194	–	–	–	–
Manganese	0.12 – 15.1	15	50	–	–
Silver	<0.008 – 0.12	–	100	–	–
Zinc	<0.02 – 0.15	–	5,000	–	–
Dissolved Metals					
Arsenic	<0.10 – 0.23	–	–	10	150
Barium	0.0013 – 0.0105	–	–	100	–
Cadmium	<0.002 – 0.003	–	–	0.22	2.2
Copper	<0.003 – 0.162	–	–	5.6	9
Iron	<2.0 – 15.0	–	–	300	–
Lead	<0.002 - <0.01	–	–	15	2.5
Manganese	<0.003 – 1.38	–	–	50	–
Mercury	<0.000126 – 0.00221	–	–	–	–
Silver	<0.008	–	–	10	3.4
Zinc	<0.02 – 1.18	–	–	16	120

Notes:
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in RWQCB-CRV (2007)
3. Drinking water standards are cited in CDPH (2008)
4. California Toxics Rule Criteria are cited in 40 CFR Part 131, May 18, 2000
5. mg/L = milligrams per liter; µg/L = micrograms per liter; MPN = most probable number

Table E.2.4-6. Summary of Water Quality Data for Metals, Cow Creek Development, May and October 2003

Constituent	Range of Concentrations (µg/L)	CA Primary Drinking Water MCL (µg/L)	CA Secondary Drinking Water MCL (µg/L)	Basin Plan Standards (µg/L)	California Toxics Rule Criteria (µg/L)
Total Metals					
Arsenic	0.13 – 0.56	50	–	–	–
Barium	0.0033 – 0.0093	1000	–	–	–
Cadmium	<0.002 – 0.005	5	–	–	–
Copper	0.056 – 0.706	1,300	1,000	–	–
Lead	<0.002 – 0.063	–	–	–	–
Manganese	3.04 – 9.12	15	50	–	–
Silver	<0.008	–	100	–	–
Zinc	<0.02 – 2.92	–	5,000	–	–
Dissolved Metals					
Arsenic	<0.10 – 0.54	–	–	10	150
Barium	0.0029 – 0.0075	–	–	100	–
Cadmium	<0.002 – 0.006	–	–	0.22	2.2
Copper	0.095 – 0.451	–	–	5.6	9
Iron	0.0133 – 0.094	–	–	300	–
Lead	<2.0 - <10.0	–	–	–	2.5
Manganese	1.11 – 3.66	–	–	50	–
Mercury	0.0003 – 0.00208	–	–	–	–
Silver	<0.008 – 0.02	–	–	10	3.4
Zinc	<0.02 – 0.24	–	–	16	120

Notes:
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in RWQCB-CRV (2007)
3. Drinking water standards are cited in CDPH (2008)
4. California Toxics Rule Criteria are cited in 40 CFR Part 131, May 18, 2000
5. mg/L = milligrams per liter; µg/L = micrograms per liter; MPN = most probable number

Table E.2.4-7. Summary of 2003 Water Quality Data for Minerals, Nutrients, and Additional Parameters, Kilarc Development

Constituent	Units	Range of Concentrations	CA Primary Drinking Water MCL	CA Secondary Drinking Water MCL	Basin Plan Standards	California Toxics Rule Criteria (µg/L)
Minerals						
Total Calcium	(mg/L)	5.31 – 11.3	–	–	–	–
Dissolved Calcium	(mg/L)	5.04 – 11.2	–	–	–	–
Total Magnesium	(mg/L)	2.20 – 5.51	–	–	–	–
Dissolved Magnesium	(mg/L)	2.20 – 5.56	–	–	–	–
Total Sodium	(mg/L)	1.7 – 4.64	–	–	–	–
Dissolved Sodium	(mg/L)	1.71 – 4.66	–	–	–	–
Chloride	(mg/L)	0.26 – 0.55	–	250	–	–
Flouride	(mg/L)	0.0015 – 0.047	2	–	–	–
Boron	(mg/L)	<0.10	–	–	–	–
Total Alkalinity	(mg/L)	20.8 – 58.8	–	–	–	–
Total Hardness, as Ca CO_3	(mg/L)	21.8 – 51.9	–	–	–	–
Nutrients						
Total Ammonia	(mg/L)	0.065 – 0.072	–	–	–	–
Nitrate, as NO_3 (mg/L) + Nitrite	(mg/L)	0.048 – 0.11	10	–	–	–
Total Phosphorous	(mg/L)	<0.015 – 0.0932	–	–	–	–
Orthophosphate	(mg/L)	0.0122 – 0.0542	–	–	–	–
Additional Parameters						
Total Dissolved Solids	(mg/L)	44 – 104	–	–	500	–
Total Suspended Solids	(mg/L)	<0.1 – 7.7	–	–	–	–
Total Boron	(mg/L)	<0.10	–	–	–	–
Cyanide	(mg/L)	<0.0050	0.15	–	–	–
Molybdenum	(mg/L)	<0.0050	–	–	–	–
PCBs	(µg/L)	<0.1 - <0.2	0.5	–	–	0.00017
Total Coliform	(MPN/100 mL)	11 - 500	–	–	–	–
Fecal Coliform	(MPN/100 mL)	<2 - 240	-	-	200	–

Notes:
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in RWQCB-CRV (2007)
3. Drinking water standards are cited in CDPH (2008)
4. mg/L = milligrams per liter; µg/L = micrograms per liter; MPN = most probable number

Table E.2.4-8. Summary of 2003 Water Quality Data for Minerals, Nutrients, and Additional Parameters, Cow Creek Development

Constituent	Units	Range of Concentrations	CA Primary Drinking Water MCL	CA Secondary Drinking Water MCL	Basin Plan Standards	California Toxics Rule Criteria (µg/L)
Minerals						
Total Calcium	(mg/L)	6.94 – 13.8	–	–	–	–
Dissolved Calcium	(mg/L)	6.55 – 13.7	–	–	–	–
Total Magnesium	(mg/L)	2.81– 10.5	–	–	–	–
Dissolved Magnesium	(mg/L)	2.81 – 10.7	–	–	–	–
Total Sodium	(mg/L)	2.51 – 4.81	–	–	–	–
Dissolved Sodium	(mg/L)	2.49 – 4.88	–	–	–	–
Chloride	(mg/L)	0.43 – 0.86	–	250	–	–
Fluoride	(mg/L)	0.024 – 0.24	2	–	–	–
Boron	(mg/L)	<0.10	–	–	–	–
Total Alkalinity	(mg/L)	32.4 – 80.5	–	–	–	–
Total Hardness, as Ca CO3	(mg/L)	27.4 – 87.0	–	–	–	–
Nutrients						
Total Ammonia	(mg/L)	<0.05	–	–	–	
Nitrate, as NO3 (mg/L) + Nitrite	(mg/L)	0.0437 – 0.119	10	–	–	
Total Phosphorous	(mg/L)	<0.015 – 0.00299	–	–	–	
Orthophosphate	(mg/L)	0.0176 – 0.0519	–	–	–	
Additional Parameters						
Total Dissolved Solids	(mg/L)	67 – 136	–	–	–	–
Total Suspended Solids	(mg/L)	<0.1 – 5.9	–	–	–	–
Total Boron	(mg/L)	–	–	–	–	–
Cyanide	(mg/L)	<0.0050	0.15	–	–	–
Molybdenum	(mg/L)	<0.0050	–	–	–	–
PCBs	(µg/L)	<0.1 - <0.2	0.5	–	–	0.00017
Total Coliform	(MPN/100 mL)	220 - 1600	–	–	–	–
Fecal Coliform	(MPN/100 mL)	11 - 900	–	–	200	–

Notes:
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in RWQCB-CRV (2007)
3. Drinking water standards are cited in CDPH (2008)
4. mg/L = milligrams per liter; µg/L = micrograms per liter; MPN = most probable number

Table E.2.4-9. Results of In Situ Monitoring, Kilarc Development, May to October 2003

Constituent	Range of Concentrations	CA Primary Drinking Water MCL	CA Secondary Drinking Water MCL	Basin Plan Standards
In Situ Parameters				
Temperature (°C)	4.4 – 16.6	–	–	–
Dissolved Oxygen (mg/L)	8.1 – 11.1	–	–	>7
Specific Conductance (mmhos/cm)	54 – 109	–	900	–
pH	7.5 – 8.7	–	–	6.5 – 8.5
Turbidity (NTU)	<0.1 – 5.8	–	5	–

Notes
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in CRWQCB (2007)
3. Drinking water standards are cited in CDPH (2008)

Table E.2.4-10. Results of In Situ Monitoring, Cow Creek Development, May to October 2003

Constituent	Range of Concentrations	CA Primary Drinking Water MCL	CA Secondary Drinking Water MCL	Basin Plan Standards
In Situ Parameters				
Temperature (°C)	5.4 – 20.5		–	–
Dissolved Oxygen (mg/L)	7.3 – 11.2	–	–	>7
Specific Conductance (mmhos/cm)	59 – 168	–	900	–
pH	7.2 – 8.6	–	–	6.5 – 8.5
Turbidity (NTU)	<0.1 -8.5	–	5	–

Notes:
1. All water quality data are presented in Appendix I.
2. Basin Plan standards are found in RWQCB-CRV (2007)
3. Drinking water standards are cited in CDPH (2008)

Table E.2.4-11. Diversion Dam Bulk Sediment Sample Results, 2007

Sample ID	Site	Total Solids (%)	Total Mercury (mg/kg)	Methyl Mercury (mg/kg)	Copper Cu 83 (mg/kg)	Silver (mg/kg)	Arsenic (mg/kg)
"Background" levels			4-51		10-75	<0.5	1.1
Threshold Effects Level (TEL)			174		35.7	–	5.9
Probable Effect Level (PEL)			486		197	–	17
K-II	Kilarc	75.3	4.13	0.011	**51.2**	0.15	1.1
K-III	Kilarc	75.54	3.52	0.011	34.2	0.19	0.7
C-I	South Cow	87.12	8.92	0.032	27	0.12	1.6
C-III	South Cow	81.65	7.14	0.011	30	0.11	2.4
C-IIID[a]	South Cow	83.36	6.33	0.012	25.6	0.09	2.5

[a] Field Duplicate

Notes:

1. "Background" levels derived from numerous national and international sources but are primarily from sediments found in the Great Lakes region. "Background" levels are not from the Cow Creek watershed.
2. TEL and PEL levels derived for freshwater sediment from Buchman (2004). The levels are not criteria or clean-up levels, and are published as screening values to aid in interpretation of sediment quality data.
3. Bold indicates concentration is greater than the Threshold Effects Level.
4. Additional testing was performed in the Kilarc Development for copper only. See Table 12.

Table E.2.4-12. Kilarc Main Canal Diversion Dam Bulk Sediment Sample Total Copper (Cu) and Leachable Copper Results

Sample ID	% Total Solids	Total Cu (mg/kg dry)	Leachable Cu (mg/kg dry)	% Leachable Cu	TEL	PEL
K-I	6.8	**819**[a]	**1120**[a]	100	35.7	197.0
K-II		51.2				
K-IIb	75.4	58.3	19.1	33	35.7	197.0
K-III		34.2				
K-IIIb	76.1	37.5	7.24	19	35.7	197.0
K-IV	77.2	43.5	8.1	19	35.7	197.0

[a] **Bold** indicates exceedance of the PEL

Notes:

1. Sample K-1 was composed of silt and clay fractions of sediment only. All other samples were made up of the sand, silt, and clay fractions of the collected sediment.
2. Testing was performed using EPA Methods 1638 (Total) or Method 1638 (mod) – leachable. The leachable copper test extracts the Cu that is weakly adsorbed to the sediment surface by running a weak hydrochloric acid over the sample for a fixed amount of time and measuring the resulting dissolved Cu concentration (Giddings et al, 1991).
3. TEL and PEL levels derived for freshwater sediment from Buchman (2004). The levels are not criteria or clean-up levels, and are published as screening values to aid in interpretation of sediment quality data.
4. "Background" levels established for Cu by Buchman (2004) are estimated to be 10 to 75 mg/kg.

Table E.2.4-13. Summary of Temperature Data for Kilarc Development, 2003

Station Name	Mean Daily Temperature[1] (°C)	Maximum Temperature[2] (°C)	Minimum Temperature[3] (°C)	No. Days Mean Daily Temp. > 18°C	No. of Days Max. Temp.[4] > 24°C
NC1					
May	8.1	11.5	4.3	0	0
Jun	10.3	12.3	8.3	0	0
Jul	11.3	13.8	8.6	0	0
Aug	10.8	12.5	9.1	0	0
Sep	10.3	12.4	8.2	0	0
NC2					
May	8.6	10.7	6.0	0	0
Jun	10.6	12.2	9.2	0	0
Jul	11.7	14.0	9.5	0	0
Aug	11.6	13.1	10.3	0	0
Sep	11.2	13.1	9.3	0	0
CC1					
May	8.4	10.4	7.3	0	0
Jun	9.0	10.8	8.3	0	0
Jul	9.6	11.8	8.3	0	0
Aug	9.7	11.3	8.5	0	0
Sep	9.7	11.4	7.7	0	0
CC2					
May	7.7	8.8	6.2	0	0
Jun	8.2	8.8	7.6	0	0
Jul	8.3	9.0	7.8	0	0
Aug	8.1	8.8	7.6	0	0
Sep	7.9	8.3	7.2	0	0
OC1					
May	8.6	13.4	4.2	0	0
Jun	11.2	16.2	6.7	0	0
Jul	12.2	16.8	7.8	0	0
Aug	11.0	15.0	7.7	0	0
Sep	9.6	13.9	6.2	0	0

Table E.2.4-13. Summary of Temperature Data for Kilarc Development, 2003

Station Name	Mean Daily Temperature[1] (°C)	Maximum Temperature[2] (°C)	Minimum Temperature[3] (°C)	No. Days Mean Daily Temp. > 18°C	No. of Days Max. Temp.[4] > 24°C
OC2					
May	9.6	13.9	5.1	0	0
June	13.0	18.6	8.2	0	0
July	15.4	20.2	11.1	0	0
Aug	14.2	18.1	11.6	0	0
Sept	12.8	16.8	10.0	0	0
OC3					
May	10.4	14.2	5.7	0	0
June	13.8	19.5	9.2	0	0
July	16.6	21.9	11.5	4	0
Aug	15.3	19.5	12.1	0	0
Sept	13.7	18.2	10.1	0	0
OC4					
May	10.1	13.4	5.9	0	0
June	12.8	16.2	9.3	0	0
July	14.5	18.3	10.5	0	0
Aug	13.4	17.0	11.3	0	0
Sept	11.8	15.2	9.1	0	0
KF1					
May	10.1	13.2	6.1	0	0
June	12.9	16.4	9.5	0	0
July	14.7	18.1	11.0	0	0
Aug	13.5	16.4	11.0	0	0
Sept	11.8	15.3	8.8	0	0

Notes:
1. At each station, temperature was measured at 20-minute intervals, 24 hours per day. Reported mean temperature is the average of 20-min. data each day, averaged over each month.
2. Maximum temperatures are the highest readings recorded during the month from 20-minute interval data.
3. Minimum temperatures are the lowest readings recorded during the month from the 20-minute interval data.
4. The maximum temperature recorded each day (20-minute interval) was used for comparison.

Table E.2.4-14. Water Temperature Monitoring Results, Cow Creek Development, May to September 2003

Station Name	Mean Daily Temperature[1] (°C)	Maximum Temperature[2] (°C)	Minimum Temperature[3] (°C)	No. of Days Mean Daily Temp. > 18°C	No. of Days Max. Temp.[4] > 24°C
MC1					
May	15.9	19.7	10.4	0	0
June	17.2	20.3	13.2	4	0
July	17.8	21.4	13.3	1	0
Aug	16.4	19.4	13.2	0	0
Sept	15.3	18.3	12.4	0	0
MC2					
May	16.0	19.6	10.5	0	0
June	17.3	20.3	13.2	6	0
July	18.0	21.4	13.4	2	0
Aug	16.6	19.4	13.0	1	0
Sept	15.6	22.0	10.9	1	0
SC1					
May	11.9	15.3	7.4	0	0
June	16.7	22.3	11.3	6	0
July	20.2	26.7	14.1	27	13
Aug	18.8	23.9	14.5	28	0
Sept	16.4	21.9	11.2	6	0
SC3					
May	12.1	15.4	7.6	0	0
June	16.7	21.9	11.5	6	0
July	19.7	25.2	14.0	26	5
Aug	18.2	22.5	14.2	12	0
Sept	16.1	20.9	11.3	4	0
SC4					
May	13.3	16.4	8.8	0	0
June	18.0	22.5	13.1	13	0
July	21.3	26.3	16.2	31	12
Aug	19.6	23.6	16.5	31	0

Table E.2.4-14. Water Temperature Monitoring Results, Cow Creek Development, May to September 2003

Station Name	Mean Daily Temperature[1] (°C)	Maximum Temperature[2] (°C)	Minimum Temperature[3] (°C)	No. of Days Mean Daily Temp. > 18°C	No. of Days Max. Temp.[4] > 24°C
Sept	17.2	22.12	13.5	6	0
SC5					
May	13.5	16.7	8.9	0	0
June	18.5	23.4	13.4	18	0
July	21.7	28.8	16.2	18	19
Aug	19.9	24.3	16.6	31	1
Sept	17.5	23.0	13.5	7	0
CCF1					
May	12.5	15.7	8.1	0	0
June	17.3	22.1	12.3	8	0
July	20.5	25.3	14.9	27	8
Aug	18.9	23.3	15.9	29	0
Sept	16.5	21.0	12.5	6	0
HG1					
May	13.1	16.0	8.8	0	0
June	17.5	22.0	12.9	9	0
July	20.6	25.1	15.6	28	6
Aug	18.9	23.1	16.4	28	0
Sept	16.7	20.9	13.2	6	0

Notes:
1. At each station, temperature was measured at 20-minute intervals, 24 hours per day. Reported mean temperature is the average of 20-min. data each day, averaged over each month.
2. Maximum temperatures are the highest readings recorded during the month from 20-minute interval data.
3. Minimum temperatures are the lowest readings recorded during the month from the 20-minute interval data.
4. The maximum temperature recorded each day (20-minute interval) was used for comparison.

E.2.5 Aquatic Resources

Table E.2.5-1. Fish Present within the Project Area

Species	Anad / Resid.	Native/ Introd.	Old Cow Creek Site			South Cow Creek Site			Hooten Gulch	Kilarc Forebay	Kilarc Main Canal	Cow Creek Forebay	South Cow Main Canal	Mill Creek Site	
			Below Tailrace	Bypass Reach	Above Div.	Below Tailrace	Bypass Reach	Above Div.						Below Div.	Above Div.
Spring-Run Chinook Salmon	A	N				x_a	x_b	x_b							
Fall-Run Chinook Salmon	A	N				x_b	x_b	x_b							
Steelhead/ Rainbow Trout	A/R	N	x_a, x_c	x_a, x_b	x_a, x_b	x_a, x_c	x_a, x_c	x_a, x_b, x_c	x_a	x_a	x_a	x_a, x_b	x_a		x_b, x_c
California Roach	R	N				x_a	x_a	x_a	x_a				x_a		
Riffle Sculpin	R	N	x_a	x_a, x_b		x_a	x_a		x_a						
Speckled Dace	R	N				x_a	x_a, x_c								
Sacramento Pikeminnow	R	N	x_a			x_a	x_a								
Sacramento Sucker	R	N				x_a	x_a					x_a, x_b			
Lamprey	R	N						x_b					x_a		
Brown Trout	R	I	x_a	x_a	x_a, x_b	x_c		x_b		x_a	x_a	x_b			
Smallmouth Bass	R	I				x_a	x_a								
Largemouth Bass	R	I				x_a									
Green Sunfish	R	I										x_a, x_b			
Golden Shiner	R	I								x_a		x_a			

Notes:
A = Anadromous SpeciesI = Introduced Species
N = Native Species
R = Resident Species
x_a = observed during Fish Distribution and Abundance Survey
x_b = historical observation
x_c=CDFG, 2002-2003 snorkel surveys

Table E.2.5-2. Special-Status Fish Species Potentially Present within the Kilarc-Cow Project Area

Fish Species	State	List Date	Federal	List Date
Central Valley Winter-Run Steelhead DPS (*Oncorhynchus mykiss*)	SE	9/22/1989	FT	5/18/1998 Reaffirmed 1/5/2006
Central Valley Fall- and Late Fall-Run Chinook Salmon ESU (*Oncorhynchus tschwytscha*)	SSC	N/A	FSC	4/15/2004
Central Valley Spring-Run Chinook Salmon ESU *(Oncorhynchus tschwytscha*)	ST	2/5/1999	FT	9/19/1999 Reaffirmed 6/28/2005

Source: CDFG website, http://www.dfg.ca.gov; NMFS website, http//www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/index.cfm

Notes:
DPS = Distinct Population Segment
ESU = Evolutionary Significant Unit
FSC = Federal Species of Concern
FT = Federal Threatened Species
SE = State Endangered Species
SSC = State Species of Concern
ST = State Threatened Species

E.2.6 Wildlife Resources

Table E.2.6-1. Wildlife Species Observed During 2003 Field Surveys

Acorn woodpecker	Jack rabbit
American coot	Killdeer
American robin	Mallard
Aquatic garter snake	Mountain chickadee
Belted kingfisher	Mountain quail
Black phoebe	Mourning dove
Bobcat	Mule deer
Botta’s pocket gopher	Northern flicker
Brewer’s blackbird	Northern mockingbird
Bullfrog	Northwestern pond turtle
California ground squirrel	Osprey
California quail	Pacific treefrog
California towhee	Raccoon
Canadian goose	Red-tailed hawk
Chipmunks	Red-winged blackbird
Common merganser turkey vulture	Rough-skin newt
Common raven	Song sparrow
Coyote	Steller’s jay
Dark-eyed junco	Western fence lizard
Foothill yellow-legged frogs	Western gray squirrel
Golden eagle	Western meadowlark
Great blue heron	Western scrub jay
Great egret	Western wood-pewee
Great horned owl	Wood duck
House finch	Yellow rumped warbler
House sparrow	

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Invertebrates				
Vernal pool fairy shrimp *Branchinecta lynchi*	FT	—	Central Valley vernal pools, swales, slumps, and basalt flow depressions, up to 950 feet in elevation.	Unlikely to occur due to lack of suitable habitat. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
California linderiella fairy shrimp *Linderiella occidentalis*	—	—	Central Valley vernal pools, swales, slumps, and basalt flow depressions.	Unlikely to occur due to lack of suitable habitat. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Vernal pool tadpole shrimp *Lepidurus packardi*	FE	—	Central Valley vernal pools, swales, slumps, and basalt flow depressions, ranging from east of Redding in Shasta County south to the San Luis National Wildlife Refuge in Merced County.	Unlikely to occur due to lack of suitable habitat. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Shasta crayfish *Pacifastacus fortis*	FE	SE	Occurs only in Shasta County within the Pit River drainage system, generally in cool, spring-fed headwaters characterized by clean, volcanic cobbles and boulders overlying sand or gravel substrates.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments located outside of species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT	—	Elderberry shrubs throughout the Central Valley and foothills below 3,000 feet in elevation.	May occur. Appropriate habitat is present in elderberry shrubs within the Kilarc and Cow Creek developments. Two shrubs are located near the South Cow Creek Main Canal. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments. No VELB were detected during 2003 focused surveys.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Amphibians				
Shasta salamander *Hydromantes shastae*	—	ST/CSC	Uncommon in limestone areas in the vicinity of Shasta Reservoir in Shasta County. Numerous small, isolated populations occurring in limestone areas in valley-foothill, hardwood-conifer, ponderosa pine and mixed conifer habitats from 1,100 to 2,550 feet.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments located outside of species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Western tailed frog *Ascaphus truei*	—	CSC	Coastal Mendocino County north to the Oregon border with a disjunct population in the Shasta region. Occurs in permanent streams with low temperatures, with steep canyon walls, in conifer and hardwood-conifer habitats from 0 to 6,500 feet.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments located outside of species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Western spadefoot toad *Spea hammondii*	—	CSC	Requires vernal pools and seasonal wetlands below 4,500 feet that lack predators for breeding. Also occurs in grassland habitat and occasionally in valley-foothill oak woodlands and orchards.	Unlikely to occur due to lack of suitable habitat. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
California red-legged frog *Rana aurora draytonii*	FT	CSC	Breeds in quiet streams and permanent, deep, cool ponds with overhanging and emergent vegetation below 4,000 feet elevation. Known to occur adjacent to breeding habitats in riparian areas and heavily vegetated streamside shorelines, and in non-native grasslands.	May occur. No appropriate spawning habitat was found in the Kilarc and Cow Creek developments during the site assessment, but several ponds on private land within the Site Assessment Area may be suitable. Potential summer habitat exists along Hooten Gulch within 100 meters (328 feet) of its confluence with South Cow Creek. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Foothill yellow-legged frog *Rana boylii*	—	CSC	Breeds in rocky streams with cool, clear water in a variety of habitats, including valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows; occurs at elevations ranging from 0 to 6,000 feet.	Known to occur. There is a CNDDB record for this species on Old Cow Creek (CDFG, 2003). This species was detected in the downstream portion of the South Cow Creek bypass reach and Hooten Gulch during 2003 reconnaissance wildlife surveys and focused foothill yellow-legged frog surveys.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Cascades frog *Rana cascadae*	—	CSC	Montane aquatic habitats such as mountain lakes, small streams, and ponds in meadows; open coniferous forests. Standing water required for reproduction. Hibernates in mud on the bottom of lakes and ponds during the winter.	No suitable habitat in the Kilarc and Cow Creek developments.
Reptiles				
Northwestern pond turtle *Actinemys marmorata marmorata*	—	CSC	Perennial wetlands and slow moving creeks and ponds with overhanging vegetation up to 6,000 feet; suitable basking sites such as logs and rocks above the waterline.	Known to occur. There is one CNDDB occurrence approximately 2 miles from the Kilarc and Cow Creek developments (CDFG, 2003). Detected incidentally in Hooten Gulch and near the Cow Creek Powerhouse during surveys.
California horned lizard *Phrynosoma coronatum frontale*	—	CSC	Exposed sandy-gravelly substrate with scattered shrubs, clearings in riparian woodlands, and annual grasslands. Ranges in the Central Valley from southern Tehama County south; in the Sierra foothills from Butte County to Tulare County below 4,000 feet; ranging from sea level to 4,000 feet in the Sierra foothills.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments located outside of species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Birds				
Aleutian Canada goose *Branta hutchinsii leucopareia*	FD (2001)	—	Occurs in pastures and grain fields in the Central Valley.	Unlikely to occur in the Kilarc and Cow Creek developments due to lack of suitable habitat. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
White-faced ibis *Plegadis chihi*	—	WL	Uncommon summer resident in sections of Southern California, rare visitor in the Central Valley. Nests in dense, fresh emergent wetland. Forages in shallow water or muddy fields.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Northern goshawk *Accipiter gentilis*	—	CSC	Prefers middle to high elevation, mature, dense conifer forests for foraging and nesting. Casual in foothills during winter, northern deserts in pinyon-juniper woodland, and low elevation riparian habitats. Nests on north-facing slopes near water.	May forage in riparian, oak woodland, or mixed conifer habitat and may also breed in forest habitats in the Kilarc and Cow Creek developments. There is one CNDDB record approximately 5 miles from the Kilarc and Cow Creek developments (CDFG, 2008a).
Sharp-shinned hawk *Accipiter striatus*	—	WL (Nesting)	Mid-elevation habitats. Roosts in intermediate to high-canopy forest. Nests in dense, even-aged, single-layered forest canopy. Winters in woodlands. Prefers, but not restricted to, riparian habitats. All habitats except alpine, open prairie, and bare desert used in winter.	May forage in riparian habitat or nest in mixed conifer forest in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Golden eagle *Aquila chrysaetos*	—	CFP/WL (Nesting and Wintering)	Habitat is typically rolling foothills, mountain areas, sage juniper flats, grasslands, and early successional forest.	Known to occur. Detected incidentally during surveys near the Cow Creek Forebay. May nest or forage in grasslands, oak woodland, or mixed conifer forest in the Kilarc and Cow Creek developments. There are no CNDDB occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Ferruginous hawk *Buteo regalis*	—	WL	Forages in grasslands, sagebrush flats, desert scrub, low foothills, and pinyon-juniper in the Modoc Plateau, Central Valley, and Coast Ranges; breeds in the Great Basin and northern plains states.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Swainson's hawk *Buteo swainsoni*		ST	Breeding resident and migrant in the Central Valley, Klamath Basin, Northeastern Plateau, Lassen County, and Mojave Desert. Requires large, open grasslands with abundant prey in association with suitable nest trees. Nests in mature riparian forest, groves of oaks, and mature roadside trees.	May occur. Appropriate habitat is present in the grassland (foraging) and woodland (nesting) habitats of the Kilarc and Cow Creek developments, particularly in the southern portion of the Cow Creek Development vicinity. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
White-tailed kite *Elanus leucurus*	—	CFP	Coastal and valley lowlands. Herbaceous and open stages of most habitats; grasslands and agricultural areas are used for foraging; typically nests in tops of dense oak, willow, or other tree stands adjacent to open areas and agricultural fields.	May occur. Appropriate breeding and foraging habitat is present in South Cow Creek. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Bald eagle *Haliaeetus leucocephalus*	FD (2007)	SE/CFP	Year-round in Shasta County. Occurs in low to mid-range elevations of the Sierra Nevada. Nests in large, old-growth or dominant live tree with open branches. Perches in large trees, snags or broken-topped trees near water for foraging.	Known to occur. Have been observed roosting and foraging at the Kilarc Forebay. Not observed during focused surveys. There are no CNDDB records within a 5-mile radius of the Kilarc and Cow Creek developments.
Osprey *Pandion haliaetus*	—	WL (Nesting)	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats. Known to breed near Shasta Lake.	Known to occur. Not detected during focused surveys. Detected incidentally at Kilarc Forebay during other surveys for the Project. There are no CNDDB occurrences of this species within a 5-mile radius of the Kilarc and Cow Creek developments.
American peregrine falcon *Falco peregrinus anatum*	FD (1999)	SE[17]/CFP	Breeds near wetlands, lakes, and rivers on high cliffs and banks.	Known to occur. Documented nesting in the Cow Creek watershed (SHN, 2001). May forage in or near Kilarc or Cow Creek forebays and in stream habitat in Kilarc and Cow Creek developments. This species was not detected during 2003 focused surveys, and there are no CNDDB records within a 5-mile radius of the Kilarc and Cow Creek developments.
Long-billed curlew *Numenius americanus*	—	WL	Found in wet meadow habitat in northeastern California in Siskiyou, Modoc, and Lassen counties. Winter visitor along the California coast and in the Central and Imperial valleys.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

17 The Fish and Game Commission voted to delist the American peregrine falcon on December 12, 2008. The delisting action is likely to occur in early 2009.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FC	SE	Valley foothill and desert riparian habitats in scattered locations in California; breeds along the Colorado River, Sacramento and Owens valleys, South Fork of the Kern River, Santa Ana River, and the Amargosa River.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Short-eared owl *Asio flammeus*	—	CSC	Occurs in the Central Valley and western Sierra foothills in open areas with few trees, such as annual and perennial grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. This species occurs only along the northeast edge of Shasta County.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Western burrowing owl *Athene cunicularia*	—	CSC	Grasslands, oak woodlands, and ponderosa pine habitat, up to 5,300 feet.	May occur. Appropriate breeding and foraging habitat is present within grasslands in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Flammulated owl *Otus flammeolus*	—	SA	Occurs in the North Coast and Klamath ranges, Sierra Nevada Mountains, and in mountains in southern California in a variety of conifer habitats from 6,000 to 10,000 feet.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within documented species' elevational range. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Northern spotted owl *Strix occidentalis caurina*	FT	CSC	Occurs in dense, old-growth, multi-layered mixed conifer, redwood, and Douglas fir habitats, from sea level up to 7,600 feet.	California spotted owl may occur (northern spotted owl is found north of the Project Area). Appropriate breeding and foraging habitat is present in mixed conifer within the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Vaux's swift *Chaetura vauxi*	—	CSC	Prefers redwood and Douglas fir habitats with nest sites in large, hollow trees and snags, especially tall, burned-out stubs. Forages over moist terrain and habitats, preferring rivers and lakes. Summer resident of northern California.	May forage and breed in mixed conifer forest near streams and forebays in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Black swift *Cypseloides niger*	—	CSC	Breeds very locally in the Sierra Nevada and Cascade ranges. Nests in moist crevices or caves, or on cliffs near waterfalls in deep canyons. Forages widely over many habitats; seems to avoid arid regions.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Rufous hummingbird *Selasphorus rufus*	—	SA	Prefers redwood and Douglas fir habitats. Breeds in the Coastal Range north of Sonoma County, the Sierra Nevada, and possibly in the Cascade Range. Fairly common migrant throughout most of California in April to May and August to September.	May breed or forage in mixed conifer and oak woodland within the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Little willow flycatcher *Empidonax traillii brewsteri*	—	SE (nesting; all subspecies)	Occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows, wet meadow, and montane riparian habitats from 2,000 to 8,000 feet. Breeding seldom occurs below 5,000 feet.	May forage in riparian habitat and may breed within reaches of South Cow Creek in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Loggerhead shrike *Lanius ludovicianus*	—	CSC	Open habitats with sparse shrubs and trees (or other suitable perch sites) and bare ground and/or low, sparse herbaceous cover; oak woodlands for nesting. Found in lowlands and foothills throughout California.	May forage in oak woodlands or riparian habitat in the Kilarc and Cow Creek developments. May breed in oak woodlands in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Bank swallow *Riparia riparia*	—	ST	Migrant found primarily in riparian and other lowland habitats in California west of the deserts. Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, or the ocean for nesting.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Hermit warbler *Dendroica occidentalis*	—	SA	Breeds in major mountain ranges from San Gabriel and San Bernardino mountains northward in mature ponderosa pine, montane hardwood-conifer, mixed conifer, Douglas fir, redwood, red fir, and Jeffrey pine habitats.	May breed in mixed conifer forests near the Kilarc and Cow Creek developments. May forage in mixed conifer and oak-pine woodland in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Tri-colored blackbird *Agelaius tricolor*	—	CSC	Breeds near freshwater, preferably in emergent wetland with tall dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs. Feeds in grassland and cropland habitats. Found throughout the Central Valley and on the coast.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Lawrence's goldfinch *Carduelis lawrencei*	—	SA	Occurs in valley foothill hardwood and valley foothill hardwood-conifer. Breeds in open oak or other arid woodland and chaparral, near water.	May forage and breed in oak woodland or oak-pine woodlands near streams or the Kilarc or Cow Creek forebays in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Lewis' woodpecker *Melanerpes lewis*	—	SA	Uncommon, local winter resident occurring in open oak savannahs, broken deciduous, and coniferous habitats. Breeds in eastern slopes of the Coast Ranges, the Sierra Nevada, Warner Mountains, Klamath Mountains, and Cascade Range. Nests in sycamore, cottonwood, oak, or conifer trees.	Found downstream from the Kilarc and Cow Creek developments along South Cow Creek and may forage or breed in oak woodland and mixed conifer habitats in the Kilarc and Cow Creek developments. There are no other reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Mammals				
Pale Townsend's big-eared bat *Corynorhinus townsendii*	—	CSC	Occurs throughout California, in all but sub-alpine and alpine habitats. Most abundant in mesic habitats and requires caves, mines, tunnels, buildings, or other human-made structures for roosting.	May occur in mesic habitat and in Project facilities such powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Spotted bat *Euderma maculatum*	—	CSC	Habitats range from arid deserts and grasslands through mixed conifer forests up to 10,600 feet. Prefers sites with adequate roosting habitat, such as cliffs. Often limited by the availability of cliff habitat. Feeds over water and along marshes.	May occur in mixed-conifer forest and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Silver-haired bat *Lasionycteris noctivagans*	—	SA	Primarily a coastal and montane forest dweller feeding over streams, ponds and open brushy areas. Roosts in hollow trees, beneath exfoliating bark, abandoned woodpecker holes and rarely under rocks. Needs drinking water.	May occur in open forests and woodlands and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Small-footed myotis *Myotis ciliolabrum*	—	SA	Occurs in the Sierra Nevada and deserts, commonly in arid uplands near water, from sea level to 9,000 feet. Roosts tend to be in rock crevices, cliff faces, and in talus formations. Maternity roosts are found in similar sites and have been observed in buildings.	May occur in uplands and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Long-eared myotis *Myotis evotis*	—	SA	Year-round resident in California, occurring in mixed hardwood/conifer forest and montane conifer forest in northern California, and in pinyon-juniper, mesquite scrub, and pine/oak woodland in southern California. Typically roosts singly or in small groups in hollow trees, under exfoliating bark, crevices in rock outcrops, and occasionally in mines, caves, and buildings during the day.	May occur in mixed hardwood/conifer and montane conifer forests and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Fringed myotis *Myotis thysanodes*	—	SA	Widespread in California, occurring in all habitats excluding the Central Valley and Mojave desert. Occurs primarily in pinyon-juniper, valley-foothill hardwood, and hardwood conifer from 4,000 to 7,000 feet. Maternity colonies are in caves, mines, and buildings.	May occur in valley-foothill woodland and mixed conifer forests and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Long-legged myotis *Myotis volans*	—	SA	Common in California, occurring in the Coastal, Sierra Nevada, and Cascade ranges from sea level to 11,000 feet, primarily in coniferous forest, but also riparian and desert habitats. Maternity roosts are found in buildings, rock crevices, and under exfoliating bark. Males roost singly or in small numbers in rock crevices, buildings, and under tree bark. Night roosts are under bridges, in caves and mines, and in buildings.	May occur in mixed-conifer forests and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Yuma myotis *Myotis yumanensis*	—	SA	Year-round resident in most of California at lower elevations in a wide variety of habitats from coast to mid-elevation. Very tolerant of human habitation and survives in urbanized environments. Day roosts are in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are in buildings, bridges, and other man-made structures.	May occur in open forests and woodlands and in Project facilities such as powerhouses and tunnels in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Sierra Nevada red fox *Vulpes vulpes necator*	—	ST	Occurs throughout the Sierra Nevada at elevations above 7,000 feet in forests interspersed with meadows or alpine forests. Open areas are used for hunting, forested habitats for cover and reproduction.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution and outside of species' elevational range. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Table E.2.6-2. Special-Status Wildlife Species Potentially Occurring in the Kilarc and Cow Creek Developments

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
California wolverine *Gulo gulo luteus*	—	ST, CFP	Mixed conifer, red fir, and lodgepole habitats, and probably sub-alpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Occurs in Sierra Nevada from 4,300 to 10,800 feet. Majority of recorded sightings are found above 8,000 feet in elevation.	Unlikely to occur in the Kilarc and Cow Creek developments. Kilarc and Cow Creek developments are not within species' documented distribution.
Pacific fisher *Martes pennanti (pacifica DPS)*	FC	CSC	Suitable habitat consists of large areas of mature, dense forest, red fir, lodgepole pine, ponderosa pine, mixed conifer, and Jeffery pine forests with snags and greater than 50 percent canopy closure. Known from 4,000 to 8,000 feet elevations.	May occur. Appropriate habitat is available in mixed conifer forests within the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.
Ringtail *Bassariscus astutus*	—	CFP	Widely distributed, occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Little information available on distribution and relative abundance among habitats.	May occur. Appropriate habitat is available in valley-foothill riparian and montane riparian forests in the Kilarc and Cow Creek developments. There are no reported occurrences within a 5-mile radius of the Kilarc and Cow Creek developments.

Legend:

FT = Federally Threatened
FE = Federally Endangered
FC = Federal Candidate Species
FD = Federally Delisted
ST = State Threatened
SE = State Endangered
CSC = State Species of Special Concern
CFP = California Fully Protected
WL = CDFG Watch List (definition assumed - code added in 2008 without explanation
SA = Special Animal - on CDFG list of Special Animals

Sources:

Life history and habitat information adapted from Zeiner et al. (1988, 1990a,b).

Habitat affiliation from California Natural Diversity Database (CDFG, 2008a).

Listing status and nomenclature from CDFG Special Animals List (CDFG, 2008b).

E.2.7 Botanical Resources

Table E.2.7-1. Special-Status Plant Taxa Potentially Present or Known to Occur in the Vicinity of the Kilarc and Cow Creek Developments

Scientific Name	Status	Flowering Period	Life Form	Presence/ Absence
Henderson's bent grass *Agrostis hendersonii*	CNPS 3	Apr-May	Annual herb	Not observed during Project surveys
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	CNPS 1B	Mar-Jun	Perennial herb (rhizomatous)	Observed at a Cow Creek Project access road
Scalloped moonwort *Botrychium crenulatum*	CNPS 2	N/A	Fern	Not observed during Project surveys
Rattlesnake fern *Botrychium virginianum*	CNPS 2	Jun-Sept	Perennial herb	Not observed during Project surveys
Long-haired star-tulip *Calochortus longebarbatus* var. *longebarbatus*	CNPS 1B	Jun-Sep	Perennial herb (bulbiferous)	Not observed during Project surveys
Callahan's mariposa lily *Calochortus syntrophus*	CNPS 3	May-June	Perennial herb (bulbiferous)	Not observed during Project surveys
Butte County morning-glory *Calystegia atriplicifolia* ssp. *buttensis*	CNPS 1B	May-July	Perennial herb	Not observed during Project surveys
Fox sedge *Carex vulpinoidea*	CNPS 2	May-June	Perennial herb	Not observed during Project surveys
Shasta clarkia *Clarkia borealis* ssp. *arida*	CNPS 1B	Jun-Aug	Annual herb	Not observed during Project surveys
Northern clarkia *Clarkia borealis* ssp. *borealis*	CNPS 1B	Jun-Sept	Annual herb	Not observed during Project surveys
Silky cryptantha *Cryptantha crinita*	CNPS 1B	Apr-May	Annual herb	Not observed during Project surveys
Mountain lady's-slipper *Cypripedium montanum*	CNPS 4	Mar-Aug	Perennial herb (rhizomatous)	Observed at the Kilarc Project
Butte County fritillary *Fritillaria eastwoodiae*	CNPS 3	Mar-May	Perennial herb (bulbiferous)	Not observed during Project surveys
Bogg's Lake hedge-hyssop *Gratiola heterosepala*	CE, CNPS 1B	Apr-June	Annual herb	Not observed during Project surveys
Baker's globe mallow *Iliamna bakeri*	CNPS 4	Jun-Sept	Perennial herb	Not observed during Project surveys

Table E.2.7-1. Special-Status Plant Taxa Potentially Present or Known to Occur in the Vicinity of the Kilarc and Cow Creek Developments

Scientific Name	Status	Flowering Period	Life Form	Presence/ Absence
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	CNPS 1B	Mar-May	Annual herb	Not observed during Project surveys
Bellinger's meadowfoam *Limnanthes floccosa* ssp. *bellingeriana*	CNPS 1B	Apr-June	Annual herb	Not observed during Project surveys
Shasta snow wreath *Neviusia cliftonii*	CNPS 1B	May-June	Shrub (deciduous)	Not observed during Project surveys
Slender Orcutt grass *Orcuttia tenuis*	CNPS 1B	May-Sept (Oct)[1]	Annual herb	Not observed during Project surveys
Ahart's paronychia *Paronychia ahartii*	CNPS 1B	Mar-June	Annual herb	Not observed during Project surveys
Newberry's cinquefoil *Potentilla newberryi*	CNPS 2	May-Aug	Perennial herb	Not observed during Project surveys
Brownish beaked-rush *Rhynchospora capitellata*	CNPS 2	Jul-Aug	Perennial herb (rhizomatous)	Not observed during Project surveys
Sanford's arrowhead *Sagittaria sanfordii*	CNPS 1B	May-Oct	Perennial herb (rhizomatous)	Not observed during Project surveys
Long-stiped campion *Silene occidentalis* ssp. *longistipitata*	CNPS 1B	Jun-Aug	Perennial herb	Not observed during Project surveys
English Peak greenbriar *Smilax jamesii*	CNPS 1B	May-Aug	Perennial herb (rhizomatous)	Not observed during Project surveys
Marsh hedge nettle *Stachys palustris* ssp. *pilosa*	CNPS 2	Jun-Aug	Perennial herb (rhizomatous)	Not observed during Project surveys
Siskiyou clover *Trifolium siskiyouense*	CNPS 3	Jun-July	Perennial herb	Not observed during Project surveys
Greene's tuctoria *Tuctoria greenei*	CNPS 3	May-Jul (Sept)	Annual herb	Not observed during Project surveys
Oval-leaved viburnum *Viburnum ellipticum*	CNPS 2	May-June	Shrub (deciduous)	Not observed during Project surveys

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Abies concolor	white fir	n	Pinaceae
Acer circinatum	vine maple	n	Aceraceae
Acer macrophyllum	bigleaf maple	n	Aceraceae
Achillea millefolium	yarrow	n	Asteraceae
Achyrachaena mollis	blow-wives	n	Asteraceae
Adenocaulon bicolor	trail plant	n	Asteraceae
Adiantum sp.	maiden-hair fern	n	Pteridaceae
Aesculus californica	California buckeye	n	Hippocastanaceae
Agoseris retrorsa	mountain dandelion	n	Poaceae
Aira caryophyllea	silver hairgrass	x	Poaceae
Allium amplectens	narrowleaf onion	n	Liliaceae
Allium sp. (not a rare taxon)	onion	n	Liliaceae
Alnus rhombifolia	white alder	n	Betulaceae
Amsinckia sp.	fiddleneck	n	Boraginaceae
Anaphalis margaritacea	pearly everlasting	n	Asteraceae
Apocynum androsaemifolium	dogbane	n	Apocynaceae
Apocynum cannabinum	Indian hemp	n	Apocynaceae
Arabidopsis thaliana (cf)	mouse-ear cress	n	Brassicaceae
Arceuthobium americanum	dwarf misletoe	n	Viscaceae
Arctostaphylos patula	green-leaf manzanita	n	Ericaceae
Arctostaphylos viscida ssp. *viscida*	smooth white manzanita	n	Ericaceae
Arctostaphylos spp.	manzanita	n	Ericaceae
Aristolochia californica	California dutchman's pipe	n	Aristolochiaceae
Artemesia douglasiana	mugwort	n	Asteraceae
Asarum hartwegii	Hartweg's wildginger	n	Aristolochiaceae
Asclepias sp.	milkweed	n	Asclepiadaceae
Athysanus pusillus	common sandweed	n	Brassicaceae
Avena barbata	oat	x	Poaceae
Avena sp.	wild oats	x	Poaceae
Balsamorhiza deltoidea	balsamroot	n	Asteraceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Balsamorhiza macrolepis var. *macrolepis*	big-scale balsamroot	n	Asteraceae
Barbarea orthoceras	American yellowrocket	n	Brassicaceae
Berberis aquifolium	Oregon grape	n	Berberidaceae
Berberis aquifolium var. *repens*	creeping Oregon grape	n	Berberidaceae
Brickellia sp.	brickellbush	n	Asteraceae
Bromus diandrus	ripgut brome	x	Poaceae
Bromus hordeaceus	soft chess	x	Poaceae
Bromus madritensis ssp. *Rubens*	red brome	x	Poaceae
Bromus tectorum	cheatgrass	x	Poaceae
Callitriche sp.	waterstarwort	n	Callitrichaceae
Calocedrus decurrens	incense cedar	n	Cupressaceae
Calochortus monophyllus	yellow startulip	n	Liliaceae
Calochortus tolmiei	Tolmie startulip	n	Liliaceae
Calyptridium sp.	pussypaws	n	Portulacaceae
Cardamine californica	milkmaids	n	Brassicaceae
Cardaria pubescens	whitetop	x	Brassicaceae
Carex multicaulis	sedge	n	Cyperaceae
Carex spp. (not rare taxa)	sedges	n	Cyperaceae
Castilleja applegatei	wavy-leaved Indian paintbrush	n	Scrophulariaceae
Castilleja applegatei ssp. *pinetorum*	wavyleaf paintbrush	n	Scrophulariaceae
Castilleja attenuata	valley tassels	n	Scrophulariaceae
Castilleja sp.	Indian paintbrush	n	Scrophulariaceae
Ceanothus cuneatus	buckbrush	n	Rhamnaceae
Ceanothus integerrimus	deerbrush	n	Rhamnaceae
Ceanothus lemmonii	California lilac	n	Rhamnaceae
Ceanothus prostratus	squawcarpet	n	Rhamnaceae
Centaurea solstitialis	yellow star thistle	x	Asteraceae
Cerastium glomeratum	mouse-ear chickweed	x	Caryophyllaceae
Cercis occidentialis	California redbud	n	Fabaceae
Cercocarpus betuloides	birchleaf mountain mahogany	n	Rosaceae
Chamomilla suaveolens	pineapple weed	x	Asteraceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Chimaphila umbellata	pipsissewa	n	Ericaceae
Chlorogalum pomeridianum	soap plant	n	Liliaceae
Chorizanthe polygonoides var. *polygonoides*	knotweed spineflower	n	Polygonaceae
Cirsium vulgare	bullthistle	x	Asteraceae
Claytonia exigua ssp. *exigua*	pale springbeauty	n	Portulacaceae
Claytonia parviflora ssp. *parviflora*	narrowleaf miner's lettuce	n	Portulacaceae
Claytonia rubra ssp. *rubra*	red-stemmed miner's lettuce	n	Portulacaceae
Collinsia sparsiflora	spinster's blue eyed Mary	n	Scrophulariaceae
Conium maculatum	poison hemlock	x	Apiaceae
Convolvulus arvensis	field bindweed	x	Convolvulaceae
Convolvulus sp.	morning glory	varies	Convolvulaceae
Cornus nuttallii	mountain dogwood	n	Cornaceae
Cornus sericea	creek dogwood	n	Cornaceae
Cynoglossum grande	Pacific hound's tongue	n	Boraginaceae
Cynosurus dactylis	dogtail	x	Poaceae
Cynosurus echinatus	dogtail grass	x	Poaceae
Cystopteris fragilis	fragile fern	n	Dryopteridaceae
Darmera peltata	umbrella plant	n	Saxifragaceae
Delphinium nudicaule	red larkspur	n	Ranunculaceae
Dicentra formosa	Pacific bleedingheart	n	Papaveraceae
Dichelostemma capitatum	blue dicks	n	Liliaceae
Dichelostemma multiflorum	Wild hyacinth	n	Liliaceae
Dodecatheon hendersonii	mosquito bills	n	Primulaceae
Draba sp.	draba	n	Brassicaceae
Equisetum arvense	horsetail	n	Equisetaceae
Equisetum hyemale ssp. *affine*	scouring rush	n	Equisetaceae
Equisetum sp.	horsetail	n	Equisetaceae
Eriogonum sp.	buckwheat	n	Polygonaceae
Eriophyllum lanatum	woolly sunflower	n	Asteraceae
Erodium brachycarpum	storks-bill filaree	x	Geraniaceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Erodium cicutarium	redstem stork's bill	x	redstem stork's bill
Erysimum capitatum ssp. *capitatum*	western wallflower	n	Brassicaceae
Eschscholzia californica	California poppy	n	Papaveraceae
Euphorbia crenulata	Chinese caps	n	Euphorbiaceae
Fraxinus latifolia	Oregon ash	n	Oleaceae
Fritillaria recurva	scarlet fritillary	n	Liliaceae
Galium aparine	goose grass	n	Rubiaceae
Galium bolanderi	Bolander's bedstraw	n	Rubiaceae
Geranium molle	wild geranium	x	Geraniaceae
Gilia sinistra ssp. *sinistra*	miniature gilia	n	Polemoniaceae
Gilia tricolor ssp. *diffusa*	bird's eyes	n	Polemoniaceae
Heuchera micrantha	crevice alumroot	n	Saxifragaceae
Hordeum sp.	barley	x	Poaceae
Hydrophyllum capitatum var. *alpinum*	woolen-breeches	n	Hydrophyllaceae
Hypericum perforatum	Klamath weed	x	Hypericaceae
Iris pseudacorus	pale yellow iris	n	Iridaceae
Juglans californica	California black walnut	n	Juncaceae
Juncus effusus	rush	n	Juncaceae
Juncus spp.	rushes	n	Juncaceae
Juncus tenuis	rush	n	Juncaceae
Kelloggia galioides	kelloggia	n	Rubiaceae
Lactuca serriola	prickly lettuce	x	Asteraceae
Lathyrus sulphureus	snub peavine	n	Fabaceae
Lepidium sp.	peppergrass	x	Brassicaceae
Lesquerella occidentalis ssp. *occidentalis*	western bladderpod	n	Brassicaceae
Limnanthes alba ssp. *versicolor*	white meadowfoam	n	Limnanthaceae
Linanthus parviflorus	false babystars	n	Polemoniaceae
Linaria vulgaris	toadflax, butter-and-eggs	x	Scrophulariaceae
Lithospermum ruderale	western gromwell	n	Boraginaceae
Lolium perenne	ryegrass	x	Poaceae
Lomatium sp.	lomatium	n	Apiaceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Lonicera hispidula	chaparral honeysuckle	n	Caprifoliaceae
Lonicera interrupta	chaparral honeysuckle	n	Caprifoliaceae
Lotus micranthus	desert deervetch	n	Fabaceae
Lotus sp.	lotus	n	Fabaceae
Lotus wrangelianus	Chilean trefoil	n	Fabaceae
Lupinus bicolor	bicolor lupine	n	Fabaceae
Lupinus nanus	sky lupine	n	Fabaceae
Lupinus pachylobus	big-pod lupine	n	Fabaceae
Lupinus sp.	lupine	n	Fabaceae
Luzula comosa	wood rush	n	Juncaceae
Marah sp.	man-root, wild cucumber	n	Cucurbitaceae
Medicago lupulina	yellow trefoil	x	Fabaceae
Medicago polymorpha	burclover	x	Fabaceae
Melissa officinalis	bee balm	x	Lamiaceae
Microseris acuminata	Sierra foothill silverpuffs	n	Asteraceae
Mimulus bicolor	yellow and white monkeyflower	n	Scrophulariaceae
Minuartia californica	California sandwort	n	Caryophyllaceae
Monardella sp.	coyote mint	n	Lamiaceae
Nasella sp.	needlegrass	n	Poaceae
Nemophila heterophylla	fivespot	n	Hydrophyllaceae
Nemophila pedunculata	meadow nemophila	n	Hydrophyllaceae
Odontostomum hartwegii	Hartweg's odontostomum	n	Liliaceae
Osmorhiza chilensis	sweet cicely	n	Apiaceae
Paxistima myrsinites	Oregon boxwood	n	Celastraceae
Pectocarya pusilla	little combseed	n	Boraginaceae
Pedicularis densiflora	Indian warrior	n	Scrophulariaceae
Pentagramma triangularis	goldback fern	n	Pteridaceae
Petrorhagia dubia	hairy pink	x	Caryophyllaceae
Petrorhagia dubia	hairypink	x	Caryophyllaceae
Philadelphus lewisii	mock orange	n	Philadelphaceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Phlox gracilis	annual phlox	n	Polemoniaceae
Phoradendron villosum	oak mistletoe		Viscaceae
Phoradendron villosum	Pacific mistletoe	n	Viscaceae
Pinus ponderosa	ponderosa pine	n	Pinaceae
Pinus sabiniana	foothill pine (grey pine)		Pinaceae
Plagiobothrys austinae	Austin's allocarya	n	Boraginaceae
Plagiobothrys canescens	grey popcornflower	n	Boraginaceae
Plagiobothrys fulvus	fulvous popcornflower	n	Boraginaceae
Plantago erecta	rock plantago	n	Plantaginaceae
Plantago lanceolata	narrowleaf plantain	x	Plantaginaceae
Plantago sp.	plantain	varies	Plantaginaceae
Platanus racemosa	western sycamore	n	Platanaceae
Plectritis ciliosa ssp. *ciliosa*	longspur seablush	n	Valerianaceae
Poa bulbosa	bulbous bluegrass	x	Poaceae
Poa sp.	bluegrass	varies	Poaceae
Polygala cornuta	milkwort	n	Polygalaceae
Polypodium calirhiza	polypody		Polypodiaceae
Polystichum imbricans ssp. *imbricans*	cliff sword fern	n	Dryopteridaceae
Polystichum munitum	sword fern	n	Dryopteridaceae
Populus fremontii ssp. *fremontii*	Fremont's cottonwood	n	Salicaceae
Potentilla sp.	cinquefoil	n	Ranunculaceae
Prunella vulgaris	self heal	n	Lamiaceae
Prunus subcordata	wild cherry	n	Rosaceae
Pseudotsuga menziesii var. *menziesii*	Douglas-fir	n	Pinaceae
Pteridium aquilinum var. *pubescens*	bracken fern	n	Dennstaedtiaceae
Pyrola picta	whiteveined wintergreen	n	Ericaceae
Quercus chrysolepis	canyon live oak	n	Fagaceae
Quercus douglasii	blue oak	n	Fagaceae
Quercus garryana	Oregon white oak	n	Fagaceae
Quercus kelloggii	California black oak	n	Fagaceae
Quercus lobata	valley oak	n	Fagaceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Quercus wislizenii	interior live oak	n	Fagaceae
Ranunculus glaberrimus	smooth buttercup	n	Ranunculaceae
Ranunculus sp.	buttercup	varies	Ranunculaceae
Rhamnus illicifolia	holly-leaf redberry	n	Rhamnaceae
Rhamnus rubra	Sierra coffeeberry	n	Rhamnaceae
Rhamnus tomentella	hoary coffeeberry	n	Rhamnaceae
Ribes nevadense	Sierra currant	n	Grossulariaceae
Ribes roezlii ssp. *roezlii*	Sierra gooseberry	n	Grossulariaceae
Rosa gymnocarpa	wood rose	n	Rosaceae
Rubus discolor	Himalayan blackberry	x	Rosaceae
Rubus laciniatus	cut-leaved blackberry	x	Rosaceae
Rumex crispus	curly dock	x	Polygonaceae
Sagina apetala	pearlwort	n	Caryophyllaceae
Salix exigua	narrow-leaved willow	n	Salicaceae
Salix laevigata	red willow	n	Salicaceae
Salix spp.	willow	n	Salicaceae
Sambucus sp.	elderberry	n	Caprifoliaceae
Sanicula bipinnatifida	purple sanicle	n	Apiaceae
Sanicula tuberosa	sanicle	n	Apiaceae
Scirous spp.	tules	n	Cyperaceae
Selaginella hansenii	spike-moss	n	Selaginellaceae
Senecio jacobaea	tansy ragwort	x	Asteraceae
Senecio triangularis	arrow butterweed	n	Asteraceae
Sherardia arvensis	field madder	x	Rubiaceae
Sisyrinchium bellum	blue eyed-grass	n	Iridaceae
Sisyrinchium sp.	blue-eyed grass	n	Iridaceae
Stellaria sp.	chickweed	varies	Caryophyllaceae
Symphoricarpos albus	common snowberry	n	Caprifoliaceae
Symphoricarpos sp.	snowberry	n	Caprifoliaceae
Taeniatherum caput-medusae	Medusa-head	x	Poaceae
Taraxacum officinale	common dandelion	x	Asteraceae

Table E.2.7-2. Plant Species Observed During 2003 and 2008 Botanical Resource Studies

Scientific Name	Common Name	Native/Exotic	Family
Taxus brevifolia	Pacific yew	n	Taxaceae
Thysanocarpus curvipes	sand fringepod	n	Brassicaceae
Tonella tenella	lesser baby innocence	n	Scrophulariaceae
Torilis arvensis	torilis	x	Apiaceae
Toxicodendron diversilobum	poison oak	n	Anacardiaceae
Tragopogon dubius	yellow salsify	x	Asteraceae
Trientalis latifolia	starflower woodland star	n	Primulaceae
Trifolium depauperatum var. *depauperatum*	dwarf sack clover	n	Fabaceae
Trifolium dubium	shamrock	x	Fabaceae
Trifolium hirtum	rose clover	x	Fabaceae
Trifolium monanthum	mountain carpet clover	n	Fabaceae
Trifolium sp.	clover	varies	Fabaceae
Trifolium willdenovii	tomcat clover	n	Fabaceae
Trillium albidum	giant white wakerobin	n	Liliaceae
Triphysaria eriantha ssp. *eriantha*	butter 'n' eggs	n	Scrophulariaceae
Triteleia hyacinthina	white brodiaea	n	Liliaceae
Typha latifolia	broad-leaved cattail	n	Typhaceae
Umbellularia californica	California bay	n	Lauraceae
Verbascum blattaria	moth mullein	x	Scrophulariaceae
Vicia sativa ssp. *nigra*	common vetch	x	Fabaceae
Vicia americana var. *americana*	American vetch	n	Fabaceae
Vicia villosa ssp. *villosa*	hairy vetch	x	Fabaceae
Viola bakeri	Baker's violet	n	Violaceae
Viola lobata ssp. integrifolia	violet	n	Violaceae
Vitis californica	California wild grape	n	Vitaceae
Vulpia microstachys var. *confusa*	confusing fescue	n	Poaceae
Vulpia sp.	vulpia	varies	Poaceae
Zigadenus venenosus	death camas	n	Liliaceae

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
CHG1	cottonwood, white alder, valley oak, walnut, blackberry, willow, wild grape, redbud	85	50	No	15
CHG2	cottonwood, white alder, valley oak, walnut, blackberry, willow, wild grape, redbud	70	30	No	15
CHG3	cottonwood, white alder, valley oak, walnut, blackberry, willow, wild grape, redbud	80	50	No	20
CHG4	white alder, valley oak, blackberry, willow, wild grape, redbud	80	60	No	35*
CSC1	white alder, willow, blackberry, herbaceous, sedges	95	40	No	30
CSC2	white alder, ash, bigleaf maple, blackberry, willow, herbaceous, sedges,	90	20	No	10
CSC3	white alder, ash, bigleaf maple, willow, blackberry, herbaceous, sedges	90	10	No	25*
CSC4	white alder, ash, bigleaf maple, willow, blackberry, herbaceous, sedges	90	20	No	25
CSC5	white alder, ash, bigleaf maple, willow, blackberry, herbaceous, sedges	90	15	No	25
CSC6	white alder, ash, bigleaf maple, willow, blackberry, herbaceous, sedges	95	30	No	25
CSC7	white alder, ash, bigleaf maple, willow, blackberry, herbaceous, sedges	99	15	No	25
CSC8	white alder, ash, bigleaf maple, blackberry, herbaceous, sedges	95	15	No	40
CSC9	white alder, ash, bigleaf maple, California bay, blackberry, herbaceous, sedges	95	25	No	40
CSC10	white alder, willow, blackberry, herbaceous, sedges	95	25	No	20
CSC11	white alder, willow, blackberry, herbaceous, sedges	95	15	No	20
CSC12	white alder, bigleaf maple, ash, willow, blackberry, herbaceous, sedges	85	40	No	20

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
CSC13	white alder, bigleaf maple, ash, willow, blackberry, herbaceous, sedges	60	40	No	20
CSC14	white alder, bigleaf maple, ash, willow, blackberry, herbaceous, sedges	95	30	No	25
CSC15	white alder, willow, blackberry, herbaceous, sedges	99	20	No	20
CSC16	white alder, bigleaf maple, California bay, willow, blackberry, poison oak, herbaceous, sedges	95	35	No	20
CSC17	white alder, bigleaf maple, California bay, cottonwood, willow, blackberry, poison oak, herbaceous, sedges	95	35	No	40*
CSC18	white alder, bigleaf maple, California bay, willow, blackberry, poison oak, herbaceous, sedges	80	20	No	20
CSC19	white alder, bigleaf maple, California bay, willow, blackberry, poison oak, herbaceous, sedges	90	20	No	20
CSC20	white alder, California bay, cottonwood, creek dogwood, willow, blackberry, poison oak, herbaceous, sedges	90	15	No	25
CSC21	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	95	15	No	50*
CSC22	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	90	15	No	20
CSC23	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	95	15	No	40
CSC24	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	90	15	No	20
CSC25	white alder, willow, herbaceous, sedges	80	30	No	50*
CSC26	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	90	15	No	20
CSC27	white alder, California bay, ash, willow, blackberry, poison oak, herbaceous, sedges	90	20	No	50*
CSC28	white alder, cottonwood, ash, willow, blackberry, poison oak, herbaceous, sedges	95	20	No	25

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
CSC29	white alder, cottonwood, ash, willow, blackberry, poison oak, herbaceous, sedges	95	20	No	60*
CSC30	white alder, cottonwood, ash, willow, blackberry, poison oak, herbaceous, sedges	95	20	No	25
CSC31	white alder, cottonwood, willow, blackberry, poison oak, herbaceous, sedges	80	10	No	20
CSC32	white alder, cottonwood, willow, blackberry, poison oak, herbaceous, sedges	99	30	No	35*
KOC1	white alder, bigleaf maple, vine maple, willow, herbaceous	90	30	No	20
KOC2	white alder, bigleaf maple, cottonwood, vine maple, willow, herbaceous	50	15	No	30*
KOC3	white alder, bigleaf maple, vine maple, willow, herbaceous	20	15	No	20
KOC4	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	40	12	No	30
KOC5	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous, sedges	80	30	No	20
KOC6	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	20
KOC7	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	20
KOC8	bigleaf maple, vine maple, willow, herbaceous	95	30	No	30*
KOC9	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	30
KOC10	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	30
KOC11	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	80	25	No	30
KOC12	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	60	25	No	30
KOC13	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	30

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
KOC14	white alder, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	30	No	20
KOC15	white alder, bigleaf maple, mountain dogwood, vine maple, willow, blackberry, herbaceous	20	10	No	15
KOC16	white alder, bigleaf maple, mountain dogwood, vine maple, willow, blackberry, herbaceous	80	15	No	15
KOC17	white alder, bigleaf maple, mountain dogwood, vine maple, willow, blackberry, herbaceous	20	8	No	15
KOC18	white alder, bigleaf maple, mountain dogwood, vine maple, willow, blackberry, herbaceous	20	8	No	500*
KOC19	white alder, bigleaf maple, mountain dogwood, vine maple, willow, blackberry, herbaceous	90	15	No	30
KOC20	white alder, cottonwood, willow, herbaceous	10	10	No	20
KOC21	white alder, cottonwood, bigleaf maple, willow, herbaceous	10	15	No	30
KOC22	white alder, cottonwood, bigleaf maple, willow, herbaceous	40	10	No	40*
KOC23	white alder, cottonwood, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	90	25	No	20
KOC24	white alder, cottonwood, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	70	30	No	30*
KOC25	white alder, cottonwood, bigleaf maple, mountain dogwood, vine maple, willow, herbaceous	95	25	No	20
KOC26	white alder, cottonwood, vine maple, willow, herbaceous	40	15	No	20
KOC27	white alder, bigleaf maple, vine maple, willow, herbaceous	99	15	No	20
KOC28	white alder, vine maple, willow, herbaceous	100	30	No	30

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
KOC29	white alder, vine maple, willow, herbaceous	95	30	No	20
KOC30	white alder, bigleaf maple, vine maple, willow, herbaceous	50	30	No	30
KOC31	white alder, bigleaf maple, vine maple, willow, herbaceous	80	25	No	20
KOC32	white alder, cottonwood, bigleaf maple, vine maple, willow, herbaceous	80	15	No	30
KOC33	white alder, bigleaf maple, vine maple, willow, herbaceous	80	15	No	40
KOC34	white alder, bigleaf maple, vine maple, willow, herbaceous	80	15	No	20
KOC35	white alder, bigleaf maple, vine maple, willow, herbaceous	90	25	No	20
KOC36	white alder, bigleaf maple, vine maple, willow, herbaceous	70	35	No	20
KOC37	white alder, bigleaf maple, vine maple, willow, herbaceous	70	25	No	30
KOC38	white alder, bigleaf maple, cottonwood, vine maple, willow, herbaceous	95	15	No	40*
KOC39	white alder, cottonwood, willow, blackberry, herbaceous	60	40	No	15
KOC40	white alder, cottonwood, willow, blackberry, herbaceous	95	20	No	15
KOC41	white alder, cottonwood, willow, blackberry, herbaceous	80	30	No	15
KOC42	white alder, cottonwood, willow, blackberry, herbaceous	70	30	No	15
KOC43	white alder, cottonwood, willow, blackberry, herbaceous	90	30	No	45
KOC44	white alder, cottonwood, willow, blackberry, herbaceous	70	35	No	15
KOC45	white alder, cottonwood, willow, blackberry, herbaceous	70	25	No	20
KSC1	white alder, bigleaf maple, mountain dogwood, vine maple, herbaceous	95	60	No	15

Table E.2.7-3. Riparian Communities Occurring in the Kilarc and Cow Creek Developments (2003)

Riparian Reach	Species Composition	Percent Cover	Average Height (ft.)	Unusual Mortality	Width of Riparian Zone (ft.)**
KNC1	white alder, bigleaf maple, mountain dogwood, vine maple, herbaceous	95	55	No	15
CM1	white alder, ash, California bay, blackberry, wild grape, sedges, and herbaceous	70	15	No	20
CM2	white alder, ash, California bay, blackberry, wild grape, sedges, and herbaceous	10	10	No	30
CM3	white alder, ash, California bay, blackberry, wild grape, sedges, and herbaceous	50	15	No	30

Notes:

Willow seedlings and young saplings were present on all reaches with bars.
*Width of riparian zone includes mid-channel islands or bars.
**Width of riparian zone is a total average of both banks.

CHG = Hooten Gulch
CSC = South Cow Creek
KOC = Old Cow Creek
KNC = North Canyon Creek
KSC = South Canyon Creek
CM = Mill Creek

E.2.8 Historical Resources

Table E.2.8-1. Architectural and Historical Resources Previously Recorded within 0.5-mile Radius

State Number	Date Recorded	Site Type	Property Type	Name/Location	Attributes	Site Record Update
CA-SHA-1764H	1989	Historic	Water systems	S. Cow Creek diversion	Diversion wing dam	482-12-02H
P-45-003241	2001	Historic	Water systems	North and South Canyon Creek		482-12-10H

Table E.2.8-2. New and Updated Architectural and Historical Resources

Site Record	State Number	Site Type	Property Type	Name/Location	Attributes
482-12-01H	Not Available	Historic	Water systems	Cow Creek Powerhouse	Hydroelectric power-generation
482-12-02H	CA-SHA-1764H	Historic	Water systems	South Cow Creek Main Canal	Diversion, ditch, bridges, forebay, penstock
482-12-03H	None	Historic	Settlement	Cow Creek caretaker's cottage	Housing foundations, utility buildings, landscape, refuse deposits
482-12-06H	None	Historic	Water systems	Kilarc Powerhouse	Hydroelectric power-generation
482-12-07H	None	Historic	Water systems	Kilarc Main Canal	Diversion, ditch, bridges, wood shacks, forebay, penstock
482-12-09H	None	Historic	Water systems	Mill Creek ditch	Diversion, ditch
482-12-10H	P-45-003241	Historic	Water systems	North and South Canyon Creek ditch	Diversion, ditch, siphon

E.2.9 Archaeological Resources

Table E.2.9-1. Archaeological Resources within 0.5-mile Radius

State Number	Date Recorded	Site Type	Property Type	Name/Location	Attributes	Site Record Update
CA-SHA-166	1958	Prehistoric	Lithic scatter	Not for Public Release	Obsidian flake scatter	No
CA-SHA-2540/H	1990	Multi-component	Lithic scatter, settlement	Not for Public Release	Stone wall, ditch, lithic scatter	No
CA-SHA-2541/H	2006	Multi-component	Lithic scatter, settlement	Not for Public Release	Housing foundations, utility buildings, landscape, refuse deposits, lithic scatter	No
No Record	1989	Prehistoric	Lithic scatter	Not for Public Release	Obsidian flake scatter	482-12-11/H
No Record	1995	Prehistoric	Isolate	Not for Public Release	Mano	No
P-45-003242	2001	Historic	Water systems	Not for Public Release		No
P-45-004319	2007	Historic	Water systems	Not for Public Release		No
No Record	1989	Historic	Settlement	Not for Public Release	Rock wall segment	No

Table E.2.9-2. New and Updated Archaeological Resources

Temporary Number	State Number	Site Type	Property Type	Name/Location	Attributes
482-12-03H	None	Historic	Settlement	Not for Public Release	Housing foundations, utility buildings, landscape, refuse deposits
482-12-04	None	Prehistoric	Lithic scatter	Not for Public Release	Obsidian flake scatter
482-12-05/H	None	Multi-component	Lithic scatter, refuse deposit	Not for Public Release	Obsidian flake scatter, historic artifact scatter
482-12-08/H	None	Multi-component	Obsidian flake, refuse deposit	Not for Public Release	Obsidian flake, historic artifact scatter
482-12-11/H	No record	Multi-component	Lithic scatter, water systems	Not for Public Release	Obsidian flake scatter, historic improved spring

E.2.10. Recreation

Table E.2.10-1. PG&E Recreational Facilities Near Project Area

PG&E Recreation Facility	Location	Facilities	Recreation Activities	Approximate Distance from Project Area (miles)
Lake Grace Day Use Area	East of Shingletown off Highway 44	10 picnic sites	Fishing, picnicking, scenic viewing	20
Lake Nora Day Use Area	East of Shingletown off Highway 44	10 picnic sites	Fishing, picnicking, scenic viewing	20
Macumber Reservoir Campground and Boat Launch	East of Redding off Highway 44. Between Shingletown and Viola	7 camping units, 5 walk-in campsites, and a nearby car-top boat launch.	Boating, fishing, camping	31
North Battle Creek Campground	East of Redding, north of Viola	10 campsites and 5 walk-in camp units	Fishing, swimming, and non-motorized boating	47

Table E.2.10-2. Shasta-Trinity National Forest Recreation Location, Facilities, and Activities (Federal)

Name of Lake or River	Location	Facilities	Recreation Activities	Approximate Distance from Project Area (miles)
Bear Creek	Near McArthur, in Shasta–Trinity National Forest	None	Fishing	60
Castle Lake	Near Mount Shasta, in Shasta–Trinity National Forest	Camp sites, picnic tables, vault toilets	Camping, fishing, swimming, hiking, picnicking, wind-surfing	110
Clear Creek	West of Redding in Shasta–Trinity National Forest	Primitive camp site	Primitive camping, fishing, swimming	54
Gumboot Lake	Near Mount Shasta, in Shasta–Trinity National Forest	Camp sites, picnic tables, vault toilets	Non-motorized boating, swimming, camping, hiking, picnicking, fishing	110
Iron Canyon Reservoir	Near Big Bend, in Shasta–Trinity National Forest	Two campgrounds, boat ramp	Boating, camping, fishing, swimming	65
Keswick Lake	Near Redding, in Shasta–Trinity National Forest	Boat ramp, day-use picnic area	Boating, fishing, jet skiing, swimming, water skiing, picnicking	50
Lake Britton	Near Fall River Mills, in Shasta–Trinity National Forest	Marina, three boat ramps, campgrounds	Boating camping, fishing, jet skiing, swimming, water skiing, picnicking, windsurfing	75
Lake Siskiyou	Near Mount Shasta, in Shasta–Trinity National Forest	Boat ramp, dock, camp sites, bathrooms with showers, marina	Boating, camping, fishing, swimming, picnicking, windsurfing	95
McCloud River	Near McCloud, in Shasta–Trinity National Forest	Four campgrounds, picnic area	Camping, fishing, swimming, rafting, picnicking	120
Picayune Lake	Near Mount Shasta, in Shasta–Trinity National Forest	None	Day use only, picnicking, swimming, trout fishing	110
Pit River	Northeast of Redding, in Shasta–Trinity National Forest	Camp sites	Camping, fishing, hot springs, swimming	30
Rock Creek	Near Lake Britton, in Shasta–Trinity National Forest	Primitive campground	Fishing, camping	50

Table E.2.10-2. Shasta-Trinity National Forest Recreation Location, Facilities, and Activities (Federal)

Name of Lake or River	Location	Facilities	Recreation Activities	Approximate Distance from Project Area (miles)
Shasta Lake	Near Redding, in Shasta–Trinity National Forest	14 boat ramps, 12 marinas, 12 campgrounds, lakeshore lodging, 400 houseboat rentals	Boating, water skiing, camping, fishing, jet skiing, swimming, windsurfing	50
Tamarack Lake	Near Castella, in Shasta–Trinity National Forest	none	Primitive camping, fishing, swimming	105
Toad Lake	Near Mount Shasta, in Shasta–Trinity National Forest	Camp sites, picnic tables, vault toilets	Camping, fishing, picnicking, hiking, swimming, wind-surfing	120
Trout Creek	Near McCloud, in Shasta–Trinity National Forest	Small campground	Camping, fishing	110
Upper Sacramento River	Near Mount Shasta, upstream of Shasta Lake in Shasta–Trinity National Forest	Camp sites, put-in sites	Camping, fishing, rafting, swimming	105
Whiskeytown Lake	Near Redding, in Shasta–Trinity National Forest	Three boat ramps, three campgrounds, picnic areas	Boating, water skiing, jet skiing, fishing, camping, swimming, wind-surfing, picnicking	50

Source: Stienstra, Tom. California Recreational Lakes and Rivers, April 2000. Stienstra, Tom. California Fishing, January 1999.

Table E.2.10-3. Lassen National Forest Recreation Location, Facilities, and Activities (Federal)

Name of Lake or River	Location	Facilities	Recreation Activities	Approximate Distance to Project Area (miles)
Digger Creek	East of Red Bluff, in Lassen National Forest	None	Fishing	40
Manzanita Lake	In Lassen Volcanic National Park	Primitive boat ramp, campground, picnic area	Non-motorized boating, camping, fishing, swimming, picnicking	45
Summit Lake	Near Manzanita Lake, in Lassen Volcanic National Park	Campground	Non-motorized boating, camping, fishing, picnicking, swimming, wind-surfing	50
Butte Lake	South of Burney in Lassen Volcanic National Park	Primitive boat ramp, campground,	Non-motorized boating, camping, fishing, swimming, picnicking, wind-surfing	75
Silver Lake	Near Westwood, in Lassen National Forest	Primitive boat ramp, two campgrounds	Non-motorized boating, camping, fishing, picnicking, swimming	100
Caribou Lake	Near Westwood, in Lassen National Forest	None	Non-motorized boating, fishing, swimming	100
Crater Lake	Near Susanville in Lassen National Forest	Boat ramp, campground	Non-motorized boating, fishing, swimming, camping	90
Eagle Lake	Near Susanville, in Lassen National Forest	Three boat ramps, several campgrounds, marina,	Boating, camping, fishing, jet skiing, swimming, water skiing, windsurfing	120
Thousand Lakes Wilderness	East of Redding, in Lassen National Forest	None	Fishing, hiking, backpacking	60
Caribou Wilderness	In Lassen National Forest	None	Fishing, hiking, backpacking	127

Source: Stienstra, Tom. California Recreational Lakes and Rivers, April 2000. Stienstra, Tom. California Fishing, January 1999.

Table E.2.10-4. Other Recreation Facilities within Close Proximity of the Project Area

Name of Hydroelectric Facility	Location	Facilities	Recreation Activities	Approximate Distance from Project Area (miles)
Baum Lake	Northeast of Burney near Cassel	Car top boat launch	Water fowl hunting, fishing, scenic and wildlife viewing	50
Big Lake	Northeast of Burney near McArthur	Boat ramp	Boating, fishing, water skiing, waterfowl hunting, scenic and wildlife viewing	67
Cassel Campground	East of Burney	27 camping units	Camping and fishing	51
Dusty Campground	North shore of Lake Britton	7 camp units	Swimming and fishing	52
Lake Grace	East of Shingletown off Highway 44	10 Picnic sites	Fishing, picnicking, scenic viewing	20
Hawkins Landing	West of Burney at Iron Canyon Reservoir Spillway	10 camping units and a boat ramp	Camping, fishing, swimming, and boating	41
Jamo Point	Lake Britton	Boat launch and a fishing access area	Fishing, boating, water skiing, and swimming.	52
Lake Nora	East of Shingletown off Highway 44	10 Picnic sites	Fishing, picnicking, scenic viewing	20
Macumber Reservoir	East of Redding off Highway 44. Between Shingletown and Viola	7 camping units, 5 walk-in campsites. There is a car-top boat launch nearby	Boating, fishing, camping	31
North Battle Creek	East of Redding, north of Viola	10 campsites and 5 walk-in camp units	Fishing, swimming, and non-motorized boating	47
Pines Picnic Area	North shore of Lake Britton	10 tables for day-use recreation	Nearby fishing and swimming opportunities	52

Source: PG&E, 2008.

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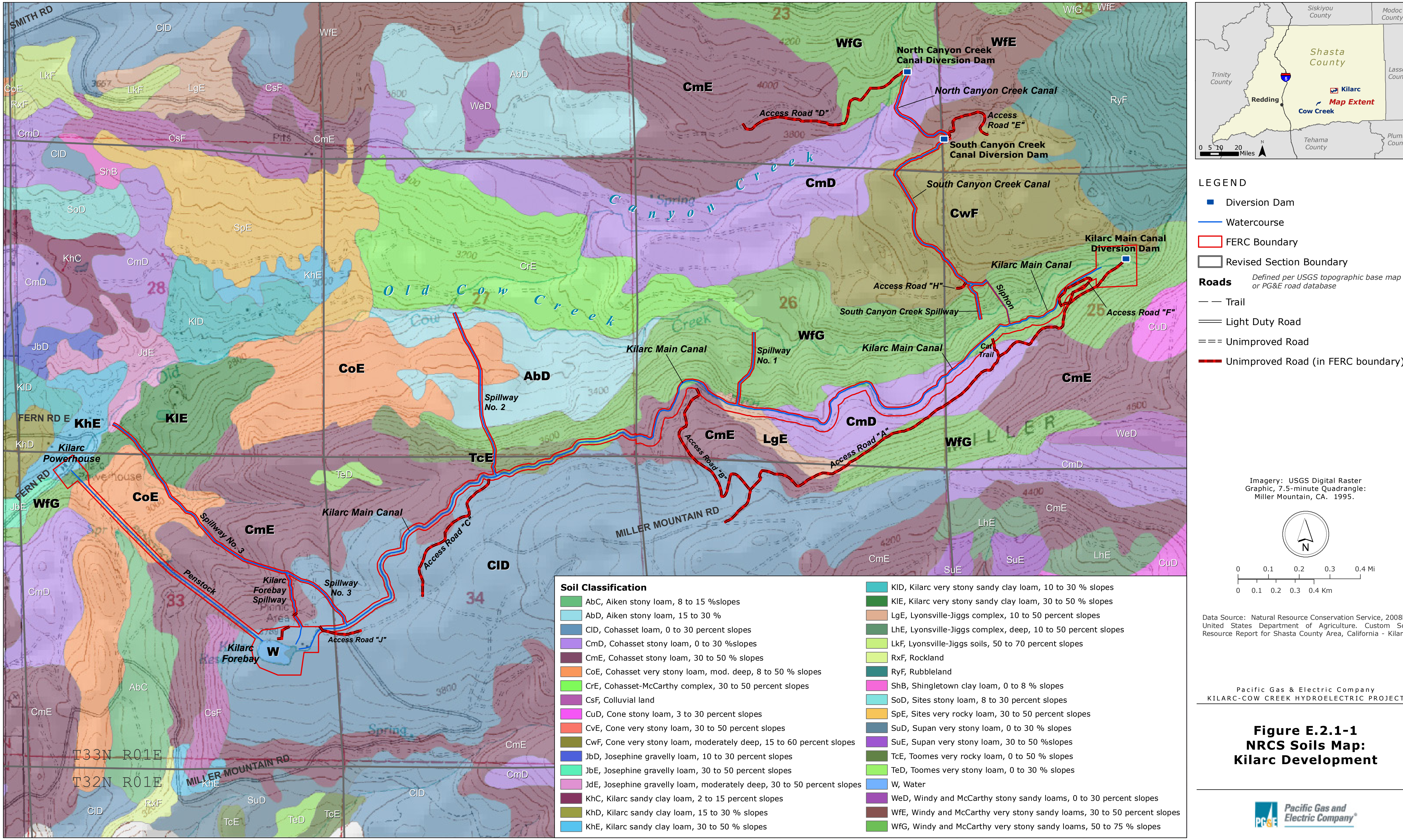

Figure E.2.1-1
NRCS Soils Map: Kilarc Development

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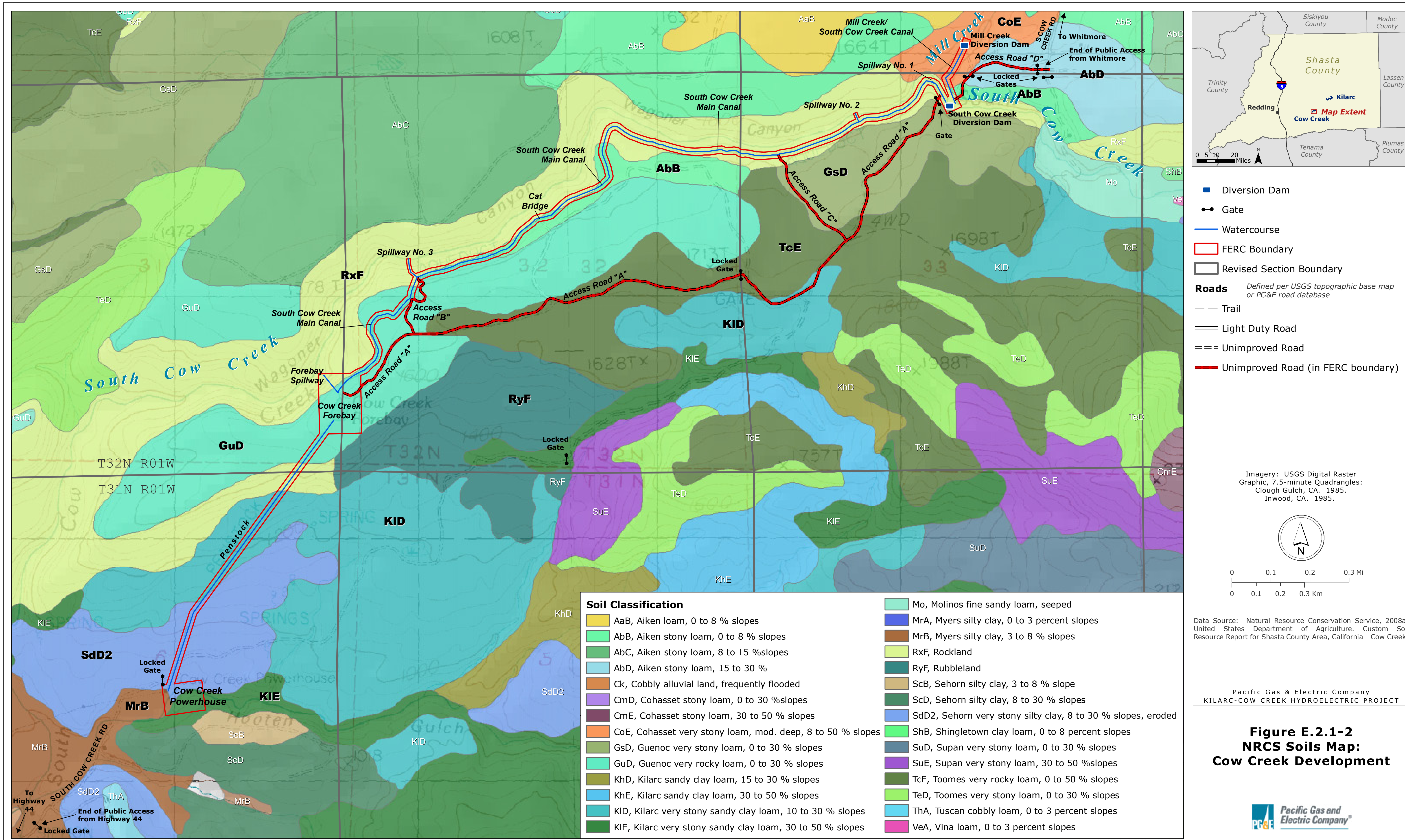

Figure E.2.1-2
NRCS Soils Map:
Cow Creek Development

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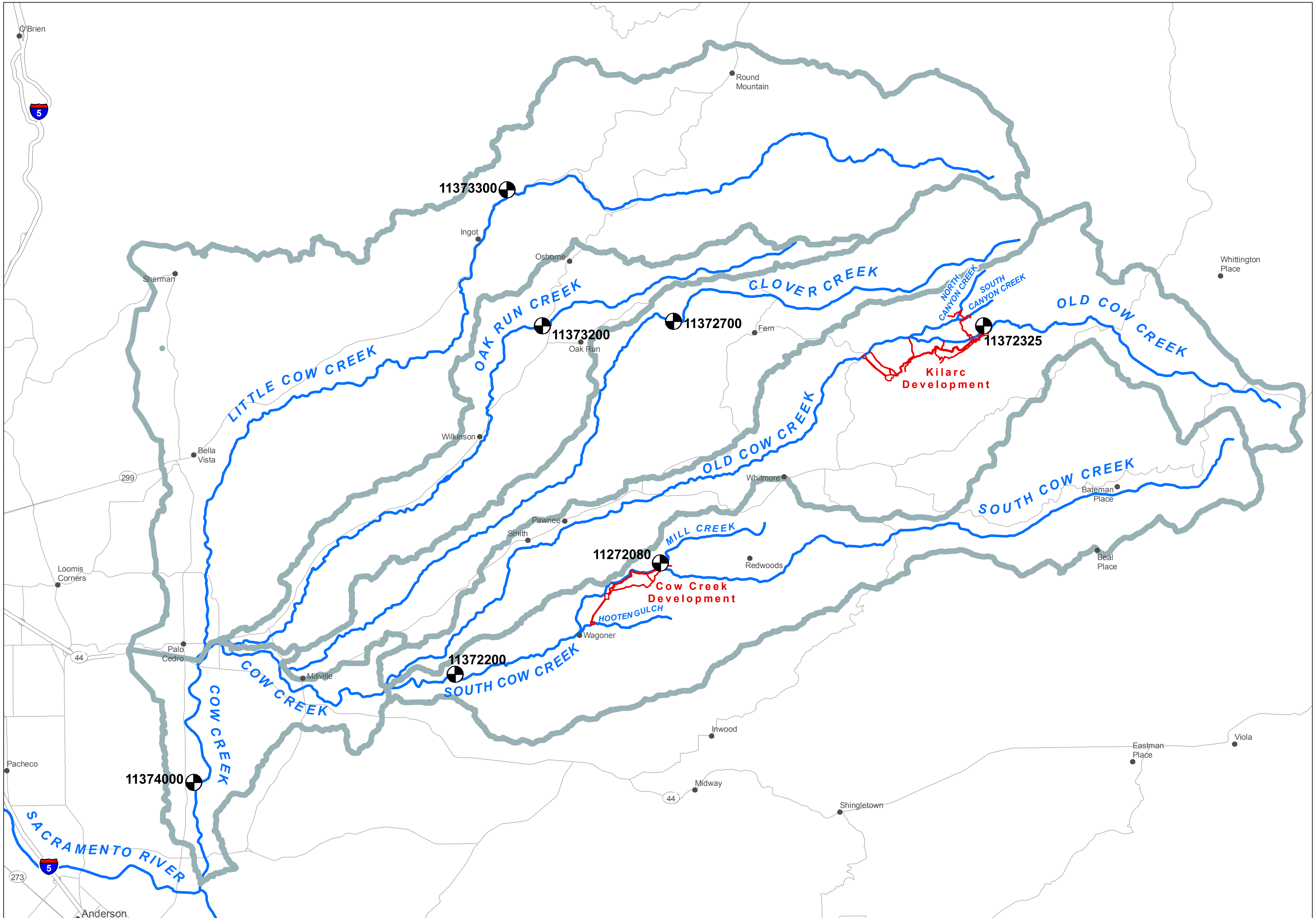

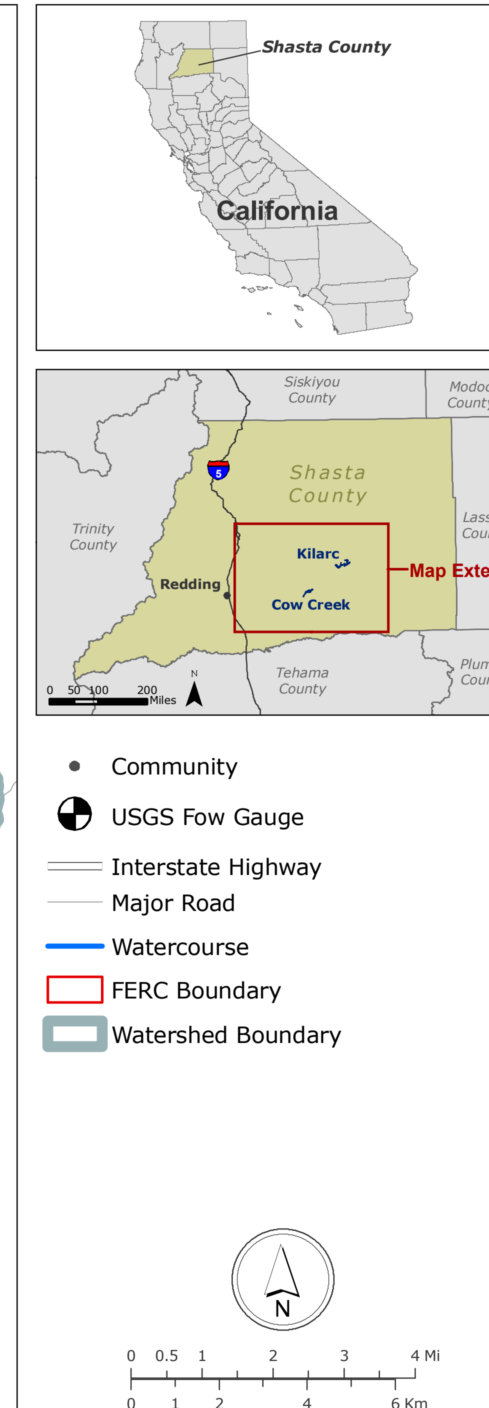

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Figure E.2.2-1
Surface Water Hydrology

Pacific Gas and Electric Company®

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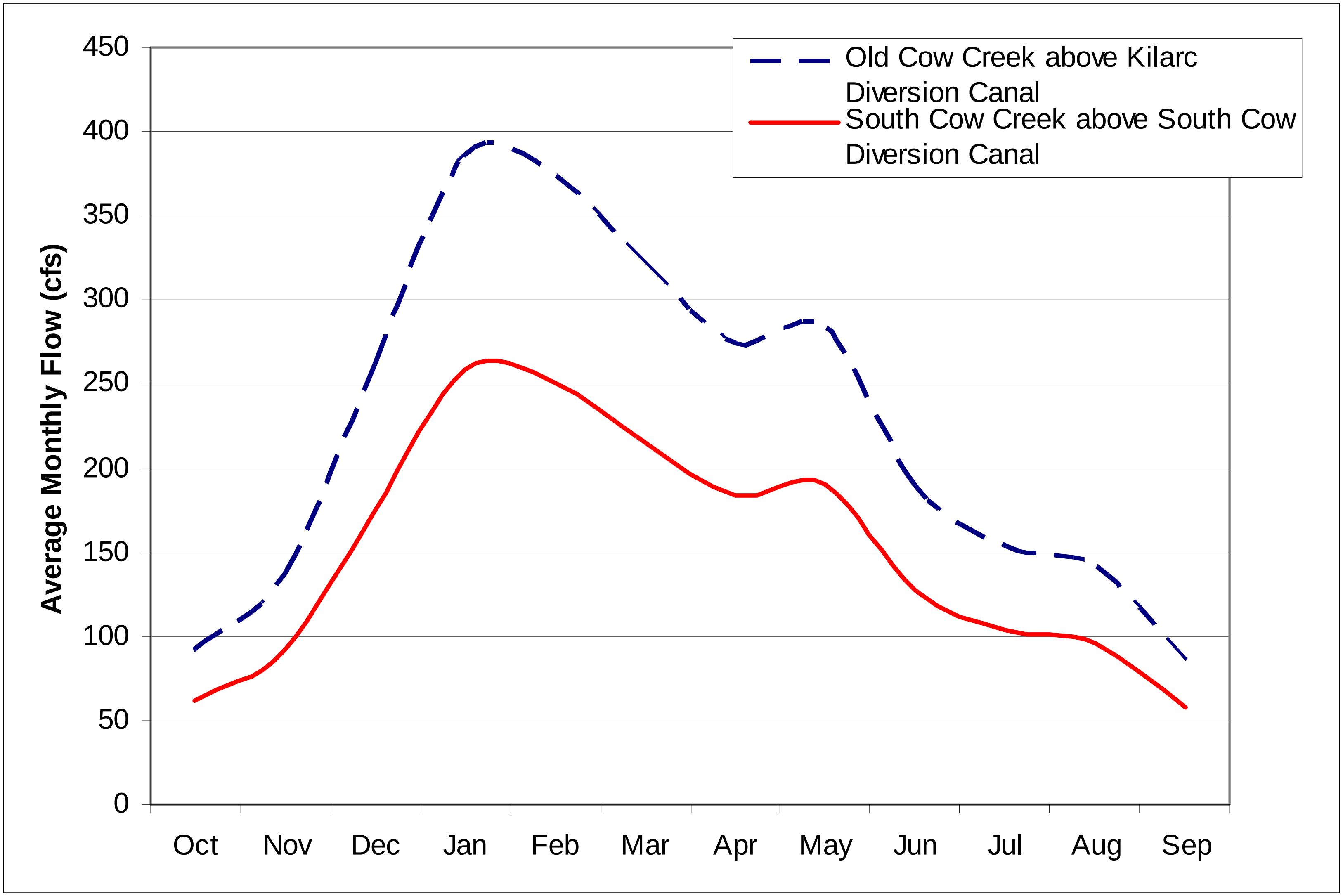
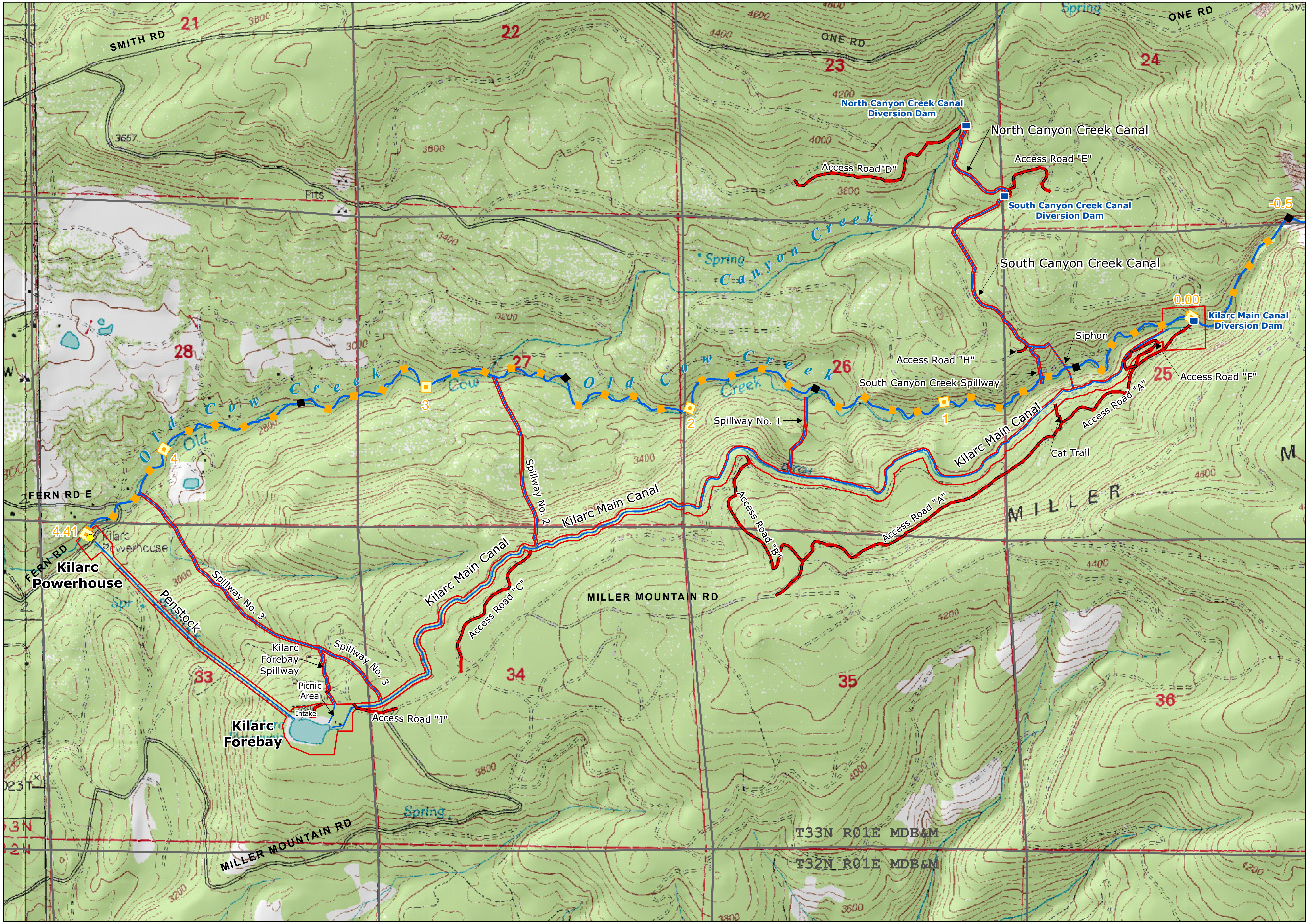
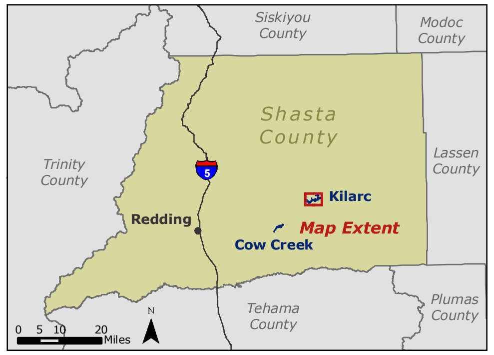


Figure E.2.2-2. **Estimated Average Monthly Flow for Old Cow Creek and South Cow Creek above Diversion Dams**





- Milepost
- Half Mile Milepost
- Tenth Mile Milepost
- Diversion
- PG&E Facility
- Watercourse
- FERC Boundary
- Revised Section Boundary

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC boundary)

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

N

0 0.1 0.2 0.3 0.4 Mi
0 0.1 0.2 0.4 Km

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.3-1 Geomorphic Reference Map for the Kilarc Development

Pacific Gas and Electric Company®

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- Milepost
- Half Mile Milepost
- Tenth Mile Milepost
- Gate
- Diversion
- PG&E Facility
- Watercourse
- Revised Section Boundary
- FERC Boundary

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC boundary)

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangles: Clough Gulch, CA. 1985. Inwood, CA. 1985.

0 0.1 0.2 0.3 0.4 Mi
0 0.1 0.2 0.4 Km

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.3-2 Geomorphic Reference Map for the Cow Creek Development

Pacific Gas and Electric Company

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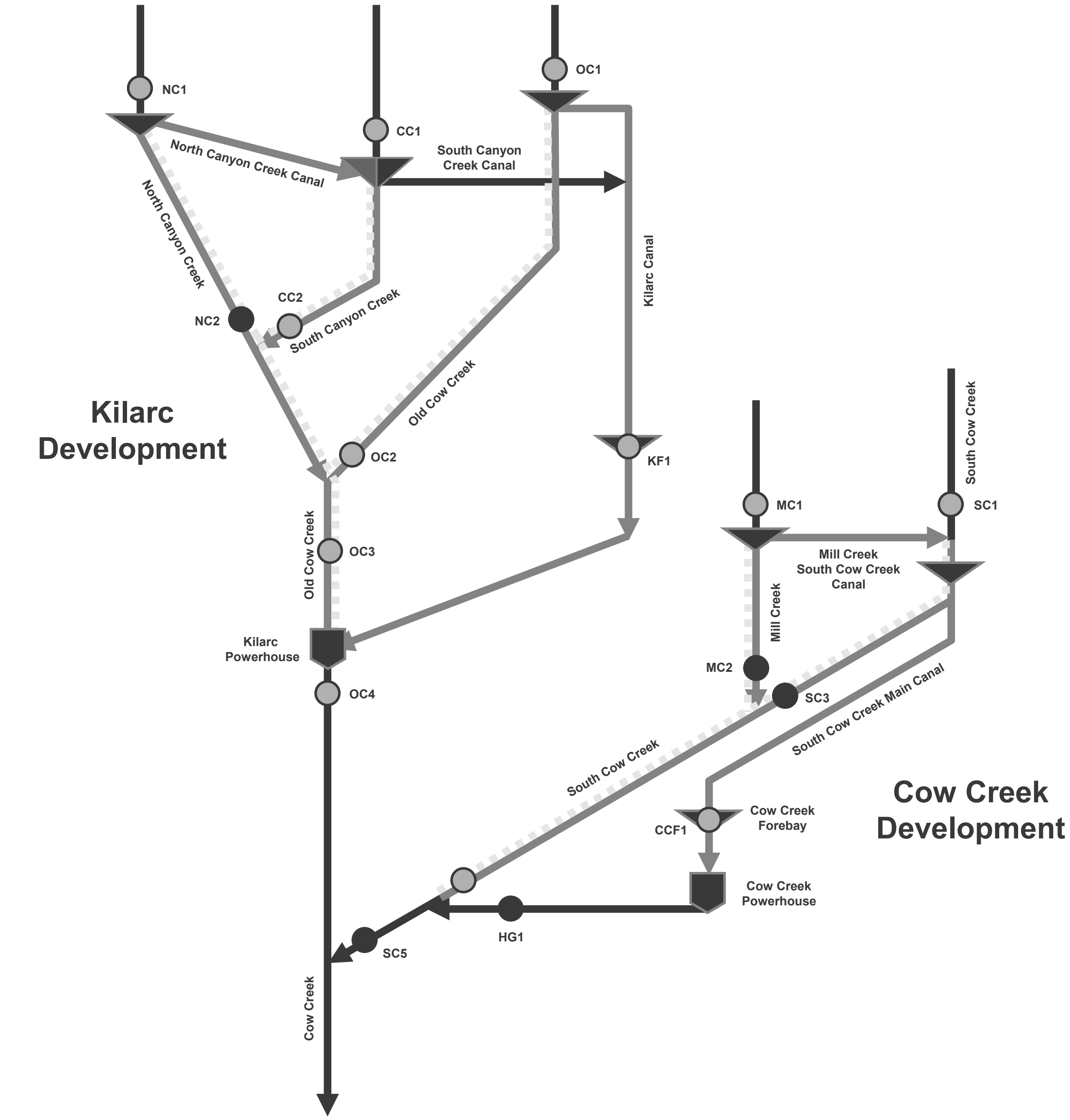

- Powerhouse
- PG&E Diversion
- Streams and Water Conveyances
- Project Area
- Bypass Stream Reaches
- Water Quality Monitoring Stations
- Temperature Monitoring Stations

Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.4-1
2003 Water Quality and Temperature Monitoring Stations

Pacific Gas and Electric Company

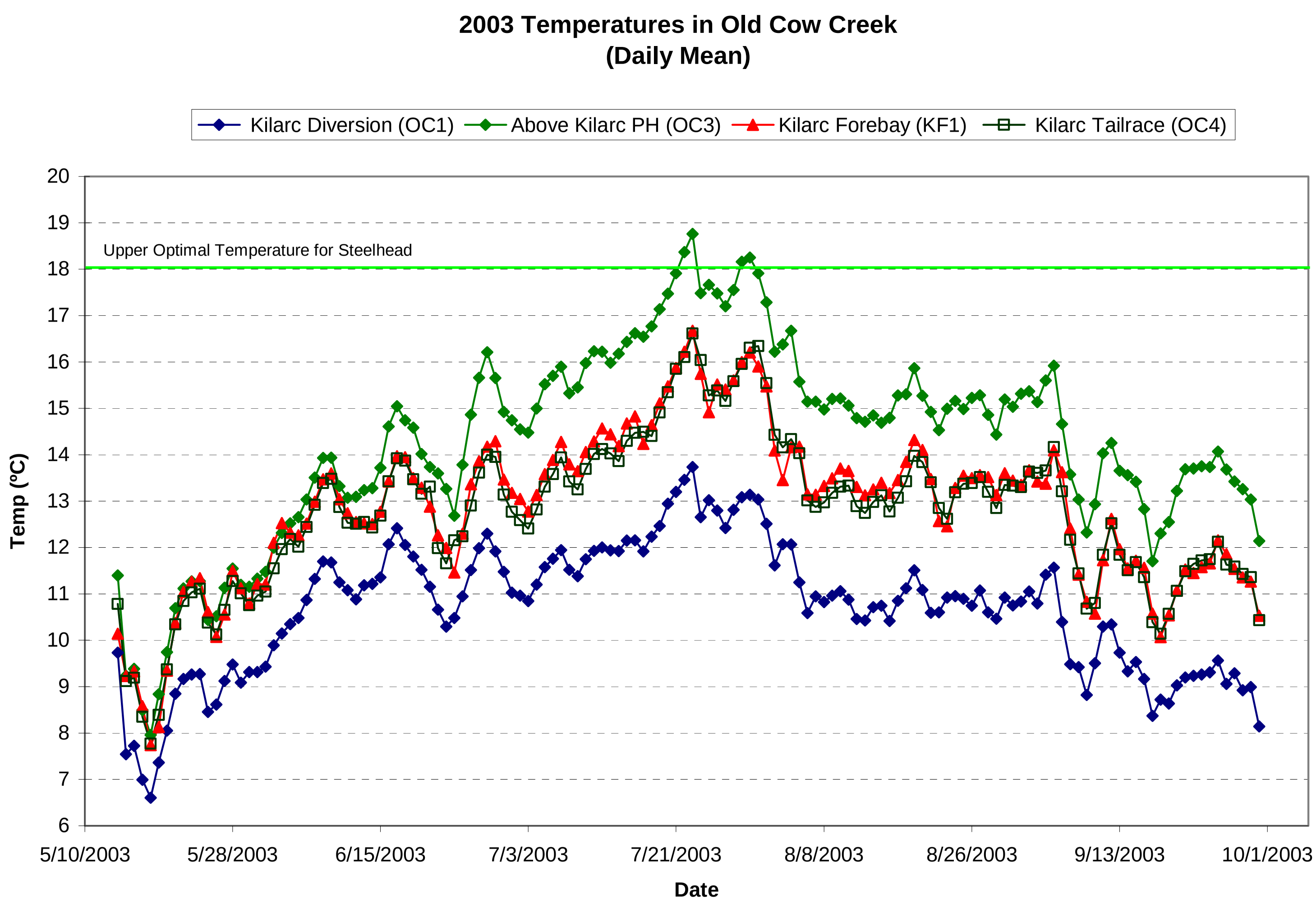

Figure E.2.4-2. Comparison of 2003 Daily Mean Temperatures, Kilarc Development

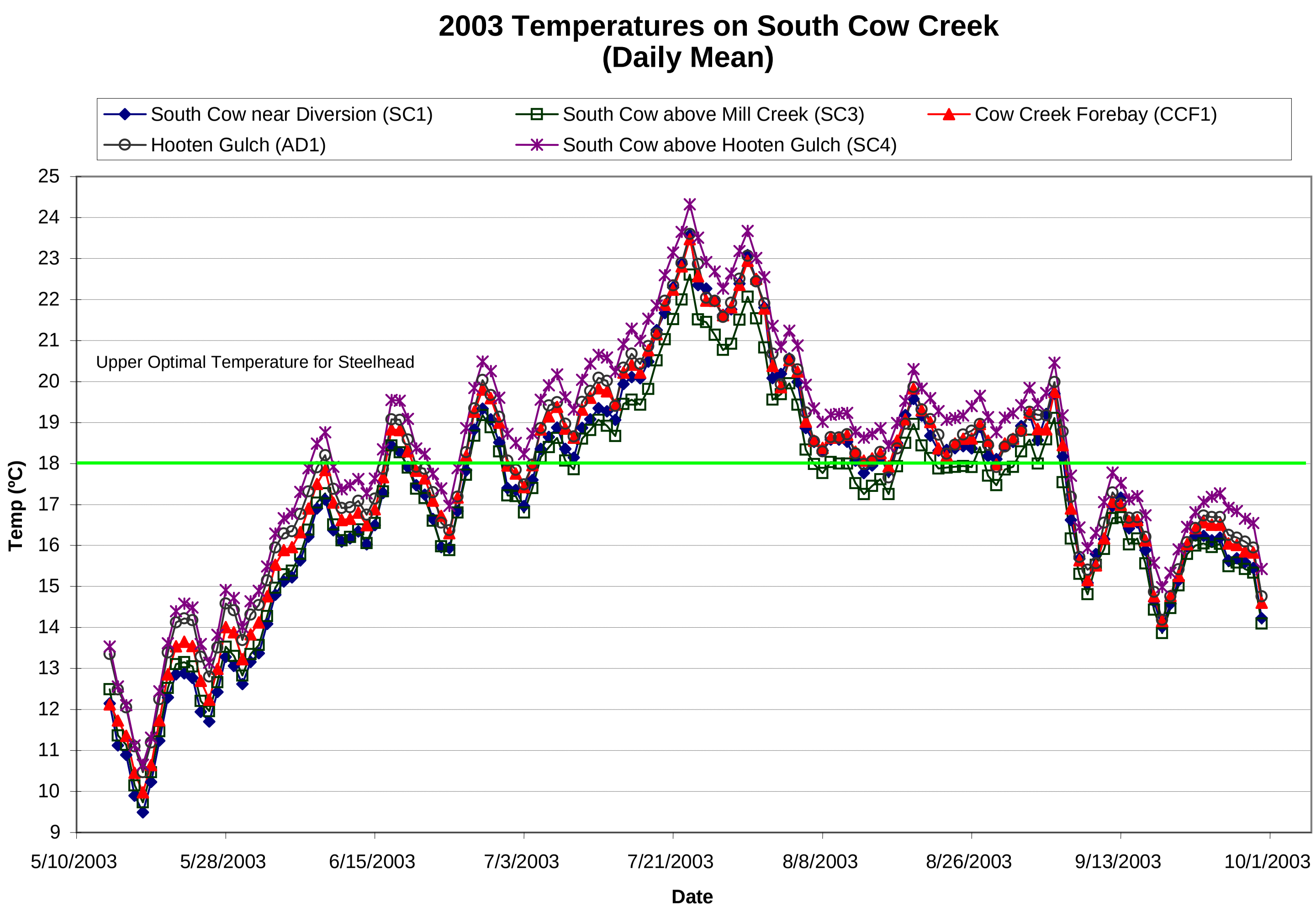

Figure E.2.4-3. Comparison of Daily Mean Temperatures, Cow Creek Development

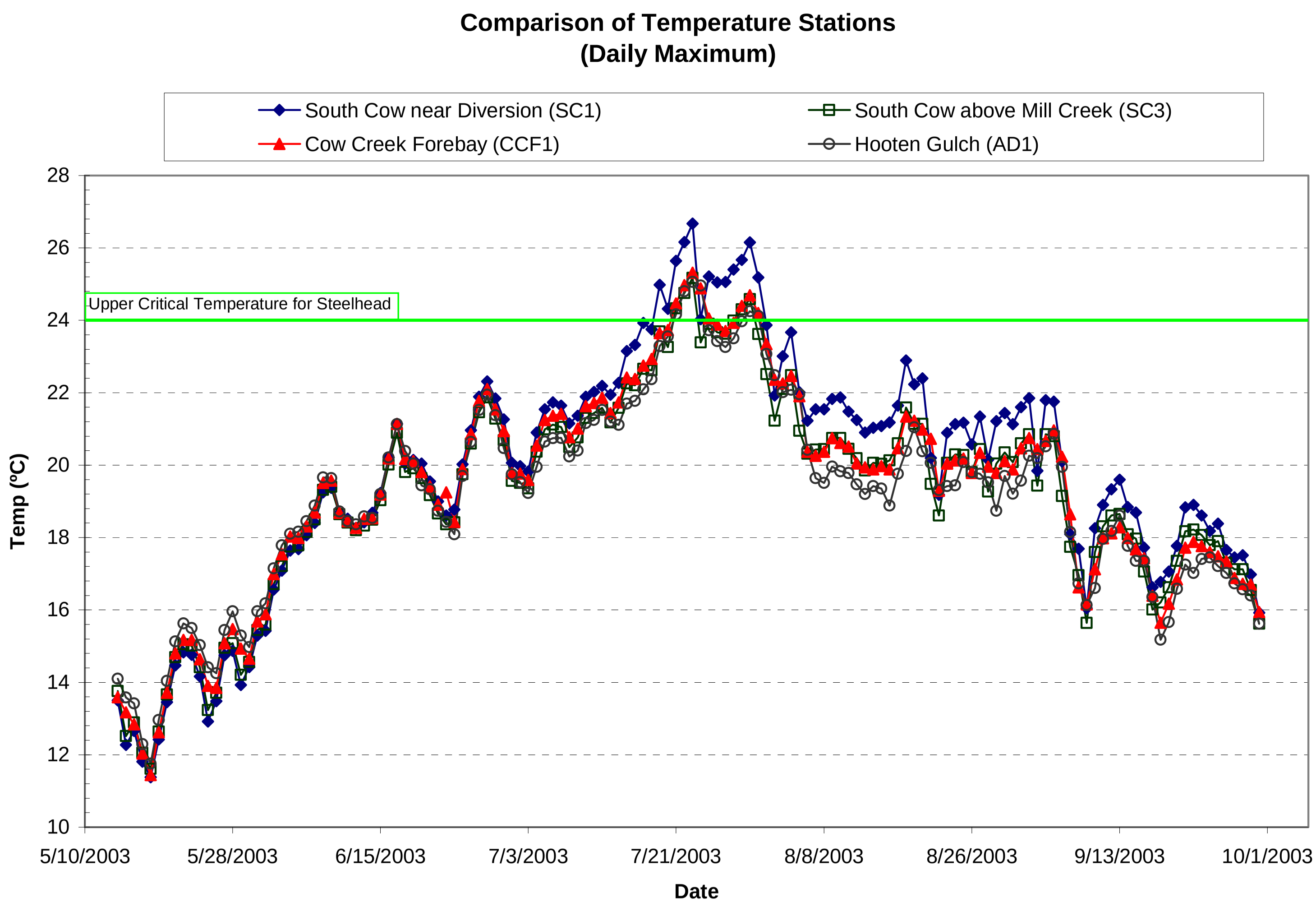

Figure E.2.4-4. Comparison of Daily Maximum Temperatures, Cow Creek Development

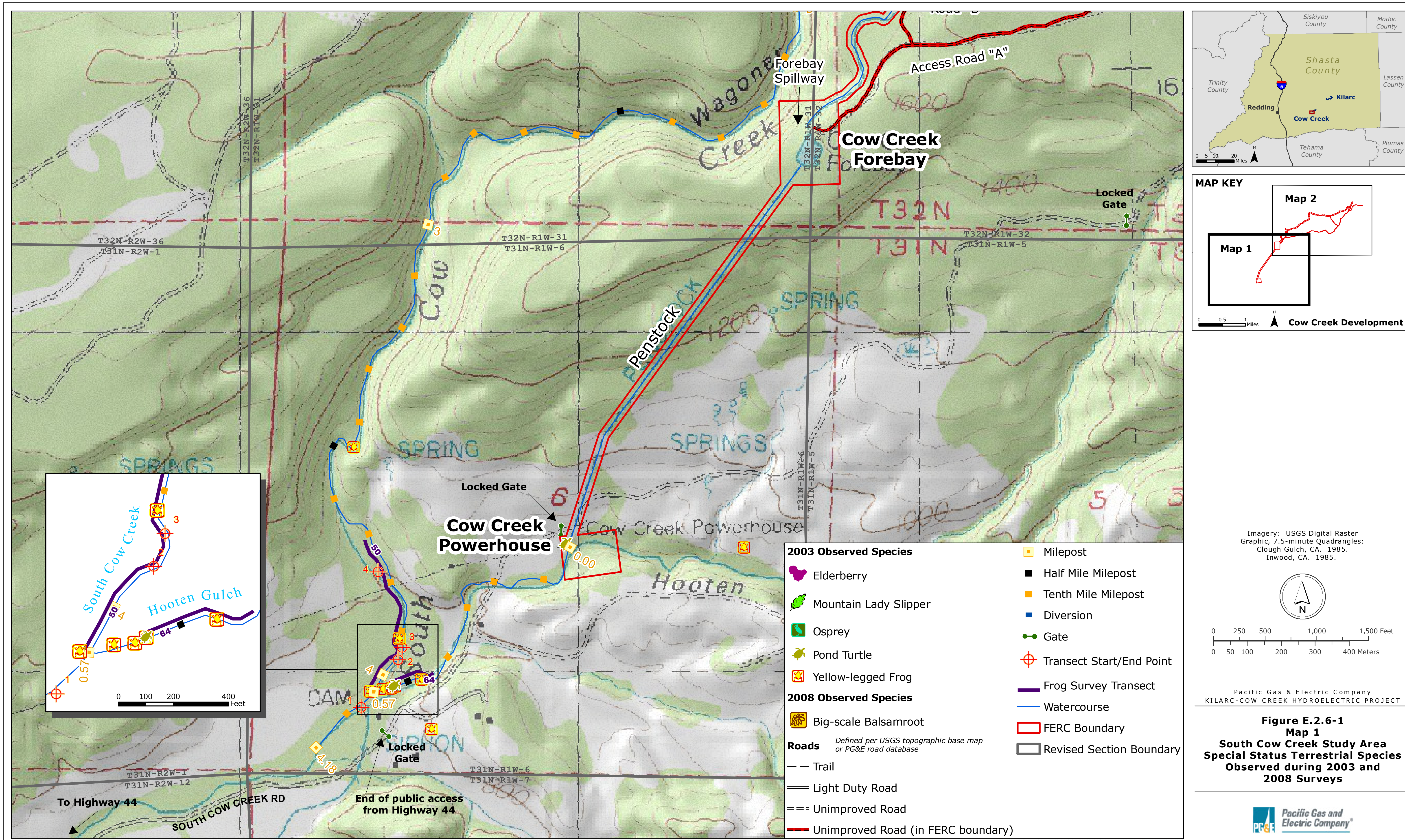

Figure E.2.6-1
Map 1
South Cow Creek Study Area
Special Status Terrestrial Species
Observed during 2003 and 2008 Surveys

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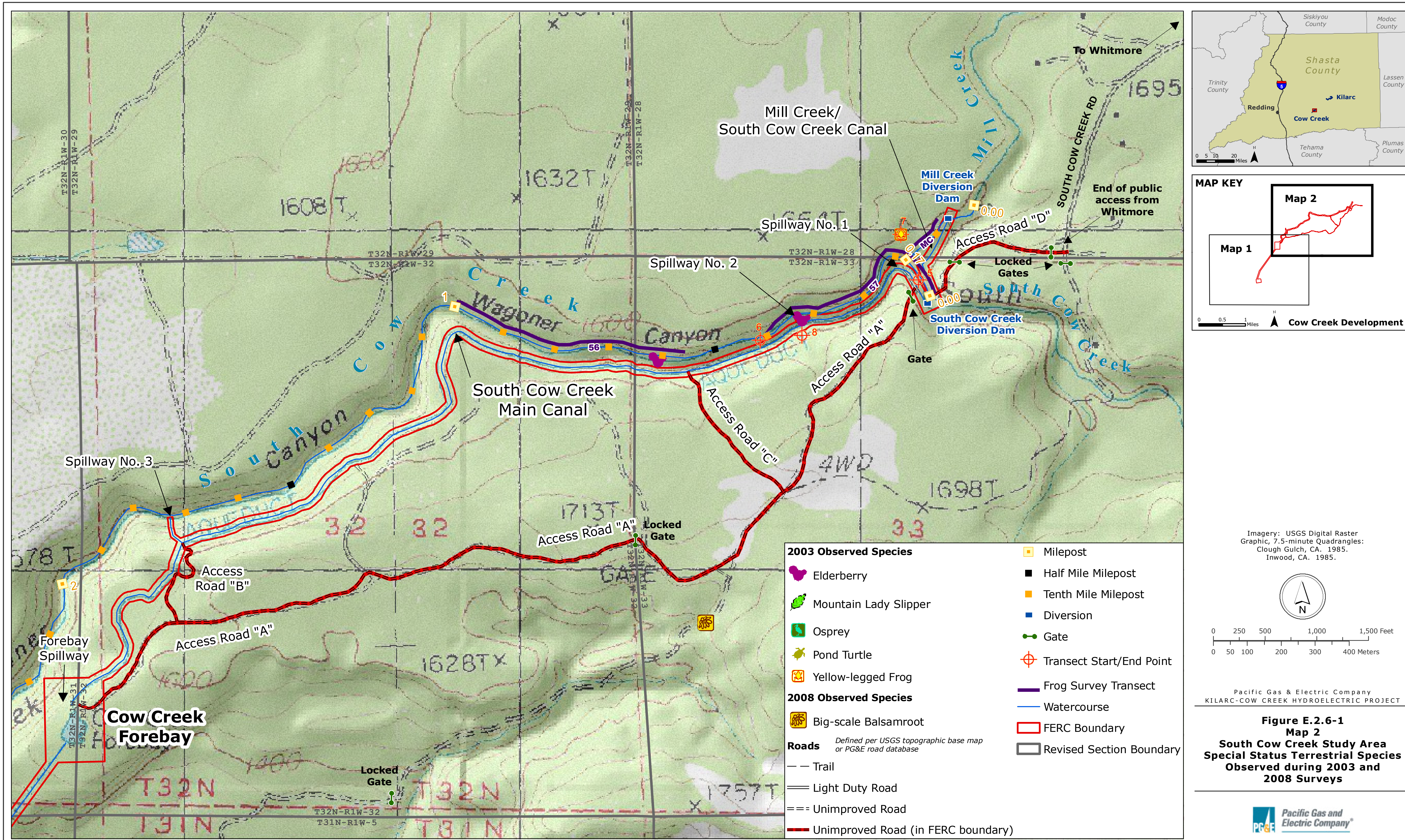

Figure E.2.6-1
Map 2
South Cow Creek Study Area
Special Status Terrestrial Species
Observed during 2003 and
2008 Surveys

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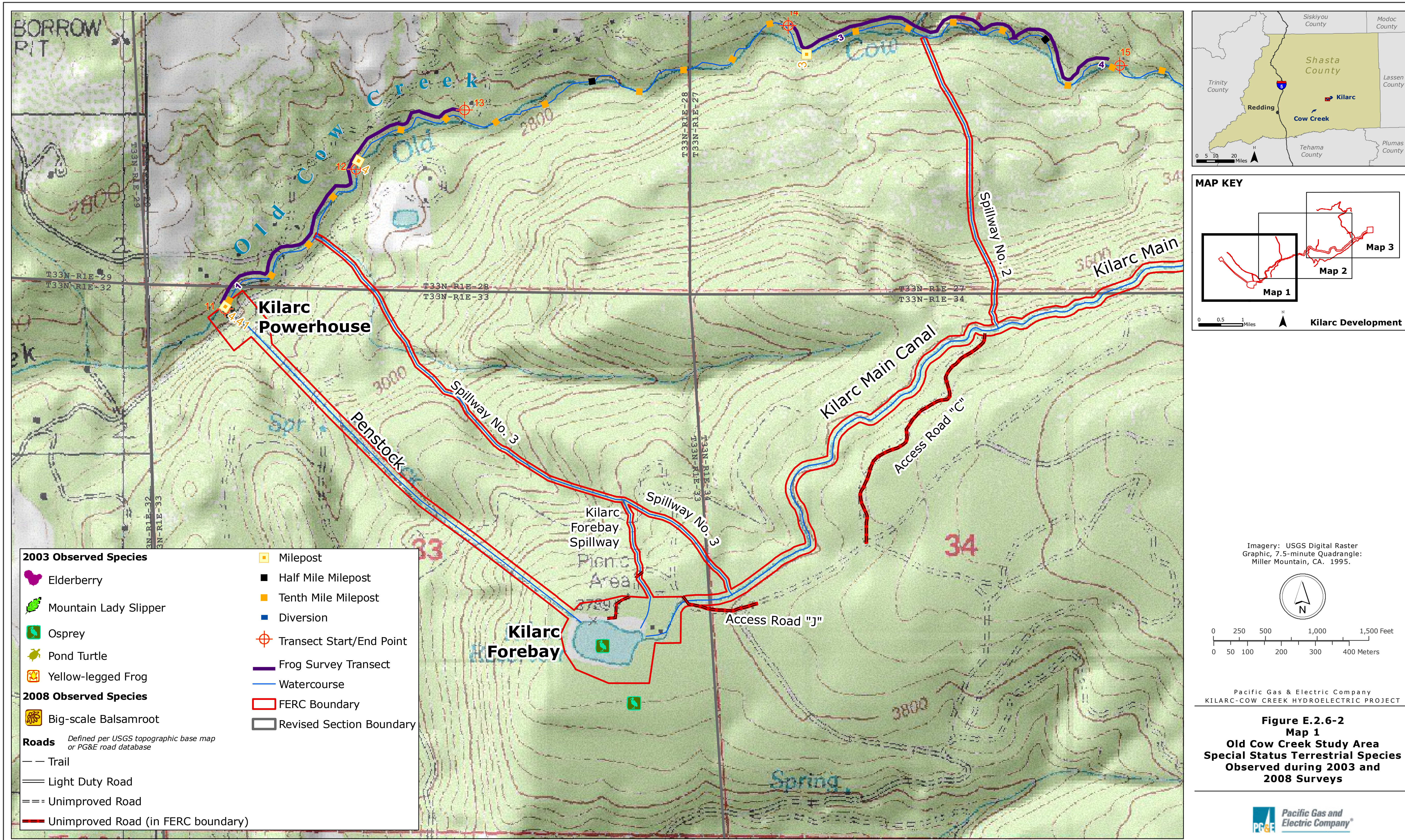

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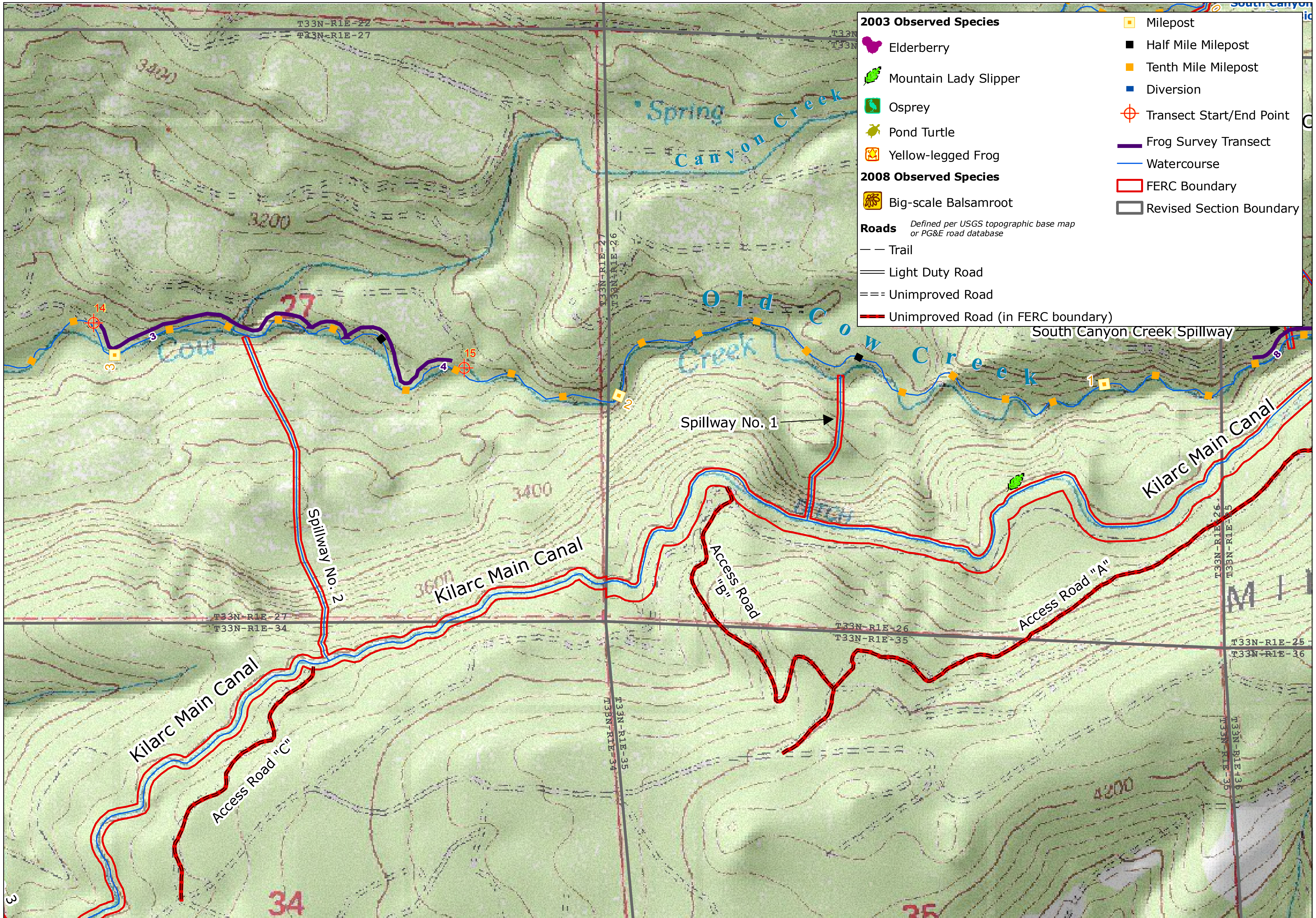
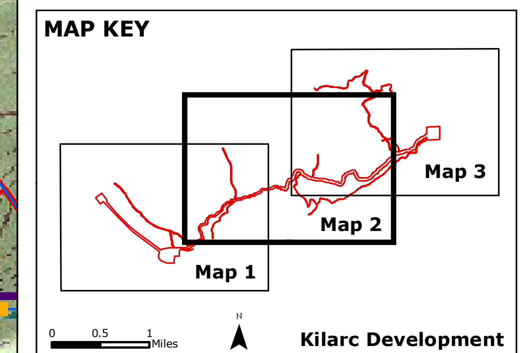
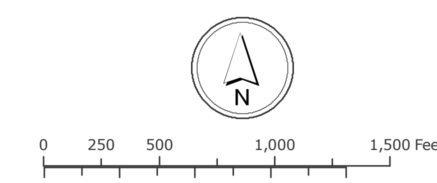
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-2
Map 1
Old Cow Creek Study Area
Special Status Terrestrial Species
Observed during 2003 and 2008 Surveys





Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.



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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-2
Map 2
Old Cow Creek Study Area
Special Status Terrestrial Species Observed during 2003 and 2008 Surveys

Pacific Gas and Electric Company

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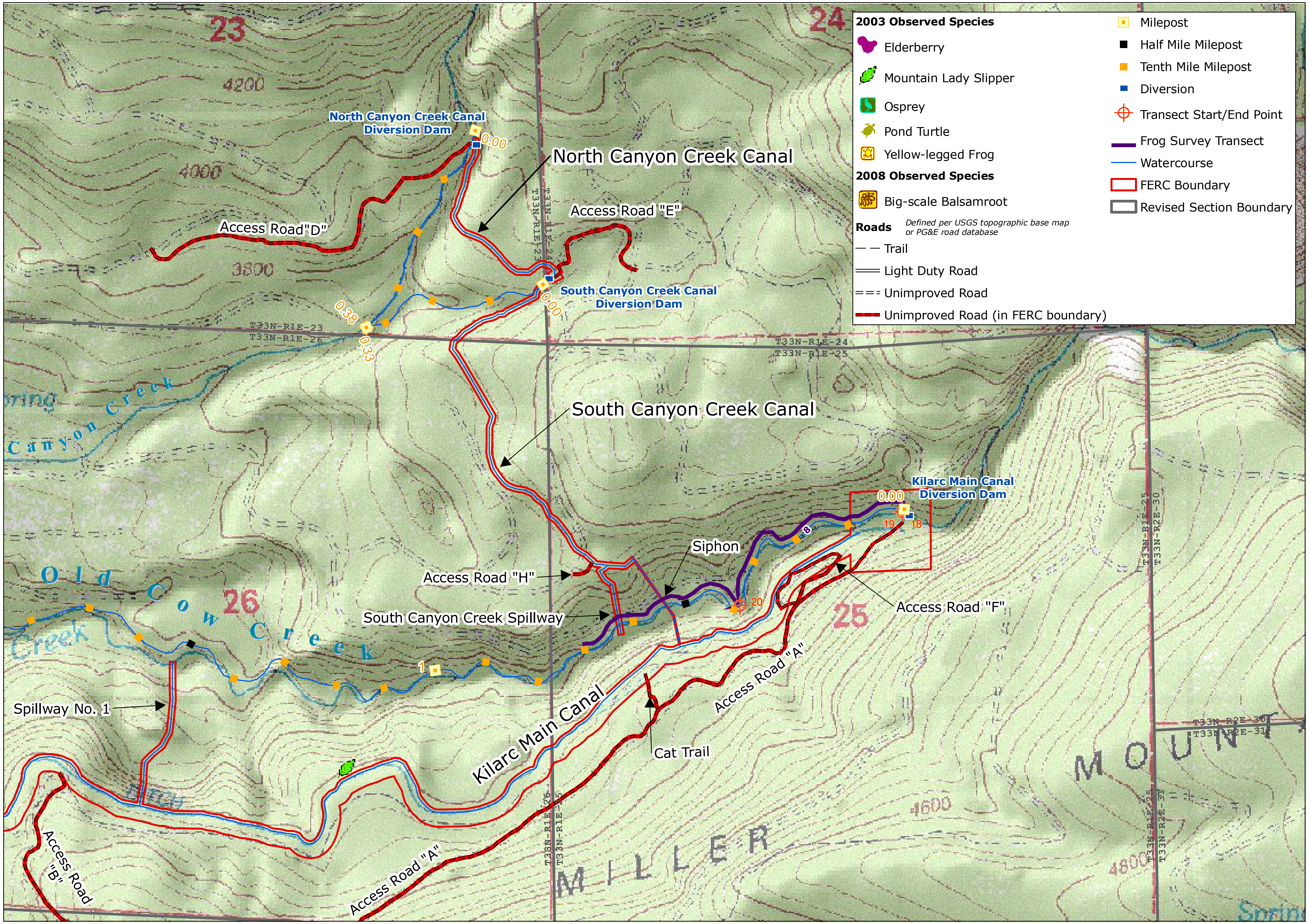

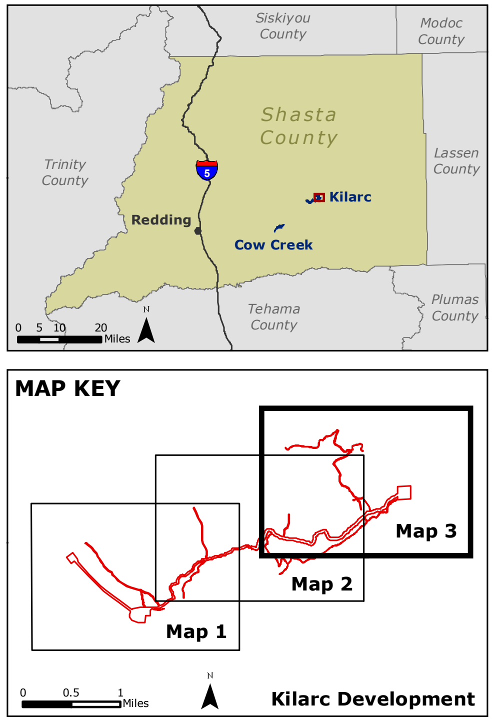

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

0 250 500 1,000 1,500 Feet
0 50 100 200 300 400 Meters

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-2
Map 3
Old Cow Creek Study Area
Special Status Terrestrial Species Observed during 2003 and 2008 Surveys

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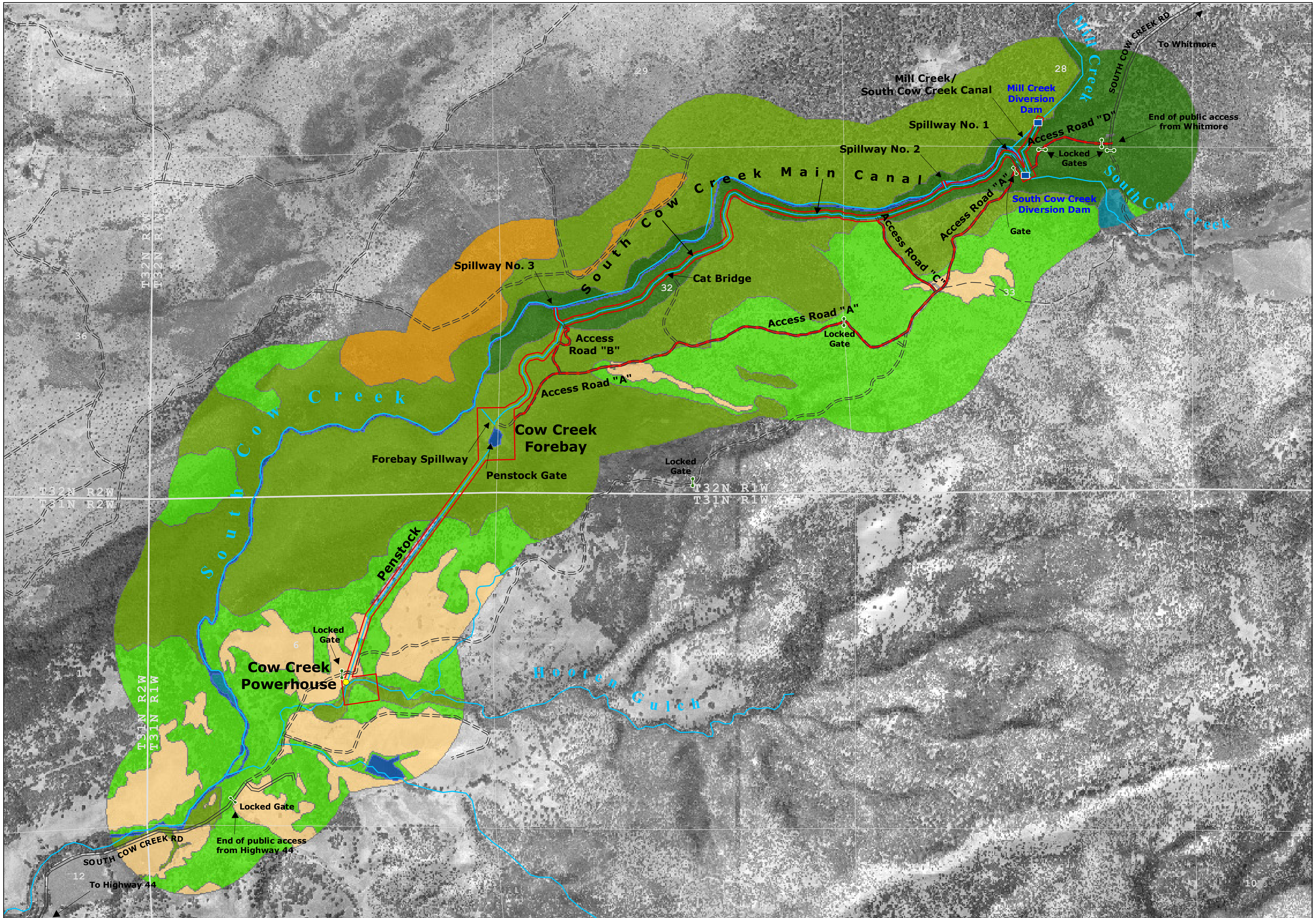

- Diversion
- PG&E Facility
- Gate
- Watercourse
- FERC Boundary
- Revised Section Boundary

Vegetation Community

- Annual grassland-chaparral-young forest
- Bare ground
- Blue oak-foothill pine woodland
- Developed
- Interior live oak woodland
- Non-native annual grassland
- Northern mixed chaparral
- Pasture
- Ponderosa plantation
- Riparian forest (white alder and mixed)
- Sierran mixed coniferous forest
- Water

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC boundary)

Imagery: USDA National Agricultural Imagery Program, 2006.

N

0 0.1 0.2 0.3 0.4 Mi

0 0.1 0.2 0.4 Km

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-3
South Cow Creek Study Area
Vegetation Communities and
Wildlife Habitats

Pacific Gas and Electric Company®

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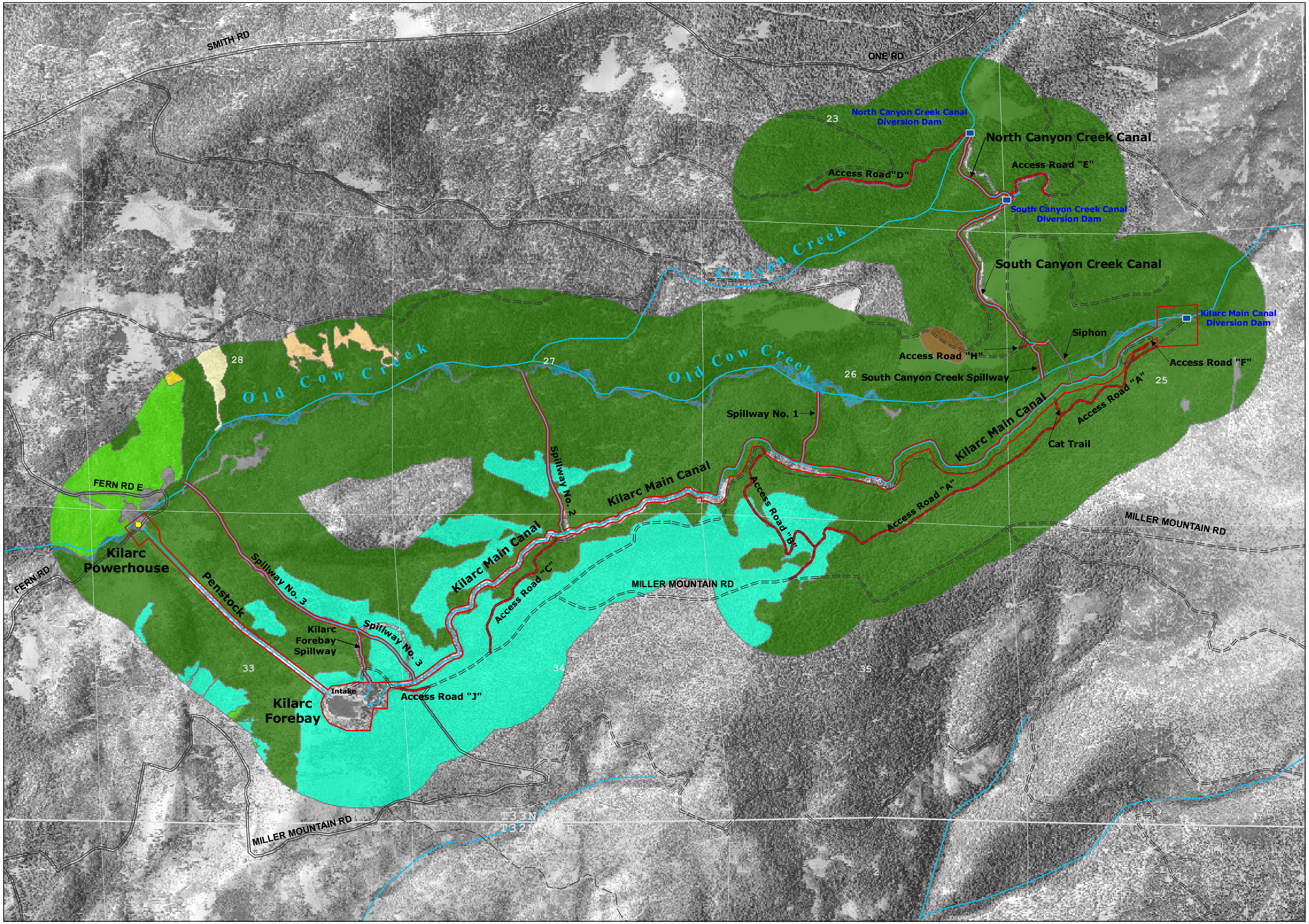

Diversion
PG&E Facility
Watercourse
FERC Boundary
Revised Section Boundary

Vegetation Community

Annual grassland-chaparral-young forest
Bare ground
Blue oak-foothill pine woodland
Developed
Interior live oak woodland
Non-native annual grassland
Northern mixed chaparral
Pasture
Ponderosa plantation
Riparian forest (white alder and mixed)
Sierran mixed coniferous forest
Water

Roads *Defined per USGS topographic base map or PG&E road database*

Trail
Light Duty Road
Unimproved Road
Unimproved Road (in FERC boundary)

Imagery: USDA National Agricultural Imagery Program, 2006.

N

0 0.1 0.2 0.3 0.4 Mi
0 0.1 0.2 0.4 Km

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-4
Old Cow Creek Study Area Vegetation Communities and Wildlife Habitats

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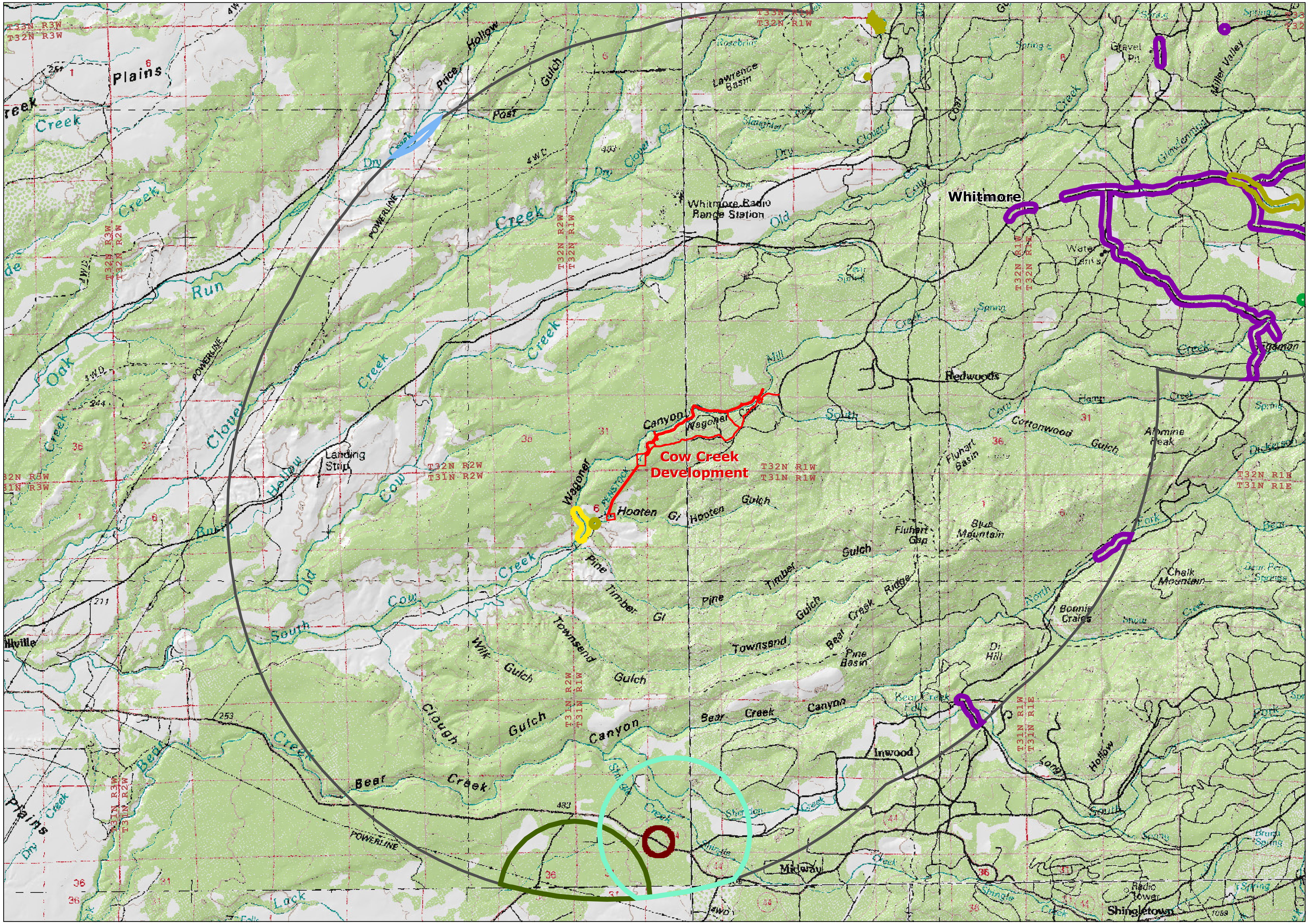

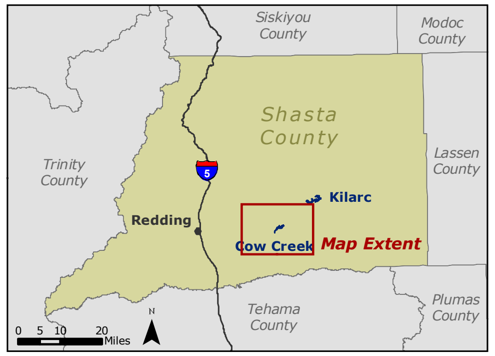

FERC Boundary
Five Mile Buffer of FERC Boundary

CNDDB Species Occurrence

- Ahart's Paronychia
- Butte County Fritillary
- Cascades Frog
- Foothill Yellow-legged Frog
- Henderson's Bent Grass
- Northern Goshawk
- Northern Interior Cypress Forest
- Northwestern Pond Turtle
- Shasta Clarkia
- Silky Cryptantha
- Silver-haired Bat

N

0 0.5 1 2 Mi
0 0.5 1 2 3 Km

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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-5
South Cow Creek Study Area
CNDDB Special Status
Species Occurrences

Pacific Gas and Electric Company®

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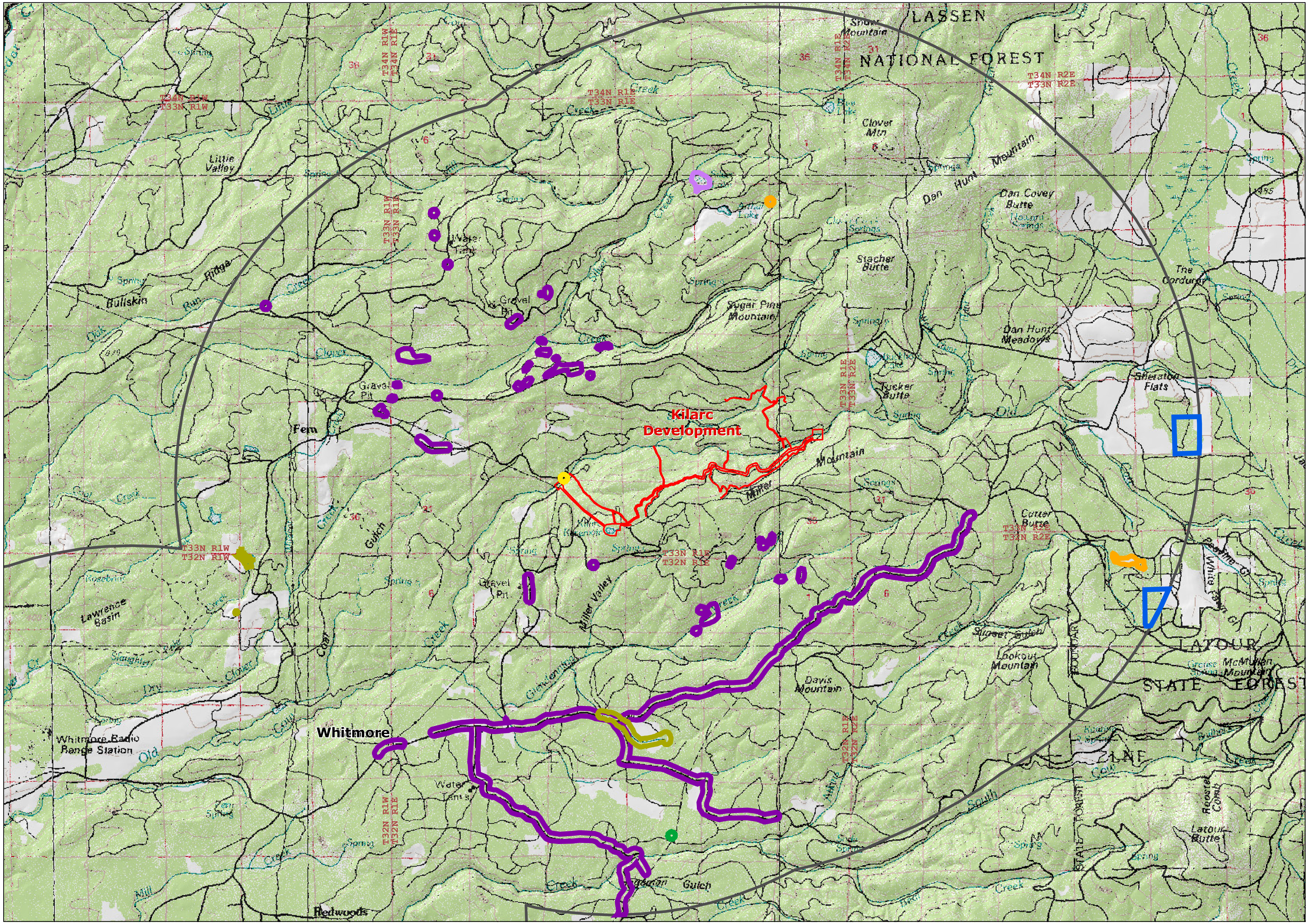
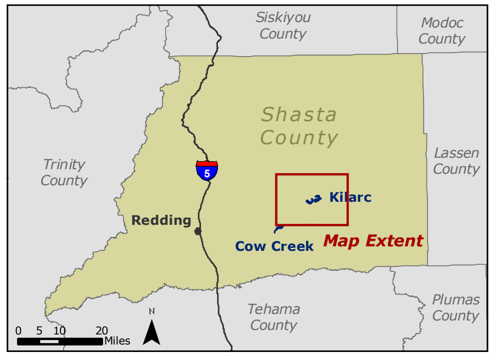
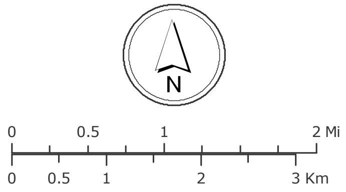




- FERC Boundary
- Five Mile Buffer of FERC Boundary

CNDDB Species Occurrence

- Ahart's Paronychia
- Butte County Fritillary
- Cascades Frog
- Foothill Yellow-legged Frog
- Henderson's Bent Grass
- Northern Goshawk
- Northern Interior Cypress Forest
- Northwestern Pond Turtle
- Shasta Clarkia
- Silky Cryptantha
- Silver-haired Bat



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KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.6-6
Old Cow Creek Study Area
CNDDB Special Status
Species Occurrences

Pacific Gas and Electric Company®

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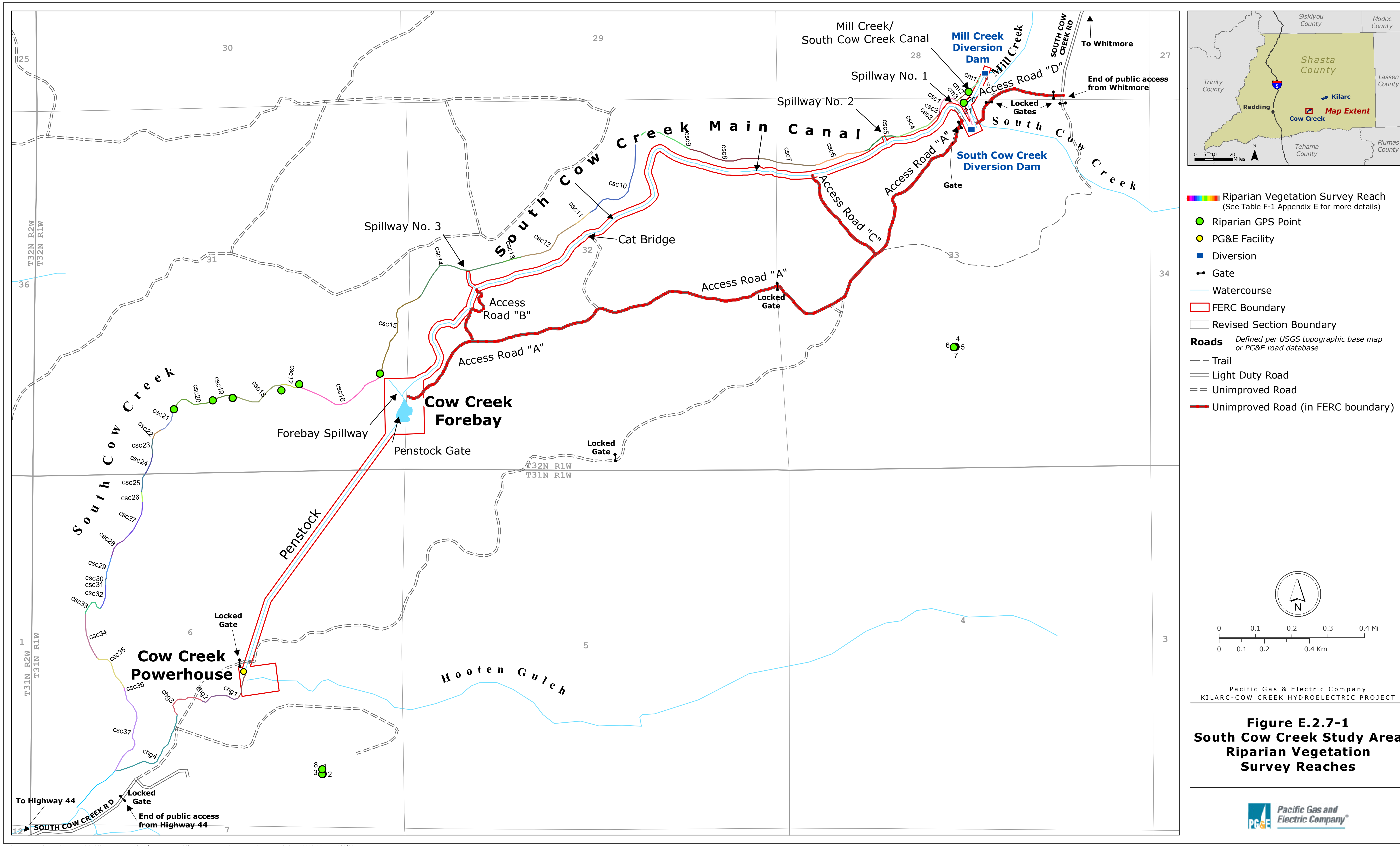

Figure E.2.7-1
South Cow Creek Study Area Riparian Vegetation Survey Reaches

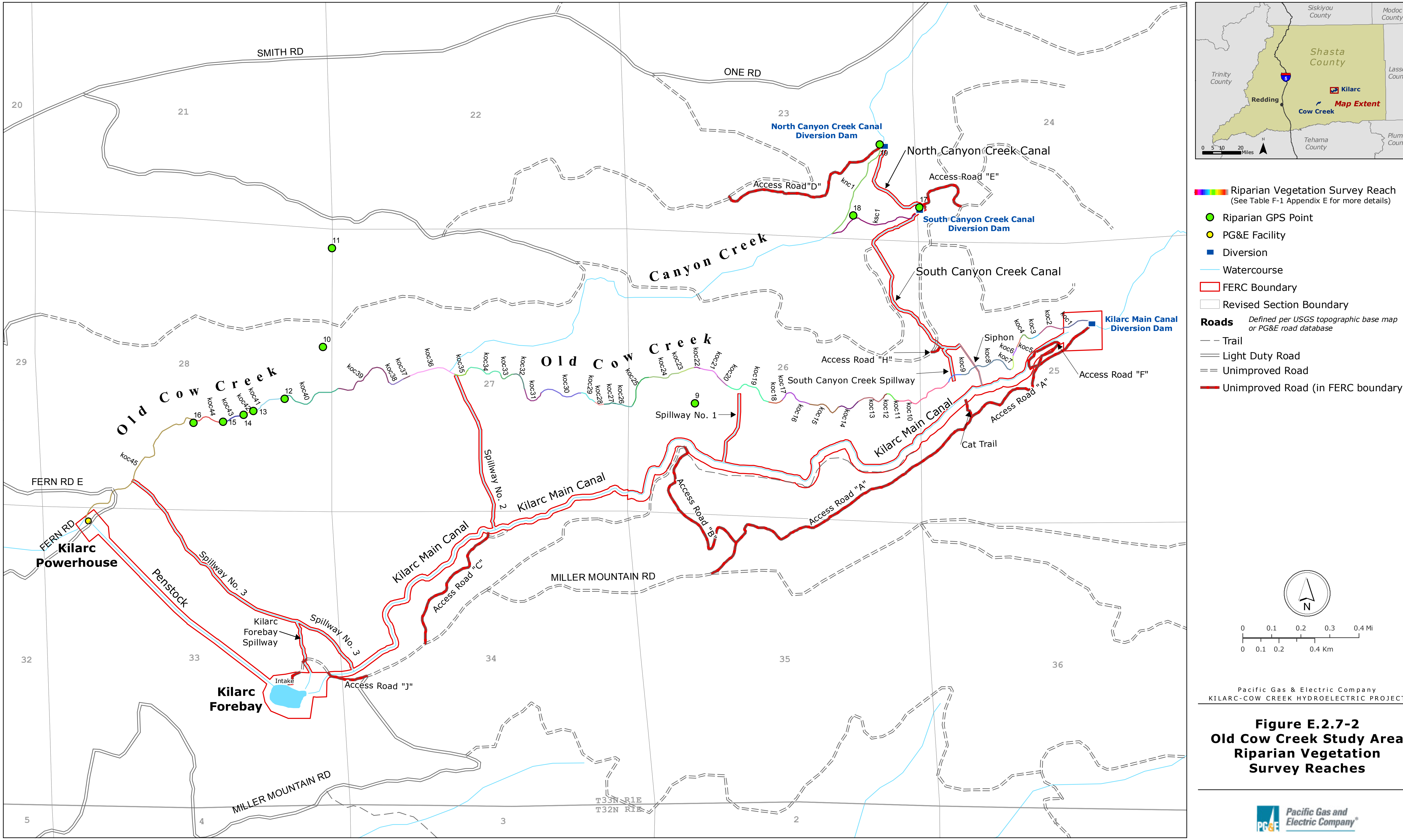

Figure E.2.7-2
Old Cow Creek Study Area Riparian Vegetation Survey Reaches

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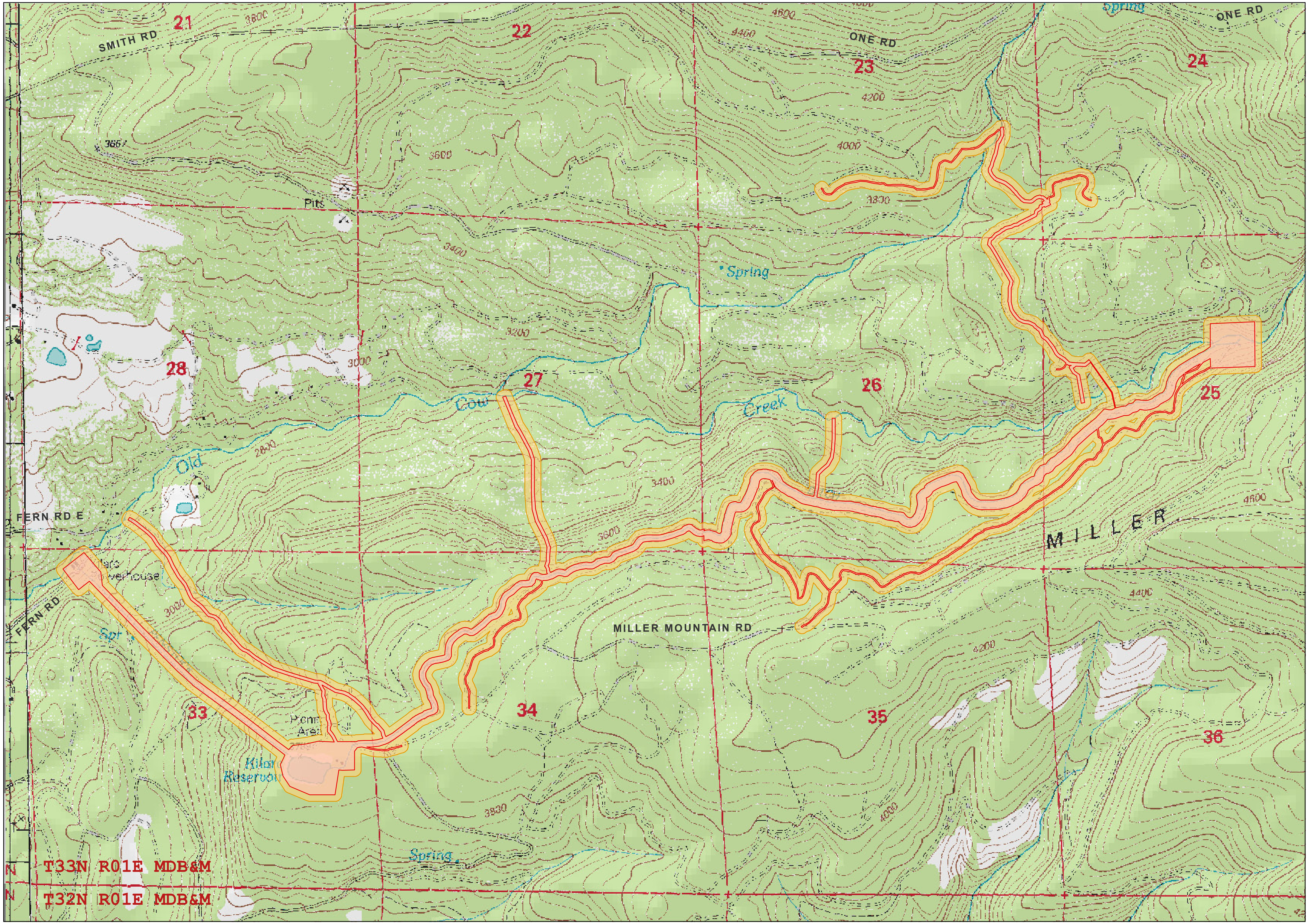

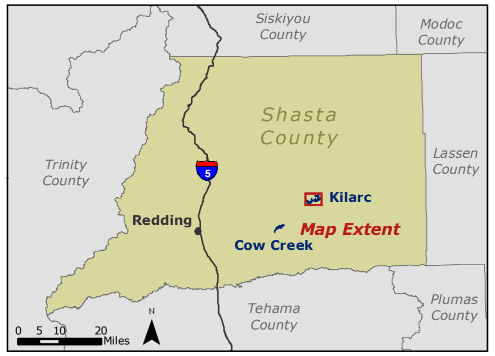

Archaeological APE and FERC Boundary

Architectural Resources APE *Extends 100 feet horizontally beyond the FERC boundary*

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

N

0 0.1 0.2 0.3 Mi

0 0.1 0.2 0.3 Km

Pacific Gas & Electric Company

KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.8-1
Project Area of Potential Effect (APE) Map: Kilarc Development

Pacific Gas and Electric Company®

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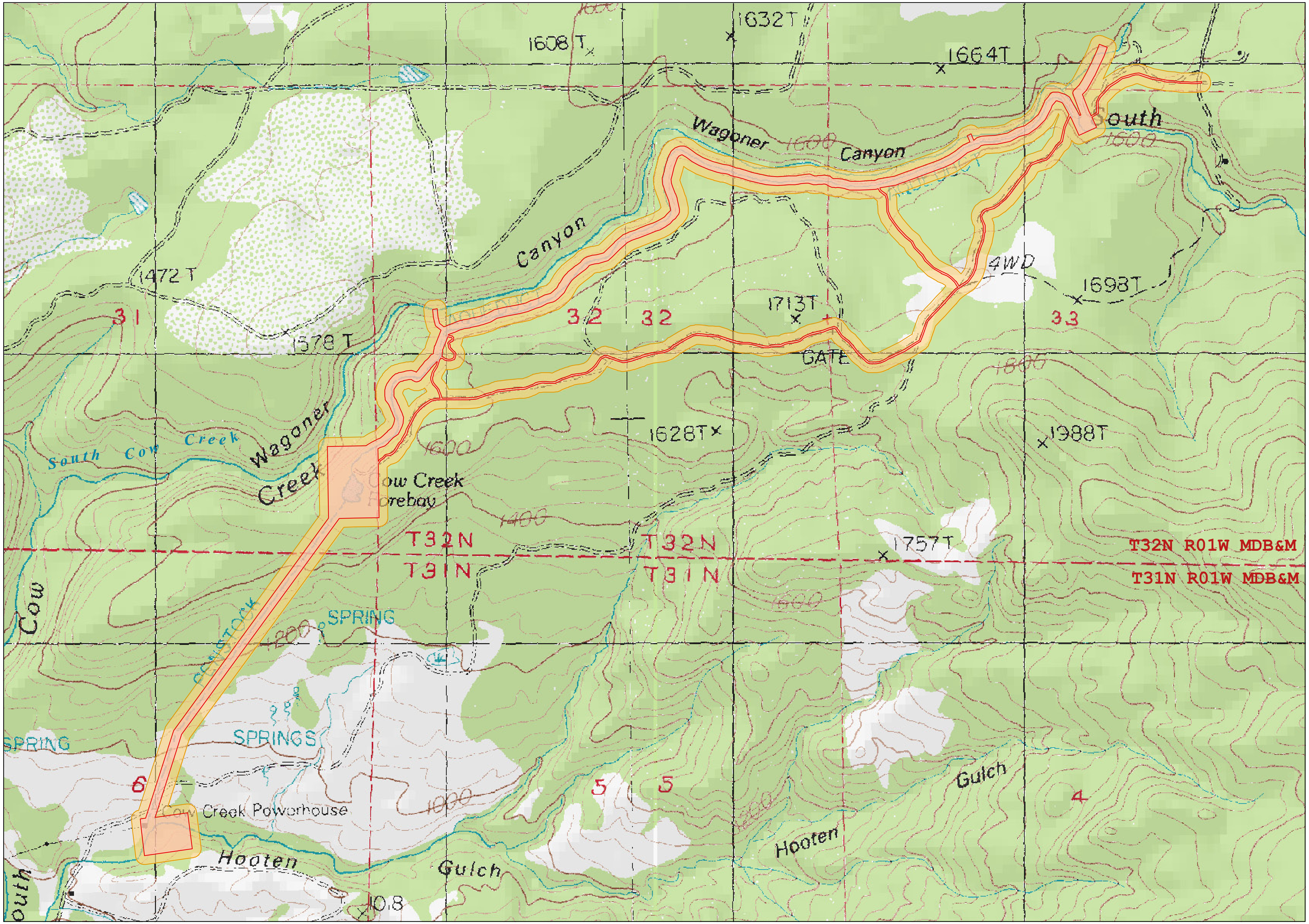

Archaeological APE and FERC Boundary

Architectural Resources APE — *Extends 100 feet horizontally beyond the FERC boundary*

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangles: Clough Gulch, CA. 1985. Inwood, CA. 1985.

N

0 0.1 0.2 0.3 Mi

0 0.1 0.2 0.3 Km

Pacific Gas & Electric Company

KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.8-2
Project Area of Potential Effect (APE) Map: Cow Creek Development

Pacific Gas and Electric Company®

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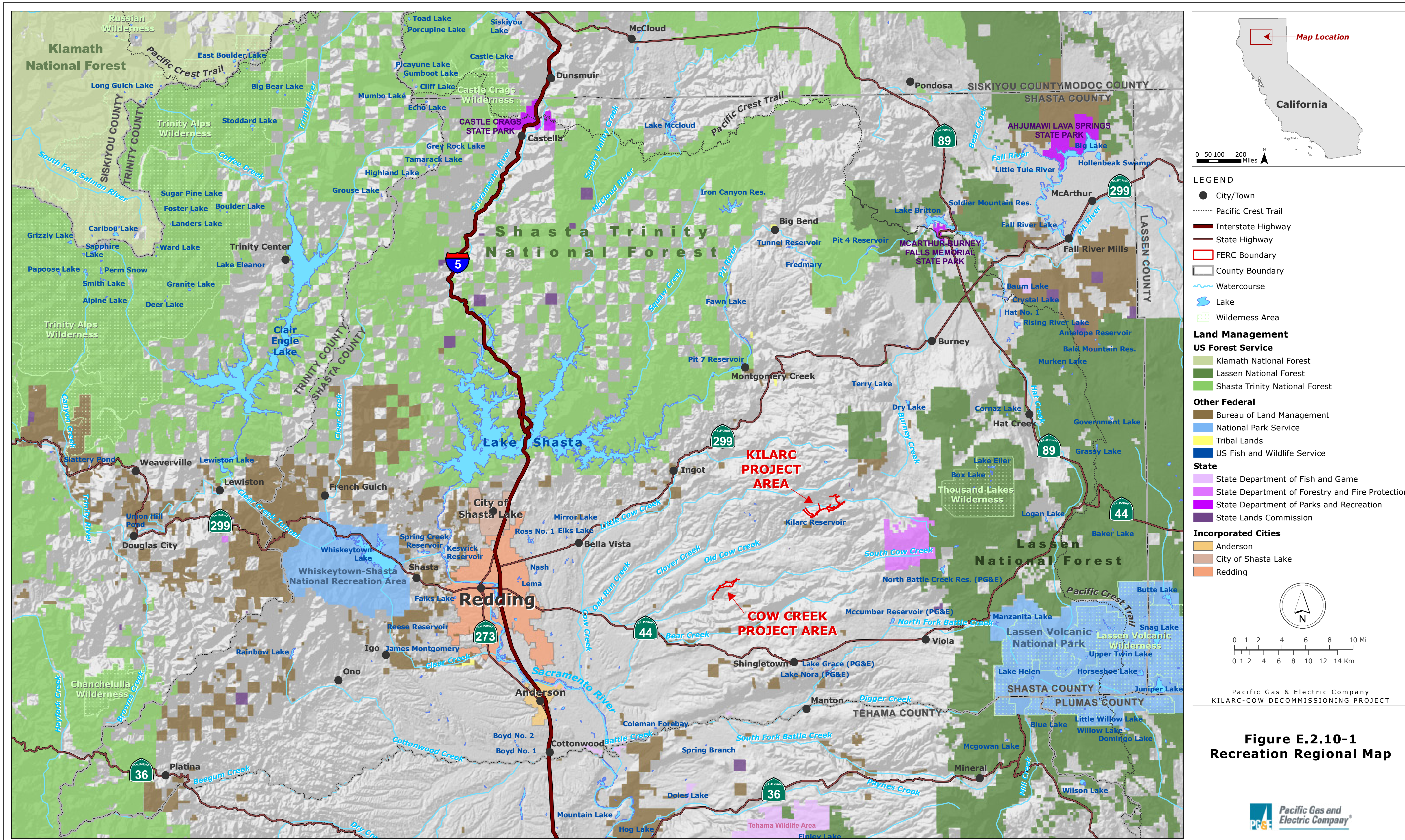

Figure E.2.10-1
Recreation Regional Map

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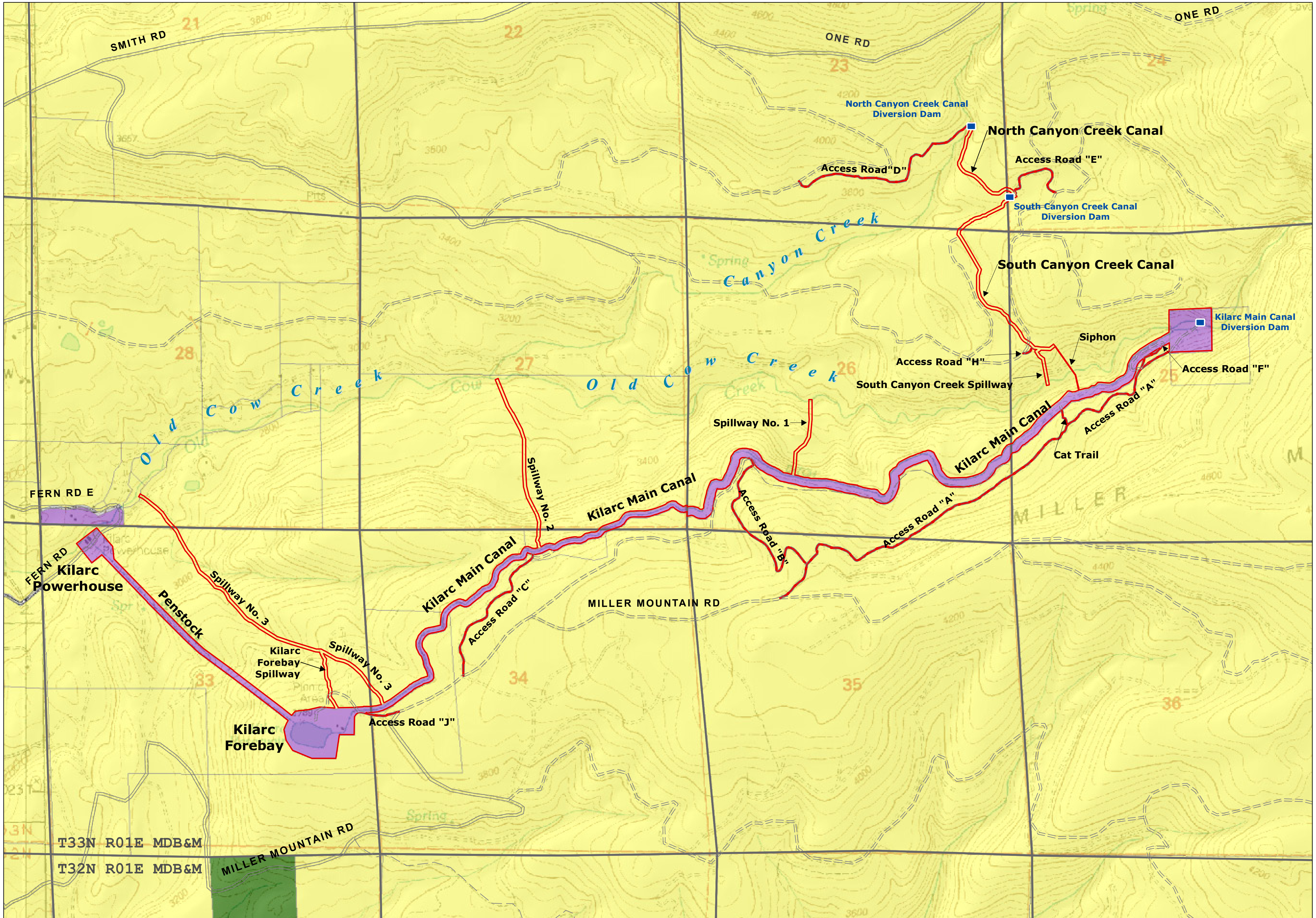

- Diversion
- FERC Boundary
- Revised Section Boundary

Ownership

- P G & E
- Patented
- Public: Federal

Roads *Defined per USGS topographic base map or PG&E road database*

- Trail
- Light Duty Road
- Unimproved Road
- Unimproved Road (in FERC boundary)

Imagery: USGS Digital Raster Graphic, 7.5-minute Quadrangle: Miller Mountain, CA. 1995.

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Pacific Gas & Electric Company
KILARC-COW CREEK HYDROELECTRIC PROJECT

Figure E.2.12-1
Kilarc Development
Land Ownership Map

Pacific Gas and Electric Company®

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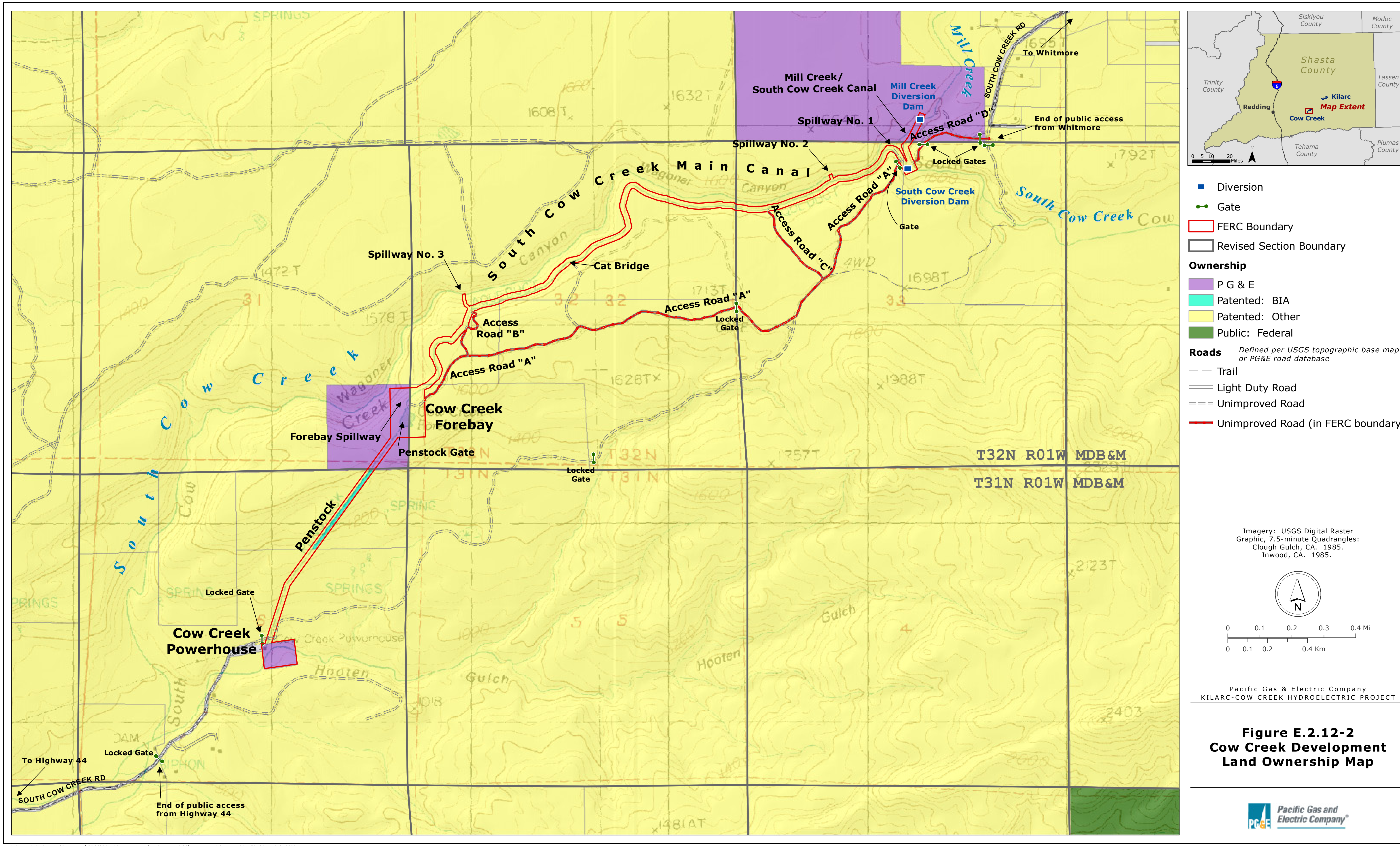

Figure E.2.12-2
Cow Creek Development
Land Ownership Map

EXHIBIT E: ENVIRONMENTAL REPORT

E.3 Project Impacts

In this section, the anticipated effects of Project decommissioning are identified relative to each environmental and cultural resource. For each resource area, potential impacts are identified and evaluated to determine if they warrant Protection, Mitigation, and Enhancement (PM&E) measures. Any impacts requiring PM&E measures are summarized. PM&E measures to minimize and mitigate potential impacts are discussed in Section E.4, Protection, Mitigation, and Enhancement Measures.

E.3.1 Geology and Soils

Potential impacts to geology and soils from decommissioning the Kilarc and Cow Creek developments are described in this section. Potential impacts could develop either during the decommissioning activities or post-decommissioning. Evaluation criteria are described below:

- Removal of instream structures would release sediments or create higher velocity, erosive peak flows.
- Increase in vehicle traffic, including heavy machinery, on forest roads would result in potential for damage to, or erosion from road surfaces.
- Deconstruction of structures along existing roads would create conditions favorable to slope instability (loosened earth materials, placement of fill, etc).

The potential impacts of Project decommissioning are discussed in the following sections.

E.3.1.1 Soil Erosion or Loss of Top Soil

Activity related to removal of the dams and other structures could promote conditions favorable to local slope instability, with subsequent downstream sedimentation and erosion, if protective measures are not incorporated into the project design. Specifically, without adequate PM&E measures, erosion could occur 1) during removal of structures in the stream banks and creek restoration activities 2) off-stream along the canals along natural drainage paths that previously drained into the canals, but which, upon Project decommissioning would be restored to their natural condition and flow to the creek, and 3) with the increased use of access roads or the construction of new access roads.

As discussed in Section E.2.1.3 (Soil Conditions), the erosion potential in the Kilarc Development is lowest on gentler slopes with relatively high hydraulic conductivity and highest on steep slopes with lower conductivity soils. Generally soils along the Kilarc Development consist of stony or gravelly loams with varying degrees of sand and clay.

Most of the main canal and its appurtenances overlie the Cohasset, and Windy and McCarthy loams with minor portions of the alignment overlying Tooms and Aiken Loams. Loam soils are described as easily retaining and transmitting water as well as having better infiltration and drainage than clayey or silty soils. Therefore, these soils have a relatively lower erosion potential.

In the Kilarc Development, construction activity related to removal of diversions and the canal, would most affect soils from the Cohasset and Windy and McCarthy series. With the exception of Cone very stony loam, the Cohasset loams tend to have low hydraulic conductivity, therefore compaction of these soils coupled with direction of concentrated runoff onto compacted soils (as resulting from construction activities) would increase their potential for local erosion or slope failure. The Windy and McCarthy unit has hydraulic conductivity ranging from low to high, as well as steep slopes (50 percent to 75 percent). A combination of low hydraulic conductivity, and steep slopes predisposes this unit to a higher erosion potential upon disturbance than surrounding units on gentler slopes.

Compaction of the downslope surface and subsurface by heavy machinery along roads would decrease conductivity downslope. On steep slopes, without adequate protective measures, compacted roads potentially act as subsurface dams, creating an area of hydraulic head upslope of the road. If hydraulic pressure in the formation were to become greater from infiltration than the formations effective hydraulic conductivity, loss of subsurface soil cohesion could result with the attending consequence of slope failure. The potential for slope failure under these circumstances increases with decreasing hydraulic conductivity, input of groundwater recharge, and steepness of slope.

In the Cow Creek Development, most of the canal is underlain by the Rockland unit, with minor portions of the canal overlying Aiken stony loam. Most of the access road is within the Toomes very rocky loam and the Guenoc very stony loam. The soil units overlain by the access road have moderate slope and hydraulic conductivity indicating a lower erosion potential of formations in the Cow Creek Development than those found in the Kilarc Development. The erosion potential of the Rockland unit is very low, as the unit is composed of bedrock. Finer materials, such as the Sehorn Silty Clay found along the penstock and in the vicinity of the Cow Creek Powerhouse near Hooten Gulch, would have the greatest potential for erosion, though disturbance should be minimal in those areas.

Erosion may occur during the construction, improvement, or use of, or following decommissioning of, access roads or road segments. Preliminary information developed to identify improvements on 1) potential new access roads, and 2) existing access roads is presented in the PDP (Appendix A), and is illustrated in Appendix A, Figures 2.1 and 2.2. Most of the roads that would be used for decommissioning access are existing roads, most of which would need only minor improvement. In the Kilarc Development, 13 short, new, temporary access roads are proposed, pending landowner permission, encompassing about 0.5 mile in total distance, or 0.7 acre. No new access roads would be needed in the Cow Creek Development.

In general, the stream channels below the Kilarc Main Canal and South Cow Creek diversion dams are stable channel types (see Section E.2.3.2 Channel Type and Channel Stability). However, upstream from the Kilarc Main Canal Diversion Dam, there are isolated areas of large hillslope failures. Evacuation of sediment stored behind South Cow Creek Diversion following dam removal (to an estimated maximum depth of 8.5 feet) could potentially subject newly exposed, unvegetated streambanks to instability or erosion (see Section E.3.3.2, Bank/Channel Stability).

E.3.1.2 Soil Stability and Liquefaction

Construction activities could cause soil to become unstable resulting in on- or off-site landslides. Specifically, the increased use of access roads or the construction of new access roads could cause small landslides. Small landslides or slumps are possible as one aspect of streambank erosion. Cut and fill earthwork that is not designed properly (i.e., cut slopes, improper fill compaction, etc.) can lead to landslide. Liquefaction is usually observed as a result of groundshaking caused by earthquake, pile driving, or similar activity. Sandy soils are most prone to liquefaction. It is not anticipated that pile driving or other related construction practices would be utilized during the decommissioning process. Thus, liquefaction would not be expected to occur.

E.3.1.3 Summary of Geology and Soils Impacts

Based on the evaluation of potential impacts presented in the preceding section, the following limited impacts on geology and soil resources are anticipated from decommissioning the Kilarc and Cow Creek developments:

No Impacts

- Liquefaction, or the loss of soil strength from ground shaking activity, is not expected to occur.

Potentially Substantial Impacts; PM&E Measures Warranted

- Streambank erosion might result from the removal of Project structures during and potentially after the construction period.
- Access road and staging area use and construction during decommissioning may result in more downstream sedimentation and erosion.
- Potential for on- or off-site landslides due to soil instability from access road construction activities.

PM&E measures to address these impacts are discussed in Section E.4.1.

E.3.2 Hydrology and Water Resources

Potential impacts to hydrology and water resources from Project decommissioning are described in this section. Potential impacts could develop either during the decommissioning work or after construction work is complete. Evaluation criteria are described below:

- Alteration of the existing drainage pattern of the site or area, either through the alteration of the course of a stream or river.

- Substantial increase in the rate or amount of surface runoff in a manner which would result in flooding.
- Change in the magnitude or timing of flows that is substantially different from a natural flow regime.

The potential impacts of Project decommissioning are discussed in the following sections.

E.3.2.1 Evaluation of Hydrologic Impacts below Diversions

Peak Flows

After decommissioning, the full natural geomorphically-significant peak flows in South Cow and Old Cow creeks would be nearly the same as under past Project operations. Therefore, no impacts would be associated with restoring the peak flows. To understand the potential impacts from decommissioning, past Project operations were evaluated. Past Project operations from either the Kilarc or Cow Creek developments have diverted only a very small proportion of the geomorphically-significant streamflow. After decommissioning, annual peak stream flows on South Cow and Old Cow creeks would change very little, increasing slightly. The 1.5-year estimated annual peak stream flow for South Cow (2,057 cfs) and Old Cow creeks (1,047 cfs) would have been reduced relatively little by Project operations (2.4 and 4.8 percent, respectively), assuming a maximum diversion rate of 50 cfs.[1] Such a small proportional reduction in the 1.5-year stream flow is well within the normal range of measurement error for gaging high flow conditions.

Unimpaired peak annual stream flows are not known on North and South Canyon creeks and Mill Creek. Therefore, it is unknown to what extent geomorphically-significant flows may have been altered by past Project operations. It is known, however, that on average less than 10 cfs have been diverted out of these channels (North and South Canyon Creek canals, Mill Creek-South Cow Creek Canal), which is the maximum capacity of these canals. Regardless of past Project operations, after Project decommissioning the full natural peak flows would be restored to these three streams. No adverse surface water impacts would be associated with restoring these peak flows.

Average Monthly Flows

After the decommissioning, the flow regime would be enhanced by restoration of natural seasonal flows to the stream channels (with the exception of any diversions unrelated to the Project). Estimated average unimpaired monthly flows for Old Cow Creek range between 90 and 127 cfs during the winter and spring runoff months. During the summer and fall, estimated average monthly flows range between 28 and 62 cfs (Table E.2.2-3). There would be an overall seasonal increase in stream flow to the bypass reach compared to the Project minimum instream flow release average of 2 to 4 cfs. However, the magnitude of the increase is not known because

[1] The maximum capacity of the Kilarc Main Canal and South Cow Creek Main Canal are 52 and 50 cfs, respectively.

any high flows or spills over the Kilarc Main Canal Diversion Dam (typically during the winter and spring months) during Project operations are not recorded.

Similarly, on South Cow Creek, the estimated average unimpaired monthly flows after the decommissioning range between 184 and 260 cfs during the winter and spring and 57 to 127 cfs during the summer (Table E.2.2-4). Minimum instream flow releases typically range between 4 and 5 cfs, but flows have been measured up to 7 cfs. Flows to the bypass reach would increase after the decommissioning, but the magnitude of the increase is not known because any spill flows that go over the South Cow Creek Diversion Dam during Project operations are not recorded.

Unimpaired average monthly stream flows are not known on North and South Canyon creeks and Mill Creek. Therefore, the extent to which flows would increase in comparison to past Project operations cannot be determined. However, after the decommissioning, the full range of natural flow would be passed downstream. No negative surface water impacts would be associated with restoring the unimpaired seasonal flow regime.

E.3.2.2 Evaluation of Hydrologic Impacts in Hooten Gulch

Currently, releases from Project operations maintain flows in Hooten Gulch downstream of the Cow Creek Powerhouse year-round. Releases from the powerhouse typically range from a high of about 50 cfs in the winter to a low of about 3 cfs during the summer. However, flows downstream of the powerhouse may be higher due to the addition of natural runoff into Hooten Gulch during storm events. Relicensing studies conducted in 2003 (see Section E.3.3, Geomorphology) noted that Hooten Gulch upstream of the Cow Creek Powerhouse was dry in the summer and fall months, indicating an ephemeral channel. However, based on the channel morphology, there are occasional episodic high flow events, probably during the winter and spring seasons, that are capable of eroding banks, scouring pools, and transporting sediments. Following decommissioning, Hooten Gulch down to the confluence with South Cow Creek would be returned to an ephemeral channel condition. No surface water impacts would be associated with returning the channel to its natural flow regime.

E.3.2.3 Evaluation of Water Rights & Use

Any impacts of decommissioning on existing surface or ground water rights are appropriately addressed under state law and not through the federal license surrender process. Upon decommissioning the Project, PG&E will abandon its water rights. As a consequence, water will no longer flow through Project conveyances, and artificial flows created by discharge from the South Cow Creek Powerhouse to Hooten Gulch will no longer occur. Similarly, water diversion from Old Cow Creek via the Kilarc Forebay and Kilarc Main Canal and discharge through the Kilarc Powerhouse back into Old Cow Creek will no longer occur.

The Wild Oak Development and the Abbott Ditch water users who currently divert water from Hooten Gulch will have their ability to do so reduced. However, their water rights will not be affected. If these users wish to divert a water flow greater than the natural flow from Hooten Gulch, they will need to develop alternate points of diversion. PG&E is consulting with water users potentially impacted by the cessation of artificial flows to Hooten Gulch regarding the development of options for alternate points of diversion.

Owners of groundwater wells in the vicinity of Kilarc Forebay do not have water rights to any artificial recharge water that may occur as a result of Project operations. Nonetheless, PG&E mailed questionnaires to owners of wells identified as being down-gradient of the forebay to document existing well conditions, and received one response indicating that the well at issue was no longer in use (Mr. Lyle Roe, personal communication, 2008). PG&E is willing to consult with any well owners who can demonstrate effects on well levels or yields from discontinuation of Project operations.

E.3.2.4 Summary of Hydrologic Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on hydrology and water resources are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Beneficial Impacts

- Enhancement of stream flows in the bypass reaches would result from an increase in the average monthly flows and by restoration of natural seasonal flows after Project decommissioning.

No Impacts

- There are no negative impacts associated with the negligible changes in the annual peak flow regime from the decommissioning of the Kilarc and Cow Creek developments.

Minor Impacts

- The existing drainage pattern of the site or area may change from either an alteration of a water course or through an increase in the rate or amount of surface runoff.

No PM&E measures have been recommended.

E.3.3 Geomorphology

Potential impacts to geomorphology from decommissioning the Kilarc and Cow Creek developments are described in this section. Evaluation criteria include the following:

- Impacts to channel morphology and associated aquatic habitat from release of stored sediments.
- Bank instability or erosion.

Water quality effects associated with sediments are discussed in Section E.3.4, Water Quality. The potential for fish passage problems associated with dam removal is addressed in Section E.3.5, Aquatic Resources.

E.3.3.1 Disposition of Sediments in Storage at Diversions

Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam

The stored sediment behind the Kilarc Main Canal and South Cow Creek diversion dams can be released from storage and allowed to naturally transport downstream without adversely impacting channel morphology over the long-term. However, there would likely be some short-term deposition of sediments in pools and across the channel bed immediately downstream of each dam as material is transported from the respective impoundments, but with diminishing effects with distance downstream. The only pools not expected to re-form are the plunge pools immediately downstream of each dam face. This potential impact is further discussed below.

Given the relatively small amount of material in storage (580 cubic yards behind Kilarc Main Canal Diversion Dam and 1,400 cubic yards behind South Cow Creek Diversion Dam), and the steep-gradient, high-energy, and supply-limited characteristics of both channels, it is anticipated that the sediment pulse represented by the released stored material would begin to mobilize and disperse downstream with high flows once the dams are removed. It is anticipated that as the stored sediments are transported downstream, they would provide an aquatic habitat benefit by increasing the available supply of gravel-size material that could be used for fish spawning, since a considerable portion of the stored sediments are gravel (59 percent at Kilarc Main Canal Diversion Dam, and 46 percent at South Cow Creek Diversion Dam; Appendices F and G, respectively). Fine sediments constitute a small proportion of the stored material at each diversion location (19 percent at Kilarc Main Canal Diversion Dam and 10 percent at South Cow Creek Diversion Dam), so that the potential for adverse effects from sedimentation is very low. All of the material in storage is naturally derived from the watershed and is naturally transported to the dam locations.

A sediment pulse introduced to a river may either be translated downstream as a sediment wave, dispersed in place, or undergo a combination of translation and dispersal (Cui et al., 2003). Flume experiments have shown that the dominant mode of sediment pulse elimination is dispersion when the particle sizes represented by the pulse of sediment is similar to that naturally transported by the river (Cui et al., 2003). If the pulse of sediment is finer than the sediment naturally transported by the river, then translation is the dominant mode of transport. Thus, the sediment pulse on South Cow Creek and Old Cow Creek would undergo dispersion, as the sediments sizes stored behind the two diversions are similar to the sizes measured in the downstream channel (predominantly boulder, cobble, gravel). This is important because sediment pulse elimination by dispersion means that the sediments would not be wholly transported as an identifiable, coherent sediment wave (as in a translation mode), but rather by gradual dispersion, thus reducing the likelihood of aggradation of the released sediments in any one river reach.

The following points summarize why the release of sediments behind the diversions to the channel would not adversely effect channel morphology and would likely provide an overall benefit to aquatic habitat:

- Very little fine sediment is stored behind the Kilarc Main Canal and South Cow Creek diversion dams (silt comprised less than 1 percent of the bulk sediment samples, sand represented less than 25 percent of any sample, and most samples were less than 10 percent sand).
- The Project channels are predominantly supply-limited (cascade and step-pool bedforms), having a much greater capacity to transport sediments than the supply delivered to the channel (see Section E.2.3, Geomorphology). Thus, a sediment pulse released by decommissioning of the dams would disperse downstream, rather than aggrading in one reach.
- The amount of bedload stored at the Kilarc Main Canal and South Cow Creek diversion dams likely represent a very small proportion of the annual sediment load carried by a supply-limited stream system.
- There are natural sediment storage features represented by cobble and gravel bars found downstream of the Kilarc Main Canal and South Cow Creek diversion dams on both streams that would moderate the sediment pulse released from the impounded sediments.
- The gravel and cobble material that represents most of the sediments in storage at the Kilarc Main Canal and South Cow Creek diversion dams are typical of the predominant particle sizes comprising the Old Cow and South Cow Creek channels. As such, the released sediments would travel in a dispersion mode.
- The channel types are considered to be very stable channel forms (A and B Rosgen channel types) that would not be altered by the sediment pulse from the Kilarc Main Canal and South Cow Creek diversion dams.
- The gravel size material in storage would provide additional spawning-size material for salmonids, a net habitat benefit.

Although the pulse of sediment released from either the Kilarc Main Canal or South Cow Creek diversion dams would not persist over the long-term and would not alter channel morphology, there would be some short-term effects to aquatic habitat. There would likely be some short-term deposition of sediments in pools and across the channel bed immediately downstream of each dam as material is transported from the respective impoundments, but with diminishing effects with distance downstream. The plunge pool immediately downstream of each dam would probably receive the largest volume of sediment, partially or entirely filling those pools. It is estimated that pools located within approximately 10 bankfull widths of each dam (approximately the first 400 to 600 feet downstream) would experience the most deposition of sediment. As the sediment moves further downstream, it would disburse and be stored on available coarse material bars, minimizing effects to habitat beyond the first 10 bankfull widths. Given that the Project streams are supply-limited, the sediment pulse would not persist as high flows transport and disperse sediments. It is anticipated that the channel bed and pool within the first 10 bankfull widths would return to pre-dam morphology after the larger seasonal high flows flush out the pools. This is supported by the fact that existing pools surveyed on both Old Cow Creek and South Cow Creek are naturally scoured by high flows, having very little sediment deposition (see Section E.2.3, Geomorphology). The only pools not expected to re-form are the plunge pools immediately downstream of each dam face. These pools are likely maintained by the high-head and energy associated with the dams themselves. Once the Kilarc Main Canal and South Cow Creek diversion dams are removed, the lower energy head would not be adequate to sustain the plunge pools. This is anticipated to be the only persistent effect on aquatic habitat associated with dam removal and the sediment pulse release.

During the period over which sediments are being transported from their respective impoundment sites upstream of the respective diversions, potential barriers to fish migration may temporarily persist until most of the sediments have evacuated (see Section E.3.5, Aquatic Resources). This could be due to either a highly mobile bed as the nickpoint causes incision and transport of the stored sediments, or a lack of a well defined low-flow thalweg that connects the channel upstream of the dam to the downstream-end of the dam reaches.

Over the long-term, once most sediments have evacuated from the former impoundment zone behind the dams, the respective channels would return to their pre-dam morphology. Old Cow Creek at the Kilarc Main Canal Diversion Dam would be expected to return to pre-dam conditions with a very steep reach of channel (6 percent) that is defined by step-pools and cascade bedforms with boulders comprising the matrix of bed material, and without a well defined low-flow channel thalweg. South Cow Creek would have a more moderate 1 percent gradient, with a step-pool/plane bed morphology downstream from the diversion and a pool-riffle morphology upstream from the South Cow Creek Diversion Dam, and coarse bed material comprised of a mix of boulder, cobble, and gravel.

Based on these data and conclusions, it is recommended that the impounded sediments be allowed to naturally transport downstream as part of the Project decommissioning. Although minimal to no impacts are expected from allowing the stored sediments to remain in the channel, PM&E measures are recommended in Section E.4.3 to ensure that the stored sediments are most efficiently disbursed and routed to the downstream reaches, and do not cause a potential temporary barrier to fish migration during the period of time it takes for streamflow to naturally disburse the stored sediments.

Mill Creek, North Canyon Creek, and South Canyon Creek Diversion Dams

Three other Project diversion dams are located within the Project Area: North Canyon and South Canyon Creek diversion dams and Mill Creek Diversion Dam. All of these impoundments are small in size, resulting in a very small volume of potentially stored sediment, if any at all. Any stored sediment located behind the diversions would be allowed to naturally move downstream during seasonal high flow events. There are no impacts associated with sediment disposition following the removal of the Mill Creek, North Canyon Creek, and South Canyon Creek diversions.

E.3.3.2 Bank/Channel Stability

Following the removal of the larger two diversion dams, South Cow Creek Diversion Dam and Kilarc Main Canal Diversion Dam, there is the potential for localized bank erosion to occur around the infrastructure removal sites. Once the stored sediment is evacuated from behind the South Cow Creek and Kilarc Main Canal diversion dams, newly exposed banks in the area defined by the former sediment deposition zone could be subject to bank instability and erosion. There is no feasible way to determine in advance of dam removal if bank instability or erosion will occur within the former sediment deposition zone.

Kilarc Main Canal Diversion Dam

Approximately 580 cubic yards (0.36 acre-feet) of sediment is stored behind the Kilarc Main Canal Diversion Dam and is comprised of primarily gravel-, cobble-, and boulder-sized material. Some of the largest boulder size material would permanently remain in place, while the smaller material would remain only until it is naturally transported downstream and redistributed during high flows. The Kilarc Main Canal Diversion Dam removal may increase the potential for unstable banks and erosion to occur within the boundaries of the former backwater influence and sediment deposition zone, a linear distance of about 110 feet upstream (Appendix G). Dam removal would create a nickpoint at the former dam site, which would cause headward erosion and downstream transport of the formerly impounded sediments. As sediments are transported from behind the dam, and the channel incises into the stored material, the pre-dam bank configuration would become exposed. The potential for bank instability increases with expected depth of sediment scour (i.e., the thickness of the stored sediment wedge impounded behind the dam). As such, the relative potential for adverse bank erosion is closest to the dam site.

It is difficult to predict in advance the likelihood or extent of any bank instability and erosion. The presence of large boulders embedded in the bank, for instance, may prevent any erosion as the channel down-cuts and redefines its new equilibrium gradient of about 6 percent. Based on the inventory of overall high bank stability below the diversion (see Section E.2.3, Geomorphology) this would appear to indicate that there would also be high stability through the impoundment sediment deposition zone. However, the bank stability inventory also identified isolated areas of large hillslope failures, and there is a substantial hillslope failure about 700 feet upstream from the Kilarc Main Canal Diversion Dam. These unstable areas upstream of the dam are not Project-induced. Thus, there is no feasible way to predict if the banks would be stable following diversion dam removal and subsequent transport of stored sediments.

South Cow Creek Diversion Dam

The South Cow Creek Diversion Dam on South Cow Creek is a concrete-capped, steel bin wall and rock fill dam that is 86.5 feet long and about 8.5 feet high with an additional 3.5-foot of cutoff wall situated below the dam structure itself. Retention of the cutoff wall below the dam will help to minimize disturbance of the streambed and also will function to provide grade control, ensuring limits on the potential for channel downcutting below the top of the cutoff wall (elevation 1549.6 above MSL). The top of the cutoff wall is estimated to be the original elevation of the pre-dam channel bed. The abutment on the north side of the canal intake is also proposed to be left in place to help ensure stability of this bank following dam removal.

When the dam is removed, approximately 1,400 cubic yards (0.87 acre-feet) of sediment, comprised primarily of boulder-, gravel-, and cobble-sized material (90 percent of total material present), would temporarily remain. Similar to the Kilarc Main Canal Diversion Dam, removal would create a nickpoint in the channel bed at the former dam site, which would cause headward erosion and downstream transport of the formerly impounded sediments. Over time, the impounded sediment would naturally be transported downstream during high flow events and the channel would establish a new equilibrium slope, about 1 percent, through the former dam site. The impounded sediment would be redistributed downstream, some of which would be deposited on storage sites such as the existing bars.

Once the impounded sediments behind the South Cow Creek Diversion Dam have been evacuated by high flows and transported downstream, it is possible that the newly exposed streambanks could be devoid of vegetation, unstable and susceptible to erosion. It is not feasible to predict to what extent unstable and eroding streambanks may occur after decommissioning. The area where unstable banks and erosion are most likely to occur is nearest to the dam site where sedimet would be evacuated to an estimated maximum depth of 8.5 feet. Progressing upstream from the South Cow Creek Diversion Dam, sediment depth and associated scour would become less (about 6 feet at a point 30 to 50 feet upstream from the dam), with a smaller associated risk of unstable banks. The total length of the sediment storage zone that is subject to scour upon dam removal is approximately 420 feet (Appendix H).

Hooten Gulch

Hooten Gulch downstream from the Cow Creek Powerhouse has greater fine sediment accumulation in pools than either South Cow or Old Cow creeks. Inspection of Hooten Gulch upstream from the powerhouse revealed significant hillslope failures that directly recruit material, including sand, to the channel. Sediment recruitment was observed in Hooten Gulch from within its stream corridor above the powerhouse, and these sediments were being temporarily deposited in the moderate gradient reach (2.5 percent) downstream of the powerhouse. Since this reach above the powerhouse is not affected by the decommissioning, it is anticipated that sediment recruitment, with some deposition in pools downstream, would continue after Project decommissioning in association with episodic high flows. Cessation of augmented flows at the powerhouse would not alter the sediment recruitment process from streambanks/hillslopes above the powerhouse, or transport of sediments with episodic high flows.

Downstream of the Cow Creek Powerhouse, bank stability was rated moderate and some bank erosion was observed. Augmented flows from the powerhouse in conjunction with episodic high flows may have increased the potential for bank erosion downstream from the powerhouse under past Project operations. After decommissioning, augmentation from the powerhouse flows would cease, and the magnitude of episodic high flows would be lower. Thus, it is most likely that existing bank instability and erosion downstream from the Cow Creek Powerhouse would not increase, and most likely would be less following decommissioning.

A short section of the Hooten Gulch channel just upstream from the Cow Creek Powerhouse is protected from erosion by gunite. The gunite is armoring the bottom of the channel and a steep section of bank that is closest to the powerhouse. The gunite section is proposed to be either completely removed or otherwise modified, in order to ensure adequate flow depth and appropriate velocities for fish passage. Removal or modification of the existing gunite would require installation of a new bank stabilization treatment.

Mill Creek, North Canyon Creek, and South Canyon Creek

The North and South Canyon Creek diversion dams, and Mill Creek Diversion Dam, occupy a small area of the channel and banks and contain very small associated backwater impoundment areas. Due to the small area of impoundment, and the associated small capacity to store sediments, dam removal is not expected to alter the channel gradient upstream of these diversions.

During decommissioning work, removing the dams and disturbing the area in their vicinity would result in small areas of bare, unvegetated banks. However, the undisturbed channel banks surrounding the impoundment are vegetated and contain areas of low angled side slopes (Photographs E.2.3-1 and E.2.3-2), which offer bank stability and protection. As such, minimal bank erosion is expected at these locations and little to no adverse effects to the vertical channel stability or to bank stability would likely occur.

E.3.3.3 Summary of Geomorphology Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on geomorphological resources are anticipated from decommissioning the Kilarc and Cow Creek developments:

Beneficial Impacts

- As stored sediments released from Kilarc Main Canal and South Cow Creek diversion dams are transported downstream, they will provide an aquatic habitat benefit by increasing the available supply of gravel-size material suitable for fish spawning.

No Impact

- No bank/channel stability impacts to Hooten Gulch would result from decommissioning. After decommissioning, augmentation from the powerhouse flows would cease, and the magnitude of episodic high flows would be lower.
- The pulse of sediment released from removal of either the Kilarc Main Canal or South Cow Creek diversion dams would not persist over the long-term and would not alter channel morphology.

Minor Impact

- Short-term deposition of sediments in pools and across the channel bed immediately downstream of Kilarc Main Canal and South Cow Creek diversion dams would be minor. All pools would naturally scour and re-form over time, except for the plunge pools immediately downstream of each of the respective dam face.
- Minimal bank erosion is expected at the North and South Canyon Creek diversion dams and Mill Creek Diversion Dam, and little to no adverse effects to the vertical channel stability or to bank stability would likely occur.

Potentially Substantial Impact; PM&E Measures Warranted

- As sediments are transported from the Kilarc Main Canal and South Cow Creek diversion dams, fish passage could be impaired until all sediments have been disbursed downstream.
- Localized bank erosion may occur following the removal of the South Cow Creek and Kilarc Main Canal diversion dams at the former dam sites and within the former sediment impoundment zone of each dam, as newly exposed banks could be unstable.

PM&E measures to address these impacts are discussed in Section E.4.

E.3.4 Water Quality

Potential impacts to water quality from decommissioning the Kilarc and Cow Creek developments are described in this section. Potential impacts could develop either during the decommissioning work or after construction work is complete. The de-construction work would need to be performed such that water quality protection standards are not violated during the construction period or in the long-term. Evaluation criteria are described below:

- Potential exceedence of the Basin Plan water quality objectives or other applicable and relevant water quality criteria.
- Increased turbidity from erosion, or other water quality impacts through the dissolution of chemicals from the sediments into stormwater runoff or directly within the streams.
- Stormwater runoff into local waters from the release of fuel or engine fluids from heavy equipment operation and maintenance or other construction activities.

The results of water quality and sediment investigations summarized in Section E.2.4 (Water Quality) are discussed in the following sections relative to potential impacts as a result of decommissioning of each development.

E.3.4.1 Kilarc Development

A review of the findings of the 2003 water quality and sediment chemistry investigations finds that most, but not all water quality objectives, standards, and screening levels were consistently met. Sampling was performed at six monitoring stations during two sampling events in March and October 2003. The findings are summarized below:

- No water quality exceedances were observed for minerals, nutrients, trace metals, PCBs, and other parameters with a few limited exceptions. Data were compared to Basin Plan objectives (RWQCB-CVR, 2007), as well as to the USEPA ambient water quality criteria for freshwater organisms (USEPA, 2006), the National Recommended Water Quality Criteria for Freshwater organisms (USEPA, 2000), California drinking water MCLs (CDPH, 2008), and the California Toxics Rule Freshwater Aquatic Life Protection (FALP) Standards.
- Temperature studies at eight stations within the Kilarc Development area indicate mean daily temperatures remained below 18°C[2] throughout the Project-affected bypass reach, even during the warmest part of the year (late July). Warming exceeded 5ºF in July, August, and September of 2003 in the bypass reach, although the degree of natural warming that would have occurred without the Project is not known, and therefore it is not known if the Basin Plan objective[3] was exceeded due to Project operations. However, decommissioning of the Project diversions (i.e., Kilarc Main Canal Diversion Dam) is expected to lower the summer temperatures in the bypass reaches due to increased flow, and warming will be closer to the level expected under natural conditions.
- The sediment behind the Kilarc Main Canal Diversion Dam was found to have mercury, methyl mercury, silver, and arsenic at levels below sediment quality screening levels (Buchman, 2004). However, copper was found above screening levels and additional testing was performed.
- Additional testing found that the copper concentrations within the sand/silt/clay fraction of the sediments were at or slightly greater than the TEL, but well below the PEL (see Section E.2.4.6).
- For the one sample tested with only the silt/clay fraction of sediments, the total and leachable copper were both above the TEL and PEL. The silt/clay fraction was estimated to be less than 0.5 percent of the measured dry weight of stored sediment, and represented a total of less than 0.5 ton of sediment. The equivalent volume of this weight is approximately 0.22 cubic yards or 6 cubic feet.

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2 A mean daily temperature of 18°C was selected as an evaluation criterion for management of trout and steelhead (see Section E.2.4.7).

3 The Basin Plan objectives state that temperatures for cold or warm interstate waters are not to be increased by more than 5°F above natural receiving water temperature and no increase is allowed which impacts beneficial uses.

Based on the results described above, further evaluation is presented below of the potential for copper in sediment to cause negative impacts to the environment.

Copper and other minerals occur naturally in the rocks and soils present in the Kilarc Development. Section E.2.1 describes the geology and soils of the region. There is a long history of copper mining in the region, particularly around Mount Shasta due to the presence of copper ore; however, mining is not known to have occurred upstream of the Kilarc Main Canal Diversion Dam (See Section E.2.8, Historical Resources). Therefore, the copper found within the sediments is believed to be naturally occurring and not from anthropogenic sources.

NOAA developed an estimate of "background" concentrations for copper in sediment. These concentrations were developed from data collected from various locations in Canada and the United States (not from the Cow Creek Watershed) and vary widely, but a general range is between 10 and 75 milligrams per kilogram (Buchman, 2004). All the sand, silt, and clay samples were found to be within this range; however, Sample K-1 composed of only silt and clay was higher (Table E.3.4-1). This sample may not be representative of a typical sediment sample used to compile background values. The leachable fraction of the naturally occurring copper found in the sediments is estimated to be about 24 percent (Appendix N, Copper Analysis).

Stream water samples collected in 2003 under high and low flow conditions indicate that copper concentrations are well below related water quality criteria. Table E.3.4-1 compares the copper concentrations measured in the Kilarc Development to these criteria as well as to hardness, alkalinity, and pH. Note that the Basin Plan objective and the acute and chronic toxicity thresholds are set based on empirical regressions of toxic concentrations versus hardness for available toxicity data across a wide range of hardness. In general, the higher the hardness, the higher the toxicity screening values are. These regressions provide the relative amount by which the criteria change with hardness and related factors (USEPA, 2007).

Table E.3.4-1 illustrates that the measured copper levels are an order of magnitude or greater below the aquatic toxicity criteria. Besides hardness, the natural buffering capacity of the water (alkalinity) and the pH also contribute to the speciation of copper within the water column. Relative to Old Cow Creek, the existing hardness, basic pH, and alkalinity would serve to minimize the amount of the toxic ionic form of copper (Cu^{++}) available in the water column. The copper would preferentially form $CuCO_3$ in the water column under these conditions and would be less available to aquatic species (Snoeyink and Jenkins, 1980; USEPA, 2007).

The copper found within the fine sediments behind the Kilarc Main Canal Diversion Dam is believed to be a result of natural weathering processes. The source of the copper is from within naturally occurring soils and rock within the watershed and not from anthropogenic sources. The release of these sediments after dam removal would be similar to the ongoing mass-wasting failures of hillslopes that directly deliver large amounts of sediment to the channel on both Old Cow and South Cow creeks (See Section E.2.3, Geomorphology).

The sediments, when transported downstream, would be redistributed and some copper could become desorbed from the sediments, dissolving in the stream flow. The neutral to basic pH of the stream would minimize the desorption, and the natural hardness and alkalinity would serve to complex copper after desorption with formation of copper carbonate ($CuCO_3$), which would minimize the amount of the ionic form of copper. Analysis of potential copper concentrations in Old Cow Creek as a result of sediment mobilization after dam removal indicates that even under highly conservative assumptions the total estimated water column copper concentration would be less than 20 percent of the 4.10 ug/l standard allowed under the California Toxics Rule (Appendix N).

Because the volume of fine sediments, which contain most of the copper, is very low (estimated to be less than 1 percent by dry weight of total material, representing a volume of about 6 cubic feet [0.22 cubic yard]), and because of the low probability of these sediments to degrade water quality to a level where adverse impact would occur, the potential impact to water quality is considered to be minimal. The conclusion of this investigation of sediment chemistry in the Kilarc Development is that the sediments could be allowed to remain in the channel to be naturally transported downstream after the Kilarc Main Canal Diversion Dam is removed.

Sediment in stormwater runoff from work areas and access roads would be the remaining potential impact. Increased sediment input into Old Cow Creek, and to a lesser extent into North and South Canyon creeks could increase turbidity, such that the California drinking water MCLs would be exceeded. In Section E.2.1.3 (Soil Conditions), erosion potential based on soil types and slope near the diversion dams is discussed (see also Section E.3.1 Geology and Soils for a discussion of soil erosion and soil stability). Bank stability and hillside failures may also occur during decommissioning activities (see Section E.2.3.2 Channel Type and Channel Stability and Section E.3.1 Geology and Soils for a more detailed discussion).

In addition, since fish and wildlife resources could be affected by accidental release of oil or hazardous materials associated with construction activities, spill prevention and clean-up measures would be needed to minimize the release of oil or hazardous materials into the environment.

In conclusion, the primary potential impacts on water quality from decommissioning the Kilarc Development are increased turbidity in the streams as a result of the deconstruction activities themselves or long-term erosion and sedimentation after deconstruction is completed, and accidental release of hazardous materials associated with construction activities.

E.3.4.2 Cow Creek Development

A review of the findings of the 2003 water quality and sediment chemistry investigations finds that most, but not all water quality objectives, standards, and screening levels are consistently met. Sampling was performed at six monitoring stations during two sampling events in March and October 2003. The findings are summarized below:

- No water quality exceedances were observed for minerals, nutrients, trace metals, PCBs, and other parameters with a few limited exceptions. Data were compared to Basin Plan objectives (RWQCB-CVR, 2007), as well as the USEPA ambient water quality criteria for freshwater organisms (USEPA, 2006), the National Recommended

Water Quality Criteria for Freshwater organisms (USEPA, 2000), and California drinking water MCLs (CDPH, 2008).

- The exceptions included 4 out of 11 samples tested for fecal coliform exceeding the Basin Plan criterion for water bodies used for contact recreation. However, this criterion is based on a mean bacterial count of a minimum of five samples per month and is not directly comparable to the individual samples collected in this study.
- Similarly, 7 out of 48 samples were found to be above the California Secondary Drinking Water MCL criterion for turbidity of 5 NTUs.
- Temperature studies at eight stations within the Cow Creek Development in 2003 indicate mean daily temperatures ranging from about 11.9°C to 21.7°C , with approximately 1ºC to 2ºC warming between the top and bottom of the bypass reach. All eight stations exceeded a daily mean temperature of 18°C at least once during the monitoring period, and generally exceeded a daily maximum temperature of 24°C in July at all temperature monitoring stations except those in Mill Creek. The Basin Plan water temperature objective (less than 5ºF (2.8ºC) increase over natural receiving water temperature) was met in the bypass reach.
- The sediment behind the South Cow Creek Diversion Dam was found to have mercury, methyl mercury, copper, silver, and arsenic at levels close to or below sediment quality background levels and below ambient freshwater sediment quality screening levels.

Water temperatures higher than are suitable for trout were observed within the Project-affected bypass reach in South Cow Creek during the water temperature monitoring study conducted in 2003. Currently, low-flow conditions exist in the summer and the stream is prone to solar heating. Decommissioning Project water diversions in this area would increase flow, and with the same amount of solar energy input, would result in lower mean and maximum stream temperatures. Thus, removal of Project diversions (i.e., South Cow Creek Diversion Dam) is expected to result in a beneficial effect of reduced water temperatures from increased flow. Similarly, turbidity and fecal coliform levels are expected to decrease with the increase in flow in South Cow Creek.

Similar to the Kilarc Development, sediment in stormwater runoff from work areas and access roads would be the remaining potential impact. Increased sediment input into South Cow Creek, and to a lesser extent into Mill Creek could increase turbidity, such that degradation of water quality could occur. In Section E.2.1.3 (Soil Conditions), erosion potential based on soil types and slope near the diversion dams is discussed (see also Section E.3.1 Geology and Soils for a discussion of soil erosion and soil stability). Bank stability and hillside failures may also occur during decommissioning activities (see Section E.2.3.2 Channel Type and Channel Stability and Section E.3.1 Geology and Soils for a more detailed discussion).

Similar to the Kilarc Development, spill prevention and clean-up measures would be needed to minimize the release of oil or hazardous materials into the environment.

In conclusion, the primary potential impacts to water quality from decommissioining the Cow Creek Development are increased turbidity in the streams as a result of the deconstruction activities themselves or long-term erosion and sedimentation after deconstruction is completed, and accidental release of hazardous materials associated with construction activities.

E.3.4.3 Summary of Water Quality Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on water quality are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Beneficial Impacts

- Beneficial effects of water temperature reduction, decreased turbidity, and fecal coliform levels might result from the removal of Project diversions at Kilarc and Cow Creek due to increase in stream flow.

No Impacts

- Release of sediment stored behind Kilarc Main Canal Diversion Dam is not likely to result in exceedance of water quality standards for dissolved copper. Therefore, sediments could be allowed to remain in the channel to be naturally transported downstream after the Kilarc Main Canal Diversion Dam is removed.

Potentially Substantial Impacts; PM&E Measures Warranted

- Water quality might be affected as a result of potential stormwater runoff from heavy equipment fuels and/or engine fluids during construction activities.
- The Basin Plan water quality objectives and/or other water quality criteria could be exceeded as a result of Project decommissioning.
- Potential for increased turbidity in streams from sedimentation that might result during the decommissioning of Project facilities at Kilarc and Cow Creek.
- Erosion and sedimentation might degrade water quality during decommissioning activities and after deconstruction is completed.
- Fish and wildlife resources could be affected by accidental release of oil or hazardous materials associated with construction activities.

PM&E measures to address these impacts are discussed in Section E.4.4.

E.3.5 Aquatic Resources

Potential impacts to aquatic resources from decommissioning the Kilarc and Cow Creek developments are described in this section. The evaluation criteria are described below:

- Creation of new, complete barriers to upstream fish migration.

- Fish mortality that substantially reduces the population of a native fish species, or negatively affects individuals of, or the long-term persistence of populations of special-status fish species.
- Adverse changes to aquatic habitat that would negatively affect populations of native or special-status fish species.

Decommissioning includes removal of Project facilities and the cessation of water diversions for hydropower production. The deconstruction activities would have short-term effects on fish habitat and may affect fish present during the deconstruction actions. The removal of Project features and the cessation of diversions would return the Project-affected bypass reaches to a more natural state and is expected to result in long-term benefits for the aquatic species. Water temperature results from 2003 indicated that decommissioning would lower water temperatures in the bypass reaches (see Section E.3.4, Water Quality); therefore no thermal impacts to aquatic resources would be expected.

E.3.5.1 Kilarc Development

Old Cow Creek

Deconstruction activities could affect resident fish species, mainly rainbow trout, brown trout, and sculpin at the Kilarc Main Canal Diversion Dam, Kilarc Main Canal, Kilarc Forebay, Kilarc Penstock, and Kilarc Tailrace. As discussed in Section E.2.5.2, it is possible, although unlikely, that steelhead could be present near the Kilarc Tailrace, as upstream fish passage to this area may be possible under some flow conditions. Neither steelhead or Chinook salmon would be able to access the Kilarc Diversion because of the impassable barrier located within the Project-affected bypass reach. Changes in water temperature resulting from decommissioning are discussed in Section E.2.4, Water Quality. Water temperatures would generally be expected to be cooler, (although they currently are suitable), and would be more favorable for salmonids throughout the bypass reach. Water temperatures downstream of the Project Area would be similar to what would have occurred naturally before the Project was constructed.

Kilarc Main Canal Diversion Dam

Potential impacts to aquatic resources resulting from the deconstruction of the Kilarc Main Canal Diversion Dam include:

- Lethal effects from shockwaves associated with breaking down the dam structure
- Crushing of aquatic species from operation of heavy equipment in the stream.
- Stored sediment behind the dam acting as a barrier to upstream migration.
- Sedimentation effects associated with the removal of the material from the dam and with the removal of the gates and other headwork structures.

Removal of the Kilarc Main Canal Diversion Dam would improve passage conditions for resident fish at this location, as the dam is likely an impassable barrier under most conditions.

After removal of the Kilarc Main Canal Diversion Dam, the stored sediment behind the dam could continue to act as a barrier to upstream migration, until natural flows remove some portion of this material. This barrier would occur because of the steep drop from the top of the stored sediment to the natural channel downstream of the dam. While this subsequent barrier would be temporary, the duration of time it persisted would depend on the magnitude and duration of high flows during the subsequent winter(s), the size of the stored substrates, and channel geomorphology. This barrier could persist for one or more years (see also Sections E.3.3.1 Disposition of Sediments in Storage at Diversions). Therefore, PM&E measures are proposed to provide passage immediately after decommissioning (see Section E.4.3, PM&E Measure GEOM-1).

As discussed in Section E.3.3.1 (Disposition of Sediments in Storage at Diversions), the release of the sediment stored behind the dam could potentially have some short-term effects associated with the release of the fine sediment fraction of these sediments. The amount of fine material that would be released would be small relative to the sediment transport capacity of Old Cow Creek. Additionally, the amount of fine sediment in the stored sediments comprises less than 10 percent of the total volume of sediment stored (see Section E.2.3, Geomorphology). The release of this fine sediment would occur over a period of several hours, days, weeks or longer, during high flow events, when suspended sediment loads would be expected to be high already. Complete dispersal of all the stored sediment may occur over one or more high flow seasons. The amount of time this would take would depend on the flow, the size of the material, and the channel configuration. The additional fine sediment that would be released would be small in relation to the amount of suspended sediment already carried by the high flows from upstream sources. Given the small volume of these fine sediments, this would not be expected to cause any impact to fish or downstream spawning habitat.

Another short term impact would be the temporary filling of pools immediately downstream of the dams. It is anticipated that pools within the first 10 bankfull widths downstream of the dam sites would experience the most deposition of material evacuated from behind the dams, but would return to pre-dam morphology after the larger seasonal high flows flush them out (see Section E.3.3.1, Disposition of Sediments in Storage at Diversions). The exception would be the plunge pools directly downstream of the dams, which would no longer be maintained by the energy head of water over the dams.

Short and long-term benefits would be associated with the release of native material stored behind the dam, particularly the spawning gravel-sized material. The release of gravels in storage behind the Kilarc Main Canal Diversion Dam would be beneficial as a source of spawning gravel for resident salmonids, as outlined in Section E.3.3.1. These gravels would move gradually downstream, maintaining existing spawning areas and potentially creating new spawning habitat. The investigation of sediment chemistry in Section E.3.4, Water Quality, concluded that the sediments could be allowed to remain in the channel to be naturally transported downstream after the Kilarc Main Canal Diversion Dam is removed without exceeding water quality standards (see Section E.3.4 Water Quality). The probability the release of these sediments would degrade water quality to a level where adverse impacts to fish would occur is low; therefore, no PM&E measures are proposed.

Kilarc Tailrace

The Kilarc Tailrace would be filled during decommissioning. This activity is not anticipated to require in-water work with heavy equipment, but could release sediments into the stream. The potential effects of filling the Kilarc Tailrace include the burial of fish by fill materials and sedimentation effects associated with placement of fill material.

North and South Canyon Creeks and Canals

North and South Canyon creeks have not been sampled, but rainbow trout is the species most likely to be present. The impacts of deconstructing South Canyon Creek Diversion Dam, and associated canal, are expected to be similar to those described for the Kilarc Main Canal Diversion Dam, although on a much smaller scale, and no heavy equipment would need to operate in the stream. North Canyon Creek is ephemeral, so decommissioning would be done after it goes dry and no impacts are expected. If water flows through South Canyon Creek Canal at the time of decommissioning (it has not been operated in several years), fish could be stranded when flows to the canals are cut off. If flows are present in the canal when decommissioning takes place, the potential impacts would be minimized using the PM&E measures proposed in Section E.4.5.

Kilarc Main Canal

Dewatering Kilarc Main Canal could strand fish in the canal, if they are present.

Kilarc Forebay

Decommissioning Kilarc Forebay could result in fish mortality during dewatering or the filling of the forebay.

E.3.5.2 Cow Creek Development

South Cow Creek

Steelhead and fall-run Chinook salmon[4] are present in South Cow Creek, and potentially Mill Creek (steelhead juveniles-year round; adults of both species and Chinook salmon fry and juveniles – primarily October through June) and could be impacted by Project decommissioning. In addition, resident rainbow and brown trout are present. Below Wagoner Canyon, an assemblage of native and introduced species occurs, including those listed above.

Decommissioning of the Project would result in increased flow in the bypass reach. This could affect water temperatures in this area. Summer water temperatures in this reach currently exceed the optimal temperatures (greater than 18°C) for steelhead juveniles and resident trout (see Section E.2.4, Water Quality). Removal of the Project facilities would increase the volume of water passing downstream of the location of the South Cow Creek Diversion Dam. This volume would have a greater thermal mass and therefore would warm more slowly as it moves

[4] Spring-run Chinook salmon strays could also be present occasionally.

downstream from this point. This could only result in lower temperatures, which would benefit salmonids in the bypass reach. Temperatures below the Project Area would also be expected to cool in response to these higher releases. Therefore, no PM&E measures are proposed to mitigate for temperature effects.

South Cow Creek Diversion Dam

The potential impacts from removing South Cow Creek Diversion Dam would be similar to those described for removing Kilarc Main Canal Diversion Dam. A key difference is that some existing structures will be left in place to minimize potential future erosion. These structures include the two parallel cutoff walls beneath the bin-wall dam structure and the retaining walls on both slopes. Retention of the cutoff walls will minimize disturbance of the stream bed and provide channel bed grade control after the dam is removed. The South Cow Creek Diversion Dam (up to 8.5 feet tall, but varying from the north to south side of the dam along its axis) sits on top of the two cutoff walls. The newer, second cutoff wall was built about 10 feet downstream of, and parallel to the original cutoff wall. The cutoff walls extends across the channel width from the abutment and retaining wall on the south bank to the intake structure on the north. The top of the cutoff wall is situated at elevation 1549.57 feet above MSL, which is probably very close to the original, native pre-dam streambed elevation, and extends 3.5 feet below the ground surface. Following dam removal, the cutoff walls would limit any incision upstream of the location of the diversion to the elevation of the top of the walls. Depending on the final profile of the stream after the sediment stored behind the dam is released, it is possible that the top of this cutoff wall could become exposed and create a barrier to fish migration through creation of: 1) a drop on its downstream face, 2) a broad crested weir, or 3) a critical riffle. This potential impact is addressed by PM&E AQUA-4 (Section E.4.3.1).

The disposition of the materials comprising the structure of the South Cow Creek Diversion Dam is not expected to affect aquatic resources. Non-native materials (concrete, bin walls, and potentially fill material) would be buried in the canal, as part of the canal decommissioning and covered with native materials. If the fill material within the bin walls is composed of native gravel, cobbles and boulders, then this material would be placed along the channel margin to allow for future recruitment by the stream, unless such placement could not be accomplished without causing other adverse effects. In this case, it would be used to fill the canal.

As with the removal of the Kilarc Main Canal Diversion Dam, there would be some short term effects associated with the release of fine sediments from behind the diversion and the temporary filling of pools downstream of the dam. These effects would be minor and short term for the same reasons described for the Kilarc Dam removal. The beneficial effect of providing spawning gravel downstream of the diversion would also occur on South Cow Creek, as this bypass reach also is sediment-limited.

Mill Creek Diversion Dam

The potential impacts from removing the Kilarc Main Canal Diversion Dam would apply as well to the removal of the Mill Creek Diversion Dam, though on a much smaller scale.

Mill Creek-South Cow Creek Canal

The potential impacts from decommissioning Mill Creek-South Cow Creek Canal would be similar to those described for decommissioning North and South Canyon Creek canals.

Hooten Gulch

Hooten Gulch supports California roach, sculpin and rainbow trout. The flashboard diversion dam for Abbott Ditch at the mouth of Hooten Gulch prevents other fish from entering Hooten Gulch from South Cow Creek.[5] This diversion is not part of the Project and belongs to private land owners. PG&E does not have the authority to modify this structure.

The impacts of decommissioning on Hooten Gulch would relate to cessation of flows from the Cow Creek Powerhouse, which currently provides perennial water to Hooten Gulch. Cessation of flows could result in fish being stranded or trapped in isolated pools and subsequently dying through predation, dehydration, or poor water quality conditions that develop as these pools dry up. Following decommissioning, Hooten Gulch would be returned to its natural ephemeral flow conditions.

A section of stream and streambank covered in gunite next to the Cow Creek Powerhouse protects the bank next to the Cow Creek Powerhouse from erosion. The gunite on the stream bed may increase water velocities through this area and potentially create a fish passage barrier at some flows. Removal of the gunite would restore the channel bed to a natural state and potentially improve fish passage. However, this could destabilize the banks currently protected by the gunite. As a result bank stabilization measures would need to be developed. Removal of this gunite and installation of alternative bank stabilization measures could create potential issues with increased turbidity and contamination from gas, oil and other substances associated with heavy equipment. There may be some flushing of fine sediments in the first flow events following construction activities. This would not be expected to affect fish, as these fish would move downstream following cessation of flows from the powerhouse and this pulse of sediment would occur during a time when turbidity from upstream areas is already high.

South Cow Creek Main Canal

The impacts from decommissioning South Cow Creek Main Canal would be similar to those described for decommissioning Kilarc Main Canal. South Cow Creek is known to support steelhead above the South Cow Creek Diversion Dam.

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5 Fish access into Hooten Gulch is currently blocked by the Abbott Ditch Diversion, which spans Hooten Gulch a few feet above its confluence with South Cow Creek. The Abbott Diversion consists of an 8 to 10 foot tall concrete weir topped with removable wooden flashboards and likely presents an insurmountable barrier for fish trying to move from South Cow Creek into Hooten Gulch. This diversion is not part of the Project and belongs to private land owners. PG&E does not have the authority to modify this structure. CDFG contends that this diversion may be operated differently in the future (the dam flashboards may need to be removed seasonally) and therefore fish would be able to access the creek. Observations by ENTRIX engineers with expertise in geomorphology and stream restoration indicate that removal of the concrete weir section of Abbott Ditch Diversion may cause substantial changes to the bed and banks of Hooten Gulch, which could potentially impact upstream non-Project private land and buildings.

Cow Creek Forebay

Most fish in Cow Creek Forebay consist of non-native species (i.e., golden shiner, sunfish). A few individual rainbow trout and steelhead and lamprey could be present. These fish would be subject to stranding or burial.

E.3.5.3 Summary of Aquatic Resources Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on aquatic resources are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Beneficial Impacts

- Fish passage would be improved following the removal of Project diversions.
- Gravel-sized material released from behind the dam would be a beneficial source of spawning gravel for resident and anadromous salmonids.
- Cooler water temperatures resulting from decommissioning would be more favorable to salmonids throughout the bypass reaches.
- Removal of gunite from Hooten Gulch could improve fish passage conditions.

Minor Impacts

- Temporary filling of pools immediately downstream of the Kilarc and Cow Creek diversion dams might impact aquatic resources.
- Turbidity may be increased slightly during one or more high flow seasons as fine sediments stored behind the dams are released.

Potentially Substantial Impacts; PM&E Measures Warranted

- Shockwaves from breaking down the dam structures might result in lethal effects to aquatic resources.
- Aquatic resources might be crushed from the operation of heavy equipment in the stream.
- Aquatic resources might be impacted from sedimentation effects resulting from the removal of dam material and the removal of gates and other headwork structures.
- Filling the Kilarc Tailrace might result in fish being buried and sedimentation in downstream areas.
- Retention of the cutoff walls under the South Cow Diversion Dam may result in a fish barrier after decommissioning.
- Upstream migration might be impeded by stored sediment behind the dam, until natural flows redistributes some portion of the sediment.

- Fish could be stranded when flows to Project canals are cut off.
- Dewatering or filling Kilarc and Cow Creek forebays could result in fish mortality.
- Fish might be stranded or trapped in isolated pools at Hooten Gulch when the Cow Creek Powerhouse is taken off-line.
- Bank stabilization in Hooten Gulch could create potential issues with increased turbidity and contamination from gas, oil and other substances associated with heavy equipment.

PM&E measures to address these impacts are discussed in Sections E.4.1, E.4.3, and E.4.5.

E.3.6 Wildlife Resources

Potential impacts to wildlife resources from decommissioning the Kilarc and Cow Creek developments are described in this section. Evaluation criteria for impacts that may warrant PM&E measures consist of the following:

- Substantial loss of foraging or breeding habitat that negatively affects the long-term persistence of a population of a special-status species or that substantially reduces the population of a native species.
- Injury or mortality of wildlife at a level that negatively affects the long-term persistence of a population of a special-status species or that substantially reduces the population of a native species.

E.3.6.1 Effects of Decommissioning Activities on Wildlife

Most Project-related impacts to wildlife resources are not expected to be adverse, but rather indirect, resulting from loss of habitat associated with decommissioning Project features including forebays, canals and diversions. Impacts to potential wildlife habitat may also occur from the construction of new access roads and/or the improvement of existing roads. Direct impacts to wildlife resources could result in injury or mortality during construction activities. Potential impacts for each section of the Kilarc and Cow Creek developments are discussed in the following section.

Diversions/Forebays/Intake Structures and Spillways/Hooten Gulch

Decommissioning activities at the Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam would consist of a combination of removal and abandonment in-place. The removal of diversion structures may eliminate backwater pools and plunge pools that have formed at Project diversions, so that these areas would no longer provide suitable habitat for pool-dwelling species. This could result in indirect impacts to northwestern pond turtle if that species utilizes the diversion pools. Up to 0.15 acre of riparian habitat would potentially be disturbed during decommissioning of the South Cow Creek Diversion Dam (see Section E.3.7.1 Effects of Decommissioning Activities on Botanical Resources).

As the Kilarc and Cow Creek forebay facilities are decommissioned and removed, direct impacts to amphibians and/or turtles and their habitat may occur. The filling of Kilarc and Cow Creek forebays would remove habitat for pond turtles. Foothill yellow-legged frogs, pond turtles, and their habitat could be negatively affected by the decommissioning of South Cow Creek Diversion Dam, and the resultant reduced flows in Hooten Gulch. Similarly, potential summer habitat for California red-legged frog could be impacted in Hooten Gulch. As described in Section E.3.7.1 (Effects of Decommissioning Activities on Botanical Resources), small stands of broadleaf cattail (*Typha latifolia*) would be impacted by the filling of both the Kilarc and Cow Creek forebays and a small seep (0.01 acre) would probably be dewatered by the filling of Kilarc Forebay.

Draining the forebays would remove foraging habitat for osprey and bald eagle. As described in Section E.2.5.2, surveys indicate that the forebay supports large numbers of naturally-produced brown trout. Rainbow trout were also present in the forebay, but most of these fish are planted by CDFG. However, the forebay is only 4 acres in area. Results from a study of bald eagles conducted in a variety of shoreline habitats in Washington indicate that the shoreline foraging areas for breeding pairs ranged from 1.25 to 2.5 miles (Watson, 2002). The perimeter of the Kilarc forebay is only approximately 0.35 mile. Consultation with USFWS indicates that the removal of Kilarc Forebay does not constitute take under the BEPA (Karuzas Pers. Comm., 2009).

Decommissioning activities could affect nesting birds, including raptors. Impacts could occur directly from disturbance to nest trees or individuals that enter the construction area. Indirect impacts could also occur from noise disturbance or construction lights.

Decommissioning activities in forested habitats could affect Pacific fisher. However, since old growth habitat will not be affected, the impacts to Pacific fisher habitat would be minimal or non-existent. Construction traffic on access roads has the potential to injure or kill Pacific fisher.

Summer flows in what is now the bypass reach of South Cow Creek would be increased as a result of the decommissioning of the South Cow Creek Diversion Dam (57 to 127 cfs, see Section E.3.2.1). South Cow Creek provides primary habitat for turtles and amphibians in this region. Increases in summer flows may be beneficial to foothill yellow-legged frog breeding habitat in South Cow Creek. Because Hooten Gulch is naturally an ephemeral stream (see Section E.3.2.2), habitat in Hooten Gulch may be seasonal after decommissioning, and impacts would be only to seasonal habitat.

The removal of the Kilarc Main Canal and South Cow Creek diversion dams may cause the release of additional sediment stored behind the diversions (see Section E.2.3, Geomorphology for additional discussion). Sediment release could have a short-term adverse effect on frogs and turtles if they occur in close proximity to dam sites. However, surveys conducted in 2003 indicate foothill-yellow legged frogs utilize the downstream portion of the South Cow bypass reach, not the reaches immediately below the diversion dams. Particle size sampling behind the Kilarc Main Canal Division Dam and the South Cow Creek Division Dam indicated that silt was virtually not present, and sand represented about 10 to 11 percent or less of the sediment. Most of the sediment stored behind these dams is gravel or cobble to boulder. There would likely be some short-term deposition of sediments in pools and across the channel bed immediately downstream of each dam as material is transported from the respective reservoirs, but with diminishing effects with distance downstream. As the sediment moves further downstream, it would disburse and be stored on available coarse material bars, minimizing effects to habitat.

Canals, Tunnels, Flumes, and Siphons

Project canals include a variety of constructed features (Exhibit A, Project Description). In general, the diversion canals (i.e., Kilarc Main Canal, the North and South Canyon Creek canals, South Cow Creek Main Canal, and Mill Creek-South Cow Creek Canal) have swiftly flowing water and no habitat complexity and are not likely to provide primary habitat for amphibians or reptiles. As described in Section E.3.7.1 (Effects of Decommissioning Activities on Botanical Resources), less than 0.01 acre of riparian vegetation could be affected by deconstruction activities at the North Canyon Creek Canal. A small seep (0.002 acre) was mapped adjacent to Kilarc Main Canal. In addition, most canals are dry for a portion of the year, further reducing their potential for providing suitable habitat. Deconstruction activities would result in minor, temporary loss of upland habitat along the canals.

Two elderberry shrubs observed near the South Cow Creek Main Canal could be affected by decommissioning activities. If an affected elderberry shrub has stems greater than 1 inch in diameter at the base, then impacts to habitat for valley elderberry longhorn beetle would occur.

Decommissioning activities could affect nesting birds, including raptors. Impacts could occur directly from disturbance to nest trees or individuals that enter the construction area. Indirect impacts could also occur from noise disturbance or the use of construction lights. To decommission the canals, a few small trees (less than two inches in diameter) growing along the steep canal banks would be removed, which would constitute a slight loss of habitat for foraging or nesting birds. Decomissioning activities in forested habitats, particularly traffic on access roads, could affect Pacific fisher. When Project tunnels are permanently sealed off at both ends for public safety, impacts to bats could occur if those species are using Project tunnels (i.e., Kilarc Main Canal Tunnel #1 and #2 and South Cow Creek Tunnel #1) for roosting.

Powerhouses and Penstocks

Decommissioning activities at the Kilarc and Cow Creek powerhouses and penstocks would be minimal, and impacts to wildlife resources are not expected. Penstocks would be left in place and potential impacts to surrounding habitat would be largely avoided. Some work would be performed at the head of the Kilarc and Cow Creek penstocks located at the forebays, and some work would be conducted at the end of the penstock where it would be plugged. No impacts to wildlife species are expected from work at penstocks. Impacts to amphibians could result during removal of the tailrace at the Cow Creek powerhouse if decommissioning is conducted when there is water in the tailrace.

Kilarc and Cow Creek powerhouses provide potential roosting habitat for bats. If these species are present, decommissioning activities at the Kilarc and Cow Creek powerhouses could disturb their lifecycle, or result in the take of individuals. However, no bats were observed in either area.

Access Roads

Decommissioning activities will include construction of a few new access road segments and improvement of existing roads. Habitat in the vicinity of access roads includes a variety of oak and pine dominated woodlands. Work may involve the removal of trees, and could potentially disturb nesting birds, particularly special-status and/or migratory species. Access road traffic at the Kilarc Development could result to direct impacts to Pacific fisher, if any are on a road during the decommissioning work. As described in Section E.3.7.1 (Effects of Decommissioning Activities on Botanical Resources), two seeps (totaling 0.006 acre) were mapped adjacent to an access road at the Cow Creek Development and a vernal swale (0.005 acre) was mapped adjacent to an access road at the Cow Creek Development. However, it is unlikely that amphibians or turtles would utilize these areas.

E.3.6.2 Summary of Wildlife Resources Impacts

Beneficial Impacts

- Increases in summer flows may be beneficial to foothill yellow-legged frog breeding habitat in South Cow Creek.

No Impacts

- No impacts to wildlife species are expected from work at penstocks.

Minor Impacts

- Small areas of upland habitat would be temporarily affected by the construction of new access roads, by the improvement of existing roads, and by the decommissioning of canals, flumes, and siphons.

Potentially Substantial Impacts; PM&E Measures Warranted

- Sediment release during removal of the Kilarc Main Canal and South Cow Creek diversion dams could have a short-term negative impact on frogs and turtles if they occur in close proximity to dam sites.
- The northwestern pond turtle and other pool-dwelling species might be impacted when backwater pools are eliminated when diversion structures are removed.
- Seasonal habitat at Hooten Gulch, due to reduced flows, could be affected after decommissioning.
- Nesting birds, including raptors, could be impacted by decommissioning activities including noise disturbance and construction lights.

- Amphibians and/or turtles might be impacted as the Kilarc and Cow Creek forebay facilities are decommissioned and removed.
- Raptors that forage at the forebays could be impacted when the forebays are drained.
- Valley elderberry longhorn beetle could be affected by removal or disturbance of elderberry shrubs near South Cow Main Canal.
- Bats may be impacted if they use Project tunnels or the Kilarc and Cow Creek Powerhouses for roosting habitat.
- Nesting birds could be impacted by the construction of new access roads and improvement of existing roads.
- Pacific fisher could be directly affected by traffic related decommissioning activities.

PM&E measures to address these impacts are discussed in Section E.4.6.

E.3.7 Botanical Resources

Potential impacts to vegetation communities due to decommissioning are discussed in this section. An evaluation criterion for potential impacts is:

- Substantial loss of vegetation communities or special-status plants.

E.3.7.1 Effects of Decommissioning Activities on Botanical Resources

Impacts to vegetation communities are generally not expected to be substantial. Impacts would occur from temporary loss of vegetation associated with decommissioning Project features, including forebays, canals, and diversions. Impacts to vegetation may also occur from the construction of new access roads and/or the improvement of existing roads. Direct impacts to special-status plant species would result from destruction of populations of mountain lady's slipper located on the Kilarc Main Canal and of big-scale balsamroot located adjacent to the access road to the Cow Creek Development. Approximately 11.5 acres (much of which is the Kilarc Forebay and the unvegetated canals) would be disturbed within the Kilarc Development, and approximately 10 acres (also mostly canals and Cow Creek Forebay) would be disturbed within the Cow Creek Development. Potential impacts are discussed in the following sections.

Diversions

Decommissioning activities at diversion dams (i.e., Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam) would be removal of diversion facilities and, in the case of South Cow Creek Diversion Dam, a combination of removal and abandonment in-place. Vegetation in the vicinity of these diversions includes riparian forest and freshwater wetland/marsh communities as well as Sierran mixed coniferous forest on the upper slopes. In locations where riparian and/or wetland vegetation has developed around these diversions, that vegetation would be disturbed during decommissioning and some loss of riparian and wetland vegetation could occur. Up to 0.15 acre of riparian habitat would potentially be disturbed during decommissioning of the South Cow Creek Diversion Dam. The riparian area meets all criteria for jurisdictional wetlands under the CWA; the seeps do not.

Forebays, Intake Structures, and Spillways

Decommissioning activities proposed at Kilarc and Cow Creek forebays would include removing intake and control equipment, filling the forebay and demolishing and filling the overflow spillway. In addition, picnic tables and bathrooms would be removed at Kilarc Forebay. Upland vegetation in the vicinity of the Kilarc Forebay consists of ponderosa pine plantation, and the Cow Creek Forebay is located within interior live oak woodland. These upland communities would not be significantly affected by decommissioning activities. Small stands of broadleaf cattail (*Typha latifolia*) would be impacted by the filling of both the Kilarc and Cow Creek forebays. A small seep (0.01 acre) was mapped adjacent to Kilarc Forebay and would probably be dewatered by the filling of the forebay.

Access road improvements (both Project and non-Project roads) and work areas associated with demolition and filling activities could impact limited areas of pondersosa pine plantation and interior live oak woodland at Kilarc and Cow Creek forebays, respectively.

Canals, Tunnels, Flumes, and Siphons

Project canals include a variety of constructed features (Exhibit A). There are several options for decommissioning at canals (Exhibit A), which may result in different potential impacts.

Upland vegetation in the vicinity of the Kilarc Development (i.e., Kilarc Main and North and South Canyon Creek canals, siphons, flumes, and tunnels) includes Sierran mixed coniferous forest and ponderosa pine plantation. Vegetation communities present in the vicinity of the Cow Creek Development (i.e., Mill and South Cow Creek Main canals and tunnel) include Sierran mixed coniferous forest and interior live oak woodland along the Cow Creek Canal. Vegetation would not be substantially disturbed at tunnels and siphons, as work would be limited to a very small area at the ends of each structure. Decommissioning work at canals could disturb limited areas of Sierran mixed conifer forest (approximately 7 acres), ponderosa pine plantation (less than 1 acre), and live oak woodland (less than 1 acre).

Decommissioning canals in the Kilarc and Cow Creek developments would eliminate the delivery of Project water to those areas. Tunnels, flumes, siphons, or concrete-lined canals do not have the potential to support wetlands. Earthen canals, with natural banks have the possibility of providing substrate for riparian wetlands that were created by introduced Project water. However, diversion canals (i.e., Kilarc Main Canal, South Cow Creek Main Canal) are typically high-gradient with swiftly flowing water which precludes the establishment of wetlands. In addition, some canals may be dry for a portion of the year, further reducing the potential for wetland development. Seepage from canals and flumes can create moist conditions that support wetlands. During the wetland delineation survey conducted in 2008, one riparian wetland was observed adjacent to the North Canyon Creek Canal. Because the riparian wetland is located upslope of the North Canyon Creek Canal and is associated with two intermittent streams that drain into the canal, removal of the canal would not affect the function of this feature. A small seep (0.002 acre) was mapped adjacent to Kilarc Main Canal and may be affected when water diversion is eliminated. Therefore, only limited effects to wetland vegetation are expected at canals, tunnels, flumes, and/or siphons in the Kilarc and Cow Creek developments. Although the riparian area meets all criteria for jurisdictional wetlands under the federal CWA; the seep does not.

One CNPS List 4 species, mountain lady's slipper, was found adjacent to the Kilarc Main Canal (Figure E.2.6-2, Map 2). This population consisted of two plants growing at the base of an above-ground reach of the canal, at the top of a steep, bare slope failure. Decommissioning activities at this portion of the canal would cause unavoidable impacts to this population.

Powerhouses and Penstocks

Decommissioning activities at the Kilarc and Cow Creek powerhouses and penstocks would be minimal, and impacts to native vegetation would not be expected. Kilarc Powerhouse and Kilarc Residence are mapped primarily as blue oak-foothill pine woodland and developed land. Cow Creek Powerhouse is surrounded by interior live oak woodland, annual grassland-chaparral-young forest, and blue oak-foothill pine woodland. Decommissioning of the Kilarc and Cow Creek powerhouses would not substantially affect these upland vegetation types. A small riparian area (0.04 acre) is located at the edge of the FERC Project boundary at the Kilarc Powerhouse. A wetland area, mapped as a seep/spring, was observed at Kilarc Powerhouse. This seep is approximately 0.04 acre in extent. This seep meets all criteria for jurisdictional wetlands under the federal CWA.

Kilarc and Cow Creek penstocks would be left in place and potential impacts to surrounding habitat would be largely avoided. Some work would be performed at the head of the penstock located at the forebay, and some work would be conducted at the end of the penstock where it would be plugged.

Access Roads

Most of the roads to be used during decommissioning are existing roads located on private property. No new access roads are proposed in the Cow Creek Development. Several new, short road segments are being considered to facilitate work on the canals in the Kilarc Development, pending landowner approval. Building these roads would require vegetation removal, including limited areas of live oak woodland and ponderosa pine plantation. However, the proposed road segments would constitute only about 0.5 miles or 0.7 acre, and would be built only in areas that have already been disturbed by logging.

Vegetation in the vicinity of access roads includes Sierran mixed coniferous forest, ponderosa pine plantation, blue oak-foothill pine woodland, interior live oak woodland, and non-native grassland. Two seeps (totaling 0.006 acre) were mapped adjacent to an access road at the Cow Creek Development and a vernal swale (0.005 acre) was mapped adjacent to an access road at the Cow Creek Development. Decommissioning work would include the removal of vegetation, including limited areas of ponderosa pine plantation (less than 1 acre), and Sierran mixed conifer forest (less than 1 acre). Both the seeps and the vernal swale associated with the Cow Creek

Development meets all criteria for jurisdictional wetlands under the federal CWA, but the seep at the access road for the Kilarc Development does not.

A population of big-scale balsamroot was found adjacent to an access road in the Cow Creek Development (Figure E.2.6-1, Map 2). This road would require minor to moderate improvements. Short areas of the road may require minor widening. This population could sustain minor impacts if the widening occurs near the plants. It is possible, however, that the big-scale balsamroot could be avoided during road improvement activities.

E.3.7.2 Summary of Botanical Resources Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following limited impacts on botanical resources are anticipated from decommissioning the Kilarc and Cow Creek developments:

No Impacts

- Kilarc and Cow Creek penstocks would be left in place. Impacts to habitat along the penstocks would be avoided.

Minor Impacts

- Plugging the ends of the Kilarc and Cow Creek penstocks would result in temporary loss of small areas of vegetation.
- Removal of the North Canyon Creek Canal would not affect the function of the upslope riparian wetland and only limited effects to wetland vegetation are expected at canals, tunnels, flumes, and/or siphons in the Kilarc and Cow Creek developments.
- Temporary loss of vegetation may occur when features are decommissioned, including forebays, canals, and diversions.
- Construction of new access roads and/or the improvement of existing roads would impact limited areas of vegetation.
- Potential, but not substantial, impacts may occur at small seeps and wetlands.

Potentially Substantial Impacts; PM&E Measures Warranted

- Unavoidable impacts would occur to the population of mountain lady's slipper located on the Kilarc Main Canal.
- The population of big-scale balsamroot located adjacent to the access road in the Cow Creek Development could be affected.
- Impacts could potentially occur to other special status plant species if any emerge in the disturbance area prior to construction.

PM&E measures to address these impacts are discussed in Section E.4.7.

E.3.8 Historical Resources

Potential impacts to historical resources from decommissioning the Kilarc and Cow Creek developments are described in this section. An evaluation criterion for potential impacts is the following:

- Adverse changes in the significance of architectural and historical resources recommended for eligibility in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR).

E.3.8.1 Impacts on Kilarc and Cow Creek Powerhouses

Based on the records searches, extensive archival research, field surveys, and resource evaluations conducted for the proposed Project, there are two historical resources within the APE that are eligible for listing in the NRHP and CRHR: the Kilarc and Cow Creek powerhouses. PG&E has determined that the associated hydroelectric and water conveyance features (penstocks, canals, diversion dams, tunnels, siphons, forebays, spillways, berms and flumes) have not retained the sufficient integrity of design, setting, workmanship, materials, feeling, and association to be eligible for listing individually or as historic districts in the NRHP or CRHR.

The Kilarc and the Cow Creek powerhouses currently are structurally sound because they have been actively used and have been reasonably well maintained over time. Long-term deterioration of the buildings may occur while the powerhouses are unoccupied. There is also a risk of sudden loss by fire or vandalism. This deteroriation would cause a substantial adverse change in the significance of the NRHP- and CRHR-eligible buildings.

E.3.8.2 Summary of Historical Resource Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following limited impact on historical resources is anticipated from decommissioning of the Kilarc and Cow Creek developments:

Potentially Substantial Impacts; PM&E Measures Warranted

- Decommissioning activities could cause a substantial adverse change in the significance of NRHP- and CRHR-eligible buildings due to the long term deterioration, fire or vandalism.

PM&E measures to address these impacts are discussed are discussed in Section E.4.8.

E.3.9 Archaeological Resources

Potential impacts to archaeological resources from decommissioning are described in this section. Evaluation criteria include:

- Adverse change in the integrity of the five identified archaeological resources that have not been evaluated for NRHP or CRHR-eligibility.

- Disturbance of human remains.

E.3.9.1 Impacts on Prehistoric Archaeological Sites

Based on records searches, extensive archival research, field surveys, and resource evaluations, no archaeological resources were identified and recommended for NRHP or CRHR eligibility. The five archaeological resources that have a prehistoric archaeological component within the APE (482-12-03/H, -04, -05/H, -08/H, and -11/H, and one historical archaeological site 482-12-03H) have not been evaluated for their potential eligibility for listing in the NRHR or CRHR. The decommissioning activities as proposed do not appear to pose potential impacts to these resources under planned avoidance procedures; however, a PM&E measure may be warranted to ensure impacts do not occur. Also, use of new or improved access roads would constitute a ground-disturbing activity and could impact unknown resources.

E.3.9.2 Impacts on Archaeological Materials

Archaeological materials may potentially be disturbed during decommissioning activities. Resources could include buried historic features such as artifact-filled privies, wells, and refuse pits; artifact deposits; concentrations of adobe, stone, or concrete walls or foundations; and concentrations of ceramic, glass, or metal materials. Native American archaeological materials could include obsidian and chert flaked stone tools (such as projectile points and knives), midden (darken soil created culturally from use and containing heat-affected rock, artifacts, animal bones, or shellfish remains), and/or groundstone implements (such as mortars and pestles).

E.3.9.3 Impacts on Human Remains

There is also the possibility during decommissioning activities of encountering human remains either in association with prehistoric occupation sites or otherwise.

E.3.9.4 Summary of Archaeological Resource Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on archaeological resources are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Potentially Substantial Impacts; PM&E Measures Warranted

- Adverse changes could be caused in the integrity of the five identified archaeological resources that have not been evaluated for NRHP- or CRHR-eligibility.
- Archaeological materials, including buried historic features and Native American archaeological materials, may potentially be disturbed.
- Potential disturbances of human remains might occur during decommissioning activities.

PM&E measures to address these impacts are discussed in Section E.4.9.

E.3.10 Recreation

Potential impacts to recreation from decommissioning are described in this section. An evaluation criterion is:

- Removal of recreational resources that impact regional recreational use.

The principal impacts would occur at the Kilarc Forebay and Day Use Area and the Kilarc Powerhouse. Within the Project Area, the Kilarc Forebay is the only location where developed formal recreation facilities have been established (Kilarc Day Use Area). The Kilarc Powerhouse has a grassy lawn that the public currently uses informally for picnicking and fishing access. No other recreational facilities are situated in the Project Area.

E.3.10.1 Impacts on Kilarc Forebay and Day Use Area

PG&E's access to the Kilarc Forebay and Day Use Area is across private property, and is permitted in conjunction with PG&E's FERC license. The site would no longer be accessible to the public after decommissioning.

The impact on recreational facilities from decommissioning would be limited given the existence of other regional recreational opportunities. The estimated 826 seasonal visitors[6] to the Kilarc Forebay per year represent less than one-half percent of the yearly visitation to other recreational facilities (see Tables E.2.1-1 and E.2.10-2) so the use of this site is low in comparison. Although a local recreational resource, the loss of fishing, sightseeing, and picnicking opportunities at the Kilarc Forebay would be minimal as ample recreational alternatives exist at a variety of comparable sites, as noted in Tables E.2.10-1 through E.2.10-3 in Section E.2.10. In addition, there are comparable recreation opportunities available to Kilarc Forebay visitors at nearby reservoirs operated by PG&E.

E.3.10.2 Kilarc Powerhouse

The Kilarc Powerhouse structure would be secured and left in place during decommissioning and potential future reuse of the structure would be preserved. PM&E measures are described in Section E.4.8 to address this.

The public use of the Kilarc Powerhouse site for fishing and other activities would not be restricted as a result of the decommissioning. In addition, there are comparable recreation locations in the region, and the site use is very low at Kilarc Powerhouse in comparison to site usage at surrounding state and federal recreational areas.

6 Calculation = 5.4 average daily visitors times 153 days from May through September (ENTRIX, 2008). Total yearly visitation, including off-peak use, cannot be calculated because the recreation survey (PG&E, 2007) studied use only during peak months.

E.3.10.3 Summary of Recreation Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on recreation are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Minor Impacts

- Regional recreational resources at the Kilarc Forebay and Day Use Area and Kilarc Powerhouse would be minimally impacted after decommissioning.

No PM&E measures have been recommended.

E.3.11 Aesthetics

Potential impacts to aesthetics from decommissioning are described in this section. Evaluation criteria include the following:

- Damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a scenic route or highway.
- Degradation of the existing visual character or quality of the site and its surroundings.

E.3.11.1 Impacts on the Kilarc Development

KOP 1 (see Section E.2.11.3) has a moderate visual quality and viewer sensitivity because the landscape surrounding the Kilarc Powerhouse is fairly typical in the area. This KOP has average scenic value because it contains significant man-made features such as the powerhouse, electric transmission poles and accessory structures, and a paved two-way road. This KOP contains some natural features, mostly dense forest to the southeast. The level of vividness, intactness, and unity at this location is average. Through the survey information contained within the 2007 Recreational Resources Report, viewers also expressed some concern for scenic quality in response to changes in views.

KOP 2 has a moderate visual quality and viewer sensitivity because there is only sparse vegetation surrounding the Kilarc Forebay, which is a man-made feature in the foreground. This KOP has average scenic value because it lacks high-quality landscape and topography that would define a higher quality scenic value. In addition, the level of vividness, intactness, and unity at this location is average. Viewers, through the survey information contained within the 2007 Recreational Resources Report, have some concern for scenic quality in response to changes in views. With the deconstruction of the Kilarc Forebay, the Kilarc Forebay would be drained and re-vegetated, the canals and diversions would be dewatered, and the picnic and restroom facilities would be removed. While the contrast of these changes with the existing conditions would be considered moderate to strong from KOP 2, the return of the area to a natural condition would actually improve the natural aesthetics of the forebay area. Upon decommissioning, Kilarc Forebay would no longer be publicly accessible and would no longer be considered an aesthetic resource.

The decommissioning activities would not affect the vividness, intactness, and unity of these views, and therefore would not cause a substantial adverse effect on the visual quality of views from KOPs 1 and 2.

E.3.11.2 Impacts on Cow Creek Development

The Cow Creek Powerhouse is not accessible or easily viewed by the public. While not considered an aesthetic resource, the Cow Creek Powerhouse structure would be secured and left in place during decommissioning and future reuse of the structure would be preserved. The building would be secured and access to the structure by the public would continue to be restricted.

E.3.11.3 Impacts on other Aesthetic Resources

No other impacts to other aesthetic resources situated in or near the Project would occur.

E.3.11.4 Summary of Aesthetic Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on aesthetics are anticipated from decommissioning of the Kilarc and Cow Creek developments:

Beneficial Impacts

- Returning Kilarc Forebay to its natural condition would improve the natural aesthetics of the forebay area.

No Impacts

- No scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings would be damaged within a scenic route or highway.

Minor Impacts

- Existing visual character or quality could be minimally degraded at the Kilarc Forebay site and its surrounding.

No PM&E measures have been recommended.

E.3.12 Land Use

Potential impacts to land use from decommissioning are described in this section. Evaluation criteria include the following:

- Conflicts with any applicable land use plan, policy or regulation of an agency with jurisdiction over the Project, including, but not limited to the general plan, specific plan, or zoning ordinance, adopted for the purpose of avoiding or mitigating an environmental effect.

- Conflicts with any land management or land ownership policies or regulations.

PG&E assessed the consistency of decommissioning activities with the Shasta County General Plan (2004), Shasta County Zoning Plan (2003), Lassen National Forest's Land and Resource Management Plan (USDA-FS, 1992), PG&E's Land Conservation Commitment, Draft LaTour Demonstration State Forest Management Plan (CAL FIRE, 2008), and CAL FIRE's Fire and Resource Assessment Program.

E.3.12.1 Compliance with Plans and Policies

Shasta County General Plan

The Shasta County General Plan (2004) has no specific policies or guidelines regarding the Project facilities, and decommissioning the Project facilities presents no policy or physical land use conflicts with the General Plan. The decommissioning of the Project facilities would not result in environmental or land use changes that would conflict with the General Plan objectives and policies related to preserving agricultural lands and timberlands, nor would it construct homes, roads, or other structures that could visually or physically interfere with open space or recreational uses and conflict with General Plan objectives and policies related to open space and recreation.

Shasta County Zoning Plan

The Shasta County Zoning Plan (2003) does not specifically address the Project facilities, and decommissioning the Project facilities would present no conflicts with the Zoning Plan.

Other Plans and Policies

Land and Resource Management Plan, Lassen National Forest

Lassen National Forest is located approximately 2 miles from the Kilarc Development. It is managed through the Land and Resource Management Plan (USDA-FS, 1992). The overall desired future condition of Lassen National Forest is to provide timber and other forest products on a sustainable level while providing for biodiversity with viable populations of native plants and wildlife. Management Area 8, which is closest to the Project facilities, is primarily managed for spotted owl, marten, and fisher habitat. In addition, small amounts of timber harvesting along with recreation concentrated around the Seven Lakes and higher country is also allowed. Because Lassen National Forest would be upstream of any potential hydrological effects on wildlife, timber production, or recreational uses, decommissioning the Project would not affect or conflict with the goals of the Land and Resource Management Plan.

Pacific Gas and Electric Company's Land Conservation Commitment

Beginning in 2008, the Stewardship Council will work with PG&E and interested stakeholders to develop a Land Conservation and Conveyance Plan (LCCP) for each of PG&E's watershed lands. Implementation and completion of the LCCPs are expected to continue through 2013. The Stewardship Council will re-evaluate the Kilarc and Cow Creek Planning Units to reflect the status and outcome of the decommissioning process and terms of a FERC order, if applicable, at that time.

Draft LaTour Demonstration State Forest Management Plan

The LaTour Demonstration State Forest is located approximately 6 miles east of the Kilarc Development. It is managed through the Draft LaTour Demonstration State Forest Management Plan (CAL FIRE, 2008). The LaTour Demonstration State Forest is zoned as a Timberland Production zone; therefore, the land is devoted to timber growing and harvesting and compatible uses. Because the LaTour Demonstration State Forest is more than 6 miles from the Project Area, and because it would be upstream of any potential hydrological effects on timber production or recreational uses, decommissioning the Project would not have any effect within the Demonstration Forest nor conflict with the Draft LaTour Demonstration State Forest Management Plan.

Fire and Resource Assessment Program (CAL FIRE)

The use of construction equipment and temporary onsite storage of diesel fuel could pose a wildland fire risk in the Project Area. The time of the greatest fire danger is during the clearing phase, when people and machines are working among vegetative fuels that can be highly flammable. If piled onsite, the cleared vegetative materials could also become a fire fuel. Potential sources of ignition include equipment with internal combustion engines, gasoline powered tools, and equipment or tools that produce a spark, fire, or flame. Such sources include sparks from blades or other metal parts scraping against rock, overheated brakes on wheeled equipment, friction from worn or unaligned belts and drive chains, and burned out bearings or bushings. Sparking as a result of scraping against rock is difficult to prevent. The other hazards result primarily from poor maintenance of the equipment. Smoking by onsite construction personnel is also a potential source of ignition during construction.

After decomissioning, the Kilarc Forebay would not be available to CAL FIRE as a fire suppression water supply. However, this would have no impact on CAL FIRE's ability to fight fires in the area because there are several similarly sized or larger lakes within 15 miles of the Kilarc Reservoir, as well as several creeks, that can be used used as a water resource for fire suppression.

E.3.12.2 Impacts on Land Management

The Project facilities represent an established land use in the Project Area and do not conflict with any other developed or planned use. Surrendering the current operating license and decommissioning the Project facilities would not conflict with the Shasta County General Plan, Shasta County Zoning Plan, Lassen National Forest's Land and Resource Management Plan, PG&E's Land Conservation Commitment, or the Draft LaTour Demonstration State Forest Management Plan; however, decommissioning activities could conflict with the Fire and Resource Assessment Program. Therefore, PM&E measures are proposed in Section E.4.12 to minimize these potential impacts.

E.3.12.3 Impacts on Land Ownership

In order to facilitate the disposition of a portion of the Cow Creek Penstock as proposed in the PDP, PG&E is exploring the option of acquiring the land rights associated with the 1.87 acres held in trust by the United States under the jurisdiction of the Bureau of Indian Affairs. It is expected that PG&E would retain ownership of the Project facilities and land throughout the decommissioning, and no additional changes to land ownership are expected as a result of the decommissioning. Where PG&E holds easements on private lands for Project facilities, upon completion of decommissioning, PG&E currently proposes to quitclaim[7] the easements back to the private landowner.

E.3.12.4 Summary of Land Use Impacts

Based on the evaluation of potential impacts presented in the preceding sections, the following impacts on land uses are anticipated from decommissioning of the Kilarc and Cow Creek developments:

No Impacts

- Decommissioning would cause no conflicts with any land management or land ownership policies or regulations.

Potentially Substantial Impacts; PM&E Measures Warranted

- The use of construction equipment and temporary onsite storage of diesel fuel could pose a wildland fire risk and conflict with the Fire and Resource Assessment Program.

PM&E measures to address these impacts are discussed in Section E.4.10.

[7] A quitclaim deed is a term used to describe a document by which an entity (the "grantor") disclaims any interest the grantor may have in a piece of real property and passes that claim to another person (the grantee).

E.3 PROJECT IMPACT TABLE

Table E.3.4-1. Summary of Copper Water Quality in the Kilarc Development

Sample	2003 Sample Date	Measured Values[1]		Water Quality Objectives for Cu[2]			Related Water Quality Measurements[3]		
		Total Copper (µg/L)	Dissolved Copper (µg/L)	Basin Plan Objective (µg/L)	Acute Concentration (µg/L)	Chronic Concentration (µg/L)	Hardness (µg/L)	pH	Alkalinity (µg/L)
NC1	March	0.11	0.07	3.25	3.3	2.5	21.8	7.98	21
	October	<0.003	<0.003	7.11	7.5	5.3	51.9	8.10	54.4
CC1	March	0.09	0.06	6.82	7.2	5.1	49.5	7.79	57.8
	October	<0.003	<0.003	6.93	7.3	5.2	50.4	7.92	52.1
CC2	March	0.62	0.05	4.62	4.8	3.5	32.2	7.85	37
	October	<0.003	<0.003	4.40	4.6	3.4	30.5	7.80	29.8
OC1	March	0.077	0.044	3.61	3.7	2.8	24.5	7.89	30
	October	<0.003	<0.003	6.82	7.2	5.1	49.5	8.06	44.8
OC3	March	0.384	0.162	3.99	4.1	3.1	27.4	7.75	33
	October	0.174	0.23	6.82	7.2	5.1	49.5	8.07	48.7
KF1	March	0.088	0.088	3.34	3.4	2.6	22.5	8.00	28
	October	<0.003	0.047	6.75	7.1	5.1	49.0	8.28	58.8
OC4	March	0.158	0.077	3.61	3.7	2.8	24.5	7.95	27
	October	<0.003	0.037	6.88	7.3	5.2	50.0	8.24	46.5
MC1	March	0.706	0.451	7.36	7.8	5.5	53.9	7.27	61
	October	0.13	0.095	11.35	12.3	8.3	87.0	8.10	80.5
SC1	March	0.309	0.187	3.99	4.1	3.1	27.4	7.55	32
	October	0.068	0.18	7.00	7.4	5.2	51.0	7.88	48.1
SC4	March	0.457	0.238	4.89	5.1	3.7	34.3	7.77	38
	October	0.056	0.163	9.04	9.7	6.7	67.6	7.89	63.2
SC5	March	0.478	0.248	5.02	5.2	3.8	35.3	7.65	42
	October	0.093	0.191	9.04	9.7	6.7	67.6	7.85	65
CCF1	March	0.309	0.275	4.12	4.3	3.2	28.4	7.23	34
	October	0.056	0.116	8.09	8.6	6.0	59.8	7.82	58

Notes:

1. Samples collected in March and October 2003.
2. Calculated values. Copper water quality objective varies based on an empirical formula that takes hardness of the water into account. Therefore, Basin Plan objectives for copper vary based on hardness (RWQCB, 2007).
3. Calculated values. Similar to the Basin Plan, NOAA provides a formula for calculation of criterion based on variability of hardness (Buchman 2004).

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EXHIBIT E: ENVIRONMENTAL REPORT

E.4 Protection, Mitigation, and Enhancement Measures

This section identifies and discusses proposed Protection, Mitigation, & Enhancement (PM&E) measures to reduce or eliminate impacts identified in Section E.3, to the extent feasible.[1] The PM&E measures are intended to accompany the PDP (Appendix A) that contains the detailed description of Project facilities. The section is organized by resource area.

E.4.1 Geology and Soils

This section describes proposed PM&E measures to offset potential impacts on geology and soils as a result of decommissioning activities.

E.4.1.1 Soil Erosion or Loss of Top Soil

As described in Section E.3.1, the removal of structures in the stream banks and creek restoration activities have the potential to result in streambank erosion. In addition, erosion and sedimentation may result from increased use and/or expansion of access roads and construction and/or use of staging areas, which could erode during precipitation events. PG&E will employ effective, site-specific, erosion control measures based on BMPs described below under FERC jurisdiction for two years following decommissioning. If monitoring indicates that further action is necessary, PG&E will work under the authority of permitting and resource agencies such as USACE (per the conditions of the CWA 404 permit) and the SWRCB (per the conditions of the CWA 401 permit).

To address these impacts, the following PM&E measures are proposed:

PM&E Measure GEOL-1: Implement Soil Erosion and Sedimentation Control Best Management Practices

The Licensee shall identify and implement Soil Erosion and Sedimentation Control BMPs that address soil erosion impacts that may occur both during and after decommissioning construction work. The Licensee shall adhere to standard erosion control procedures, including applicable measures developed by the U.S. Forest Service (USDA-FS) and published in the Water Quality Management for Forest System Lands in California Best Management Practices (USDA-FS, 2000b).[2]

[1] PM&E measures to be implemented by the applicant under FERC jurisdiction are specified in this section as actions that the Licensee "shall" undertake. Additional requirements expected to be imposed by permitting agencies are also identified below, as actions that "will" be undertaken.

[2] Water Quality Management for Forest System Lands in California (USDA-FS, 2000) provides a set of standardized BMPs to protect water quality during the planning and construction of projects. The BMPs are organized into eight land use activity categories including Road and Building Site Construction and Watershed Management.

Prior to construction, the Licensee shall identify all natural drainage paths along the canals and tunnel during pre-construction surveys. Slopes prone to instability shall be identified, and site specific BMPs shall be implemented to avoid potential slope erosion and increased sedimentation in streams during and after construction activities.

During the construction period, the Licensee shall install BMPs in all areas where soil is disturbed and could result in an increase in sedimentation and/or erosion. The Licensee shall perform inspections after storm events and perform any necessary repairs, replacements and/or addition of BMPs.

At the end of construction, the Licensee shall identify potential future erosion sites and install long-term BMPs.[3] Specific areas to be addressed are listed below:

- After removal of the canals, diversions, and impoundment structures, the Licensee shall implement BMPs such as restoration of natural drainage paths, and recontouring of slopes to match pre-existing slope morphology, as feasible. Revegetation shall be implemented to increase bank stability (See PM&E Measure BOTA-1).

- The Licensee shall implement BMPs to address potential erosion of access roads and staging areas throughout the Kilarc and Cow Creek developments. Artificial swales, culverts, and/or other structures shall be designed to direct runoff away from disturbed areas based on the natural drainage features of the area. For any temporary access roads that are removed, the Licensee shall implement measures in accordance with BMP 2-26 Obliteration or Decommissioning of Roads, as defined in the USDA-FS Water Quality Management for Forest System Lands in California Best Management Practices (USDA-FS, 2000).

To ensure the effectiveness of the long term BMPs, post-construction monitoring will be conducted for two years within the stream channel (See PM&E Measure GEOM-2) and for one year in all other construction areas.[4] The post-construction inspections will be to ensure that BMPs installed at the end of construction are effective and/or to identify areas where installation of additional BMPs is necessary.

PM&E Measure GEOL-2: Implement Stormwater Pollution Prevention Best Management Practices

The Licensee shall identify all potential pollutant sources, including sources of sediment (e.g., areas of soil exposed by grading activities, soil/sediment stockpiles) and hazardous pollutants (e.g., from petroleum products leaked by heavy equipment or stored in maintenance areas). Also, the Licensee shall identify any non-storm water discharges

[3] If, for example, stabilization measures are warranted, the Licensee shall design BMPs to protect the banks at dam abutments and diversion canal intakes during high flow events.

[4] The erosion control measures will be designed to develop and maintain geomorphically-stable stream channels above, below, and at the diversions, and the erosion control measures will also be designed to prevent contributions of sediment to drainages and streams.

and implement BMPs[5] to protect streams from potential pollutants and minimize erosion of topsoil. The Licensee shall include a monitoring and maintenance schedule to ensure BMP effectiveness for sediment control, spill containment, and post-construction measures.

The Licensee shall include a monitoring and reporting program, including pre- and post-storm inspections, to determine if BMPs are sufficient to protect streams and to identify any areas where stormwater can be exposed to pollutants. The monitoring program will include provisions for sampling and anaysis to evaluate whether pollutants that cannot be visually observed are contributing to degradation of water quality.

Expected Outcome

Implementation of PM&E measures GEOL-1 and GEOL-2 would reduce the potential impacts related to soil erosion and sedimentation and potential release of hazardous chemicals into stormwater runoff (See Section E.4.4.1).

E.4.1.2 Soil Stabilization and Liquefaction

It is not anticipated that pile driving or other related construction practices would be utilized during the decommissioning process. Thus, PM&E measures for liquefaction are not proposed.

As described in Section E.3.1, construction activities could cause soil to become unstable resulting in on- or off-site landslides. To address this impact, the following PM&E measure is proposed:

PM&E Measure GEOL-3: Professional Engineering Design Plans and Specifications

The Licensee shall develop detailed design plans and specifications after FERC orders the Project to be decommissioned. These plans shall consider the potential for landslides and shall include provisions to minimize this potential. The Licensee shall prepare engineering plans for new access roads or staging areas to minimize grades and cut and fill volumes, as well as to minimize any potential for landslides as a result of the grading work.

Expected Outcome

Implementation of PM&E measure GEOL-3 would reduce the potential for landslides to occur during construction activities.

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[5] These measures may include: (1) requiring that fueling or maintenance of equipment (including washing) only be performed in specified areas outside an approved protective strip of predominately undisturbed and vegetated soil; (2) not allowing refueling of construction equipment within 100 feet from riparian or aquatic habitats; (3) reporting any release of oil or hazardous materials immediately upon detection in accordance with all applicable laws and regulations; and (4) requiring all contractors to have materials on hand to control and contain a spill of oil or hazardous materials.

E.4.2 Hydrology and Water Resources

No substantial impacts are anticipated on hydrologic resources as a result of decommissioning activities. Therefore, no PM&E measures are proposed.

E.4.3 Geomorphology

This section describes proposed PM&E measures to offset potential impacts on geomorphology as a result of decommissioning activities.

E.4.3.1 Disposition of Sediments in Storage

As described in Section E.3.3, the release of sediment behind the Kilarc Main Canal and South Cow Creek diversion dams may result in the short-term filling of pools downstream of the dams and the creation of fish passage impediments. The plunge pools located immediately downstream of each of the dams would partially or mostly fill with sediment, and would probably not reform after the dams are removed. Other than these two plunge pools, pools further downstream would also temporarily store sediment, but seasonal high flows are sufficient to maintain these pools over the long-term, so that any sediment deposition would not persist. The downstream face of the sediment wedge (along the upstream face of the former dam site) could be a temporary impediment to fish passage until there are sufficient high flows to incise into the sediment wedge at the nickpoint created by the dam removal, producing a low-flow channel suitable for passage. Additionally, a highly mobile bed associated with transport of stored sediments could impede fish passage. To address this impact, the following PM&E measure is proposed:

PM&E Measure GEOM-1: Sediment Release Measures

Following removal of the South Cow Creek and Kilarc Main Diversion dams, the Licensee shall reshape the downstream face of the sediment wedge left in place at each diversion structure to an appropriate angle of repose. The Licensee shall also form a pilot thalweg to ensure temporary fish passage until the stored sediments have been transported by flow from the former impoundment sites and to help advance the processes of natural channel formation at the nickpoint created by the dam removal, by performing the following measures:

- Excavate a pilot thalweg through the sediment wedge that connects with the existing thalweg at a nearby upstream point to the thalweg immediately downstream of the dam.
- Shape the pilot thalweg on-site during the dam removal process.
- Dimension the pilot thalweg so that it has at minimum a 6-foot bottom width, which is approximately 20 percent of the 30 foot bankfull channel width downstream from the dam.
- Lay back the side slopes of the pilot thalweg to a natural, stable angle of repose.

- Construct the thalweg channel so that the starting depth at the downstream end of the channel is approximately equivalent to the water surface elevation of the plunge pools immediately downstream from each of the respective dams.
- Incorporate into the pilot thalweg channel, coarse bed-elements, or other techniques, to ensure appropriate depth and velocities for fish passage, as needed.

The final design will be based on the best available information at the time prior to implementation, in consultation with NMFS and CDFG. The Licensee shall make adjustments to the thalweg dimensions and elevation if site-specific conditions make it infeasible to construct the pilot channel to the recommended dimensions at either of the dam sites.

The Licensee shall allow the sediments remaining behind the diversions after excavation of the pilot channel to redistribute downstream during natural high flow events.[6]

The Licensee shall place sediments excavated from the South Cow Creek and Kilarc Main Canal diversion impoundments along channel margins for future recruitment during high flow events to downstream areas. The Licensee shall place these native sediments so they do not interfere with riparian vegetation.[7] The Licensee shall not place non-native angular rock material (which may be found between the bin walls of South Cow Creek Dam) in the stream, but shall dispose of it locally at a suitable site (e.g. as canal fill).

The Licensee shall monitor fish passage conditions along the pilot thalweg channels and for 10 channel widths downstream of the dams for two years following removal. The monitoring program is discussed under PM&E Measure AQUA-5.

Expected Outcome

Implementation of PM&E measure GEOM-1 would reduce the potential for creating fish passage barriers from the face of the sediment wedge and from release of sediments stored behind the dam. Fish passage monitoring (implemented under PM&E Measure AQUA-5) would ensure that dam removal does not result in long term fish passage barriers.

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6 It is estimated that up to approximately 150 cubic yards (0.09 acre feet) of sediment behind South Cow Creek Diversion Dam would need to be removed in order to remove the dam itself, to help shape the sediment wedge against the upstream dam face, and to create a pilot thalweg channel. This would leave approximately 1,150 cubic yards (0.70 acre-feet) stored behind the dam, all of which will be mobilized over time by natural sediment transport processes. Approximately 50 cubic yards (0.03 acre-feet) of sediment would need to be removed from behind Kilarc Main Canal Diversion Dam to accomplish dam removal, shape the sediment wedge, and to create a pilot thalweg connecting the upstream and downstream channels. This would leave approximately 530 cubic yards (0.31 acre-feet) behind the diversion dam. Of the 530 cubic yards, about 250 cubic yards of predominantly gravel and cobble material will be entrained over time and transported through the diversion and dispersed to the downstream reach by natural fluvial processes. About 230 cubic yards (approximately 40 percent of the 530 cubic yards) is boulder sized material, most of which will likely remain in place.

7 This assumes that on-site inspection during dam removal indicates that the excavated sediments are comprised of mostly gravel to cobble size material. The particle size composition obtained from bulk samples of the sediments stored behind the diversions (Appendices G and H) indicates that most material is within the gravel-cobble size range.

The cobble and gravel stored behind the South Cow Creek and Kilarc Main Canal diversion impoundments will distribute downstream during high flow events and will increase the amount of spawning habitat available for resident and anadromous salmonids. The flow-transported material may also fill some of the pools downstream of the diversions. There are no feasible and therefore no proposed PM&E measures for pools temporarily filling with sediment. For most of the pools (except the plunge pools at the dam face), the sediment deposition would be temporary and would extend downstream from the respective dam locations for about 10 bankfull widths (approximately the first 400 to 600 feet downstream). There would not be impacts to channel stability, or long-term habitat conditions. It is expected that once several high flow transport events have occurred, any pools that are temporarily filled with sediment would scour and return to their prior condition. Because of the changed hydraulics associated with the dam removal (reduction in kinetic energy associated with plunge off the top of the dam), the plunge pools immediately below the dams would not be expected to reform.

E.4.3.2 Bank Erosion at Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam

As described in Section E.3.3.2, there is the potential for localized bank erosion to occur following the removal of the larger two diversion dams, South Cow Creek and Kilarc Main Canal diversion dams. Erosion may occur at the site where dam abutments or diversion canal intakes were located, or along the stream banks upstream from the respective dam sites in the backwater impoundment area once the sediments have been naturally transported downstream. Following two years of monitoring, PG&E will consult with the resource agencies on the need for any additional monitoring that may be conducted as part of the USACE 404 permit.

To address this impact, the following PM&E measures are proposed:

PM&E Measure GEOM-2: Bank Erosion Measures

To minimize potential impacts associated with bank erosion, the Licensee shall conduct the following monitoring and mitigation:

- The Licensee shall conduct a monitoring assessment after removal of the Kilarc Main Canal and South Cow Creek diversion dams. The monitoring shall consist of a visual assessment with photographic documentation of the impounded sediment wedge and streambanks adjoining the perimeter of the former sediment impoundment area. The monitoring shall be conducted after spring runoff, as soon as weather permits access to the sites and flows are low enough that the streambanks can be easily observed. The Licensee shall utilize the visual assessment to identify any areas of active erosion or undercutting, or areas that appear to be susceptible to erosion. The Licensee shall conduct the monitoring assessment for two years.
- If during the monitoring assessment, the Licensee observes significant erosion or bank undercutting, then the Licensee shall implement and install erosion control measures, as feasible, in the channel. The Licensee shall adhere to standard erosion control procedures, including applicable measures developed by the USDA-FS and

published in the Water Quality Management for Forest System Lands in California Best Management Practices (USDA-FS, 2000).[8]

During the permitting process, the Licensee will design bank erosion control measures in consultation with CDFG, and the RWQCB-CVR. These erosion control measures may include planting vegetation on the exposed banks to help in stabilization, use of geotextile fabric, dormant pole plantings, or other techniques that may be suitable, potentially in combination with rip-rap for stabilization. Any re-vegetation will be consistent with the MMP (see PM&E Measure BOTA-1).

PM&E Measure GEOL-1 will also be implemented to address slope stabilization and erosion control protection at the site of infrastructure removal including the dam abutments and diversion canal intakes.

Expected Outcome

Implementation of PM&E Measures GEOM-2 and GEOL-1 would reduce the potential impact of bank erosion occuring from the removal of the Kilarc Main Canal and South Cow Creek diversion dams. There is no feasible way to determine in advance of dam removal if bank erosion would occur within the former zone of sediment deposition. If monitoring determines bank erosion is occurring, PG&E would implement measures as described above to address erosion. It is expected that any erosion would be minimized as a result of dam removal with implementation of PM&E Measure GEOM-2.

E.4.3.3 Bank Erosion at Mill Creek, North Canyon Creek, and South Canyon Creek

As described in Section E.3.3.2, there is the potential for localized bank erosion to occur following the removal of the Mill Creek, North Canyon Creek, and South Canyon Creek diversion dams. However, these dams are small in size, with a small potential area for impact. To address this impact, the following PM&E measure is proposed:

PM&E Measure GEOL-1 will be implemented.

Expected Outcome

With the implementation of PM&E Measure GEOL-1, the potential impacts for bank erosion would be minimized.

E.4.4 Water Quality

This section describes proposed PM&E measures to offset potential impacts on water quality as a result of decommissioning activities.

8 The Water Quality Management for Forest System Lands in California (USDA-FS 2000) provides a set of standardized BMPs to protect water quality during the planning and construction of projects.

E.4.4.1 Degradation of Water Quality from Sediment or Hazardous Material Release

As discussed in Section 3.4, decomissioning Project facilities may cause turbidity through the addition of sediments to the creeks. More specifically, the potential exists for degradation of water quality through erosion of streambanks, as part of the natural process of restoring the creeks and/or as a result of removal of stream bank structures. Although the decommissioning plans would be designed to develop and maintain geomorphically-stable stream channels near the diversions, and to prevent contributions of sediment to drainages and streams, the potential nevertheless exists for erosion to occur. Additionally, erosion and subsequent downstream sedimentation could occur along natural drainage paths that previously drained into the canals.

Further concern with impacts to water quality are related to the potential release of hazardous materials to stormwater runoff from unanticipated petroleum leaks from heavy equipment used during construction, or accidental spills or releases to ground of hazardous materials in equipment storage and maintenance areas. To address these impacts, the following PM&E measures are proposed:

PM&E Measures GEOL-1 and GEOL-2 will be implemented.

Expected Outcome

With the implementation of PM&E Measures GEOL-1 and GEOL-2, the potential impacts to water quality as a result of soil erosion, sedimentation, and/or hazardous materials release would be minimized.

E.4.5 Aquatic Resources

This section describes proposed PM&E measures to offset potential impacts on aquatic resources as a result of decommissioning activities.

E.4.5.1 Impacts Resulting from Instream Decommissioning Activities

As discussed in Section E.3.5, deconstruction of the Kilarc Main Canal, South Cow Creek, and Mill Creek diversion dams may result in potential lethal effects from shockwaves associated with breaking down the dam structure; potential crushing of aquatic species from operation of heavy equipment in the stream; sedimentation effects associated with dam removal and removal of gates and other headwork structures; and potential fish passage impediments. Deconstruction of North and South Canyon Creek diversion dams may result in all of these impacts, except the potential crushing from heavy equipment in the stream. Finally, the decommissioning of the Kilarc Tailrace could potentially impact aquatic resources. The potential effects of filling the Kilarc Tailrace include the burial of fish by fill materials and sedimentation effects associated with placement of fill material. To address these impacts, the following PM&E measures are proposed:

PM&E Measure AQUA-1: Isolate Construction Area

To minimize the deconstruction impacts at the five diversion dams and the Kilarc Tailrace (where instream construction would be required), the Licensee shall isolate the construction area from the active stream using coffer dams or other such barriers. The Licensee shall route water around the construction area in pipes or by removing the dam in two or more phases, allowing the flow to move down the other portion of the stream, while the isolated portion of the dam is removed.

PM&E Measure AQUA-2: Conduct Fish Rescue in Instream Work Area

After a work area is isolated, the Licensee shall conduct a fish rescue to remove any fish trapped in the work area. The Licensee shall relocate these fish to an area of suitable habitat within Old Cow Creek or South Cow Creek downstream of the work area.

PM&E Measure AQUA-3: Avoid Sensitive Periods for Steelhead and Chinook Salmon for the Removal of South Cow Creek Diversion Dam

The Licensee shall conduct decommissioning work at South Cow Creek Diversion Dam from July through September when adult anadromous salmonids are not present in South Cow Creek.

In addition, PM&E Measure GEOL-2 will be implemented to control sediment input, and thus, turbidity, into the stream channels through use of sediment control BMPs.

Expected Outcome

Implementation of PM&E Measures AQUA-1 through AQUA-3, and GEOL-2 would minimize impacts to fish during deconstruction activities in the Kilarc and Cow Creek developments through a combination of avoidance and monitoring measures.

E.4.5.2 Potential Fish Passage Barriers resulting from Retention of Cutoff Walls beneath the Cow Creek Diversion

PG&E intends to leave a portion of the South Cow Creek Diversion Dam (i.e., the cutoff walls) in place. The top of the cutoff walls are at about the same elevation as the natural stream bed in this area and also approximate the elevation of the head of the downstream riffle. Because of this, it is not anticipated that the cutoff walls would form a passage barrier. However, if such a barrier is formed, the following PM&E measure is proposed:

PM&E Measure AQUA-4: Meet NMFS Passage Guidelines for Anadromous Salmonids

If the South Cow Creek Diversion Dam cutoff walls become fish passage barriers, the Licensee shall modify these cutoff walls or implement other appropriate measures to meet NMFS passage guidelines (drop, velocity, depth, roughened channel and other site specific factors) for anadromous salmonids. The Licensee shall consult with NMFS on designs to provide adequate fish passage.

Expected Outcome

Implementation of PM&E Measure AQUA-4 would eliminate any potential passage barrier associated with retention of the cutoff walls below South Cow Creek Diversion Dam.

E.4.5.3 Potential Fish Passage Barriers Resulting from Dam Removal

As discussed in Section E.3.5, after removal of the Kilarc Main Canal Diversion Dam and South Cow Creek Diversion Dam, the stored sediment behind the dams could continue to act as a barrier to upstream migration, until natural flows removed some portion of the sediment. While this subsequent barrier would be temporary, the duration of time it persisted would depend on the magnitude and duration of high flows during the subsequent winter(s), the size of the stored substrates, and channel geomorphology (see Section 3.3.1 for a detailed description of the sediment release). This barrier could persist for one or more years. PM&E Measure GEOM-1, which calls for creation of a pilot thalweg channel through the stored sediments, is designed to address this impact. The redistribution of the remaining stored sediment could result in new passage impediments being formed in the vicinity of the former dams. While some short-term impediments (days or weeks) may develop as a result of this sediment movement, long-term barriers (years) are not likely to develop as a result of dam removal. However, to monitor for the development of long-term barriers, the following PM&E measure is proposed:

PM&E Measure AQUA-5: Monitor Passage Conditions Following Removal of Kilarc Main Canal and South Cow Creek Diversion Dams

To assess the efficacy of PM&E Measure GEOM-1 and monitor for any potential development of long-term barriers, the Licensee shall monitor fish passage conditions from upstream of the current sediment accumulations above the dam to a point approximately 10 channel widths downstream of the dam after the diversions are removed.

The Licensee shall conduct monitoring for two years after decommissioning of each diversion dam. In each year of monitoring, the Licensee shall conduct monitoring once after the first major runoff event (as access conditions and staff safety allows) and once again later in the year, during the low-flow season, when the condition of the streambed can be more easily assessed. A biologist with experience in assessing fish passage shall conduct the monitoring. The biologist shall walk the stream segment described above and visually assess for any passage challenges arising from sediment movement (i.e., shallow riffles or bars) and obtain depth and velocity measurements at critical high elevation points. The Licensee shall provide notification to resource agencies prior to monitoring so that agency staff may participate in this survey. The Licensee shall provide a summary of monitoring results at the conclusion of each year of monitoring to FERC, NMFS, CDFG, USFWS, and SWRCB.

If, during the monitoring, a long-term passage impediment is identified as a result of the diversions being removed, the Licensee will consult with CDFG and NMFS and the USACE under the Section 404 permit to determine appropriate measures to remedy the situation.

Expected Outcome

Implementation of the PM&E Measure GEOM-1 would minimize fish passage impacts below the Kilarc Main Canal and South Cow Creek diversion dams by reshaping the downstream face of the sediment wedge left in place to a reasonable angle of repose and excavating a pilot thalweg channel. The monitoring outlined in PM&E Measure AQUA-5 would determine whether any new long-term passage impediments relating to dam removal formed, and, if so, ensure that they are addressed in consultation with CDFG and NMFS.

E.4.5.4 Impacts Associated with Decommissioning of Canals and Forebays

As discussed in Section E.3.5.1, fish could be stranded in the North and South Canyon Creek canals to the extent that flows in the canals, if any, are cut off. Dewatering Kilarc Main Canal, South Cow Creek Main Canal, and the Mill Creek-South Cow Creek Canal could strand fish in the canals. Decommissioning the Kilarc and Cow Creek forebays could result in fish mortality during dewatering or the filling of the forebay. To address these impacts, the following PM&E measures are proposed:

PM&E Measure AQUA-6: Consult with CDFG

The Licensee shall consult with CDFG on fish management options (including reduced stocking, increased catch limits and other measures) to reduce the number of fish in Kilarc Forebay prior to decommissioning, with the intent of minimizing the number of fish needing to be rescued.

PM&E Measure AQUA-7: Conduct Fish Rescue in Canals and Forebays, as Needed

The Licensee shall conduct fish rescues in the Kilarc Main Canal and Forebay to rescue any fish that remain in these waters during the decommissioning process. These fish shall be relocated to suitable areas to be determined in consultation with CDFG and NMFS. The Licensee shall consult with CDFG and NMFS with regard to the need to conduct fish rescues in South Cow Creek Main Canal and Cow Creek Forebay.[9] If consultation determines that a fish rescue is required for Cow Creek Canal or Forebay, the Licensee shall target salmonids and lamprey for rescue. Non-native fish, such as golden shiner, will not be rescued. The North Canyon Creek and South Canyon Creek diversions shall be decommissioned after diversions cease (these diversions have been out of service for several years), so that the channels are dry and cannot support fish. If the area is not dry, the Licensee shall conduct fish rescues as described for Kilarc Main

9 Fish surveys in 2003 indicated that these waters are dominated by non-desirable golden shiner and sunfish and have a very low incidence of rainbow trout/steelhead or lamprey due to the fish screens at the South Cow Creek Diversion Dam.

Canal and relocate the rescued fish to an area to be determined in consultation with CDFG and NMFS.

PM&E Measure AQUA-8: Retain Fish Screen in South Cow Creek Main Canal

The Licensee shall retain the fish screen in South Cow Creek Main Canal until after any fish rescue, if needed (see PM&E Measure AQUA-7), is complete and the canal is closed off so fish can no longer enter the canal.[10] Once the fish rescue has been accomplished, the Licensee shall close off the head of the canal before the screens are removed.

Expected Outcome

Inplementation of PM&E Measures AQUA-6, AQUA-7, and AQUA-8 would minimize impacts to fish from decommissioning Project canals and forebays through fish rescues.

E.4.5.5 Impacts in Hooten Gulch

As discussed in Section E.3.5.2, following decommissioning, Hooten Gulch would be returned to its natural ephemeral flow conditions. Cessation of perennial flows could result in fish being stranded or trapped in isolated pools and subsequently dying through predation, dehydration, or poor water quality conditions that develop as these pools dry up. Additionally, the removal of the gunite in Hooten Gulch adjacent to the South Cow Creek Powerhouse and replacement with alternative bank stabilization measures could create potential issues with increased turbidity and contamination from gas, oil and other substances associated with heavy equipment. To address these impacts, the following PM&E measures are proposed:

PM&E Measure AQUA-9: Discontinue Cow Creek Powerhouse Operations in Spring

The Licensee shall discontinue Cow Creek Powerhouse operations in the spring when natural flow is present upstream of the powerhouse.

PM&E Measure AQUA-10: Remove Hooten Gulch Gunite and Implement Bank Stability Measures during the Dry Season

The Licensee shall remove the gunite in Hooten Gulch and install any replacement bank stabilization measures during the summer when the gulch is dry.[11]

Expected Outcome

Implementation of PM&E Measures AQUA-9 and AQUA-10 would minimize potential impacts to aquatic resources, as Hooten Gulch would return more gradually to its natural ephemeral state as natural flows subside. Any fish in Hooten Gulch downstream of the powerhouse would then

[10] This will minimize potential impacts to steelhead and resident fish.
[11] This will minimize the potential for turbidity and contaminant impacts, as no fish or aquatic organisms would be present.

move downstream with the recession of natural flows in Hooten Gulch and would not be stranded as the result of decommissioning. Conducting channel work after the channel has naturally gone dry would avoid direct impacts to aquatic species as they would not be present at this time.

E.4.6 Wildlife Resources

This section describes proposed PM&E measures to offset potential impacts on wildlife resources as a result of decommissioning activities.

E.4.6.1 Potential Habitat Loss Associated with Removal of Diversions

As described in Section E.3.6.1, the release of sediments stored behind the Kilarc Main Canal Diversion Dam and the South Cow Creek Diversion Dam may result in the short-term loss of turtle and frog habitat directly below the dam sites. However, surveys conducted in 2003 indicate foothill-yellow legged frog utilize the downstream portion of the South Cow Creek bypass reach, not the reaches immediately below the diversion dams. Foothill yellow-legged frogs and pond turtles could be adversely affected by the decommissioning of South Cow Creek Diversion Dam, and the resultant reduced flows in Hooten Gulch. Similarly, potential summer habitat for California red-legged frog could be impacted in Hooten Gulch, but only if appropriate spawning habitat exists within one mile of Hooten Gulch. Because diversion flows into Hooten Gulch are low in summer, habitat in Hooten Gulch may be seasonal. Habitat may also be lost in backwater pools that have formed at Project diversions. These areas would no longer provide suitable habitat for pool-dwelling species, such as the northwestern pond turtle if it utilizes the diversion pools. Construction activities may disturb birds nesting in the vicinity. To address these impacts, the following PM&E measures are proposed:

PM&E Measure WILD-1: Conduct Pre-Construction Surveys for Amphibians, Pond Turtles and Nesting Birds and Implement Avoidance and Protection Actions for Species Present

The Licensee shall conduct pre-construction surveys for amphibians (foothill yellow-legged frog and California red-legged frog) reptiles (pond turtles), and any other individual at risk prior to construction activities at the diversions, forebays, and powerhouse tailraces, using standard protocols, including USFWS species-specific protocols.[12] The Licensee shall capture and relocate to suitable habitat any individuals of these species observed in the construction area. The Licensee shall install exclusion fencing around the construction area. The Licensee shall have a biological monitor on-call throughout the construction phase to identify and relocate, if necessary, any individual animals found in the construction area. If a California red-legged frog is found, the Licensee shall stop construction work and notify USFWS; construction activity will recommence upon USFWS approval.

12 USFWS, 2005. Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog. August 2005.

The Licensee shall conduct pre-construction surveys for nesting birds if vegetation removal is scheduled during the breeding period (generally March 1 - September 1). The Licensee shall use biologists with experience in conducting breeding bird surveys to conduct the surveys. These biologists shall conduct the surveys between dawn and 10 am. If an active nest occupied by a special-status species or by other species protected by the Migratory Bird Treaty Act is found, the Licensee shall avoid the area and construction activities shall be restricted to an appropriate distance to avoid nest disturbance until nestlings have fledged.

PM&E Measure WILD-2: Conduct Environmental Training for Construction Personnel

The Licensee shall conduct environmental tailboard sessions with construction personnel to provide information on special-status-species potentially present in the area and the avoidance/minimization measures to be implemented. The Licensee's biological monitor shall be responsible for conducting worker environmental awareness training for all construction personnel (including new, added, and/or replaced workers) prior to the onset of active construction. The training shall include a brief description of the special-status species that potentially occur at the site and distribution of a brochure or pamphlet that describes the species to all workers. Workers shall be instructed to drive carefully and look for amphibians, reptile or mammal in the path of their vehicles. In the event that an amphibian of any species is observed, workers shall stop their equipment immediately until such a time that the onsite biological monitor has identified it, relocated it if necessary or it moves from the active construction area by its own initiative.

In addition to PM&E Measures WILD-1 and WILD-2, PM&E Measure AQUA-9 will be implemented.

Expected Outcome

The implementation of PM&E Measures WILD-1, WILD-2, and AQUA-9 would minimize any decommissioning-related impacts to individuals resulting from the loss of habitat from the removal of diversions.

E.4.6.2 Habitat Loss Associated with Decommissioning of Forebays, Intake Structures, Spillways, and Hooten Gulch

As discussed in Section E.3.6.1, fhe filling of Kilarc and Cow Creek forebays would remove habitat for northwestern pond turtles and foraging habitat for raptors. Individuals that enter the construction area during deconstruction could be adversely affected. Decommissioning activities could affect nesting birds, including raptors. To address these impacts, the following PM&E measure is proposed:

PM&E Measure WILD-3: Conduct Pre-Construction Surveys for Raptors and Implement Avoidance and Protection Actions for Species Present

The Licensee shall conduct pre-construction surveys for raptors at protocol or standard distances (0.5 mile for peregrine falcons, 0.75 mile for goshawk, 660 feet for the bald eagle, and 300 feet for other raptors) from the deconstruction area (Call, 1978; Fuller and Mosher, 1987; Cade, et. al., 1996, PBRG 2007, USFWS 2007). For peregrine falcon, the Licensee shall conduct pre-construction surveys no earlier than 14 days prior to start of construction during the protocol survey period (March 15 to August 15). For northern goshawk, the Licensee shall conduct dawn acoustical surveys if the surveys must be done from February to April, or implement intensive search surveys from late June to fall. If goshawks are detected, the Licensee shall conduct a brief search of the detection area during the late incubation or nestling stage to determine the location of an active nest. For the bald eagle, the Licensee shall conduct an initial survey from late February through March (Jackman and Jenkins, 2004). If necessary, the Licensee shall conduct additional surveys in mid-nesting season (late April through May) and late in the season (early June to early July). Surveys may be conducted on foot, or with terrestrial vehicles, or aircraft. If an active raptor nest is found within the survey area, the Licensee shall avoid the nest and deconstruction activities shall be restricted to an appropriate distance to avoid nest disturbance until nestlings have fledged.

In addition to PM&E Measure WILD-3, PM&E Measures WILD-1, WILD-2, and AQUA-9 will be implemented.

Expected Outcome

The implementation of PM&E Measures WILD-1, WILD-2, WILD-3, and AQUA-9 would minimize and/or avoid decommissioning-related impacts resulting from the loss of habitat and wildlife during deconstruction of the forebays, intake structures, and spillways. Implementation of PM&E Measure AQUA-9 would allow Hooten Gulch to return more gradually to its natural ephemeral state as natural flows subside, thereby minimizing potential impacts to amphibians and turtles. Furthermore, scheduling deconstruction activities at the Cow Creek Powerhouse tailrace during the dry season when the channel is naturally dry will avoid impacts to aquatic species (PM&E Measure AQUA-10).

E.4.6.3 Potential Habitat Loss and Mortality Associated with the Decommissioning of Canals, Tunnels, Flumes, and Siphons

As discussed in Section E.3.6.1, potential impacts at the canals, tunnels, flumes, and siphons include minor, temporary loss of upland habitat and potential direct impacts to individuals present in aquatic habitat at these locations, individuals breeding/nesting in vegetation that must be removed (i.e., nesting birds, VELB), individuals that enter the construction area during deconstruction, and bats in the tunnels. To address these impacts, the following PM&E measures are proposed:

PM&E Measure WILD-4: Conduct Pre-Construction Surveys for Elderberry Shrubs and Implement Existing Mitigation Measures

The Licensee shall conduct protocol pre-construction elderberry surveys within 100 feet of any deconstruction activities that could affect vegetation. If an elderberry shrub with one or more stems greater than 1 inch in diameter could be directly or indirectly affected by the activities, the measures provided in the Biological Opinion covering the Licensee's service area in the range of the VELB (USFWS, 2003) shall be implemented.

PM&E Measure WILD-5: Conduct Pre-Construction Surveys for Bats

If deconstruction activities are initiated between March 1 and September 30, the Licensee shall conduct pre-construction surveys for bats at the tunnels and powerhouses. For the surveys, during the day, the Licensee shall search these facilities for bats or bat sign such as guano, staining, and culled insect parts. Internal surveys shall consist of surveying the interiors of tunnels and powerhouses. External surveys shall consist of surveying the external features of structures that could be used for roosting. Nighttime surveys in or near the facilities shall consist of counting bats as they exit to forage in the evening, assessing use of facilities to roost in at night, and acoustic monitoring with ultrasonic equipment in conjunction with computer software and visual observation. At its discretion, the Licensee may conduct limited capture of bats using nets to facilitate species identification (captures shall be conducted by a qualified bat biologist). If deconstruction activities occur between October 1 and February 28 (non-breeding season) the Licensee shall not be required to conduct pre-construction surveys for bats unless existing facilities with known (previously documented through monitoring surveys or historic observations) or potential hibernation roost sites will be disturbed.

PM&E Measure WILD-6: Exclude Wildlife from Tunnels

The Licensee shall seal off Project tunnels at both ends for public safety, which will exclude wildlife (i.e., bats) from entry or habitation. The Licensee shall verify that the tunnels are uninhabited through pre-construction surveys (see PM&E Measure WILD-5). If bats are present, the Licensee shall install one-way exclusion devices prior to the breeding season before construction begins, in order to allow bats to leave the tunnels, but not return. The exclusion devices shall be placed at all active entry points and shall remain in place for at least five to seven days. These devices shall be removed after the bats are excluded, and then exclusion points shall be sealed (BCI, 2008).

In addition, PM&E Measures WILD-1 and WILD-2 will be implemented.

Expected Outcome

The implementation of PM&E Measures WILD-1, WILD-2, WILD-4, WILD-5, and WILD-6 would minimize and/or avoid decommissioning-related impacts resulting from the loss of habitat or individuals during deconstruction of the Canals, Tunnels, Flumes, and Siphons.

E.4.6.4 Potential Impact to Roosting Habitat for Bats Associated with Decommissioning of Powerhouses and Penstocks

As discussed in Section E.3.6.1, decommissioning activities at the Kilarc and Cow Creek powerhouses could disturb roosting bats, or result in the take of individuals if bats are present. No impacts to wildlife species are expected from work at penstocks. To address this impact, the following PM&E measures are proposed:

PM&E Measures WILD-2 and WILD-5 will be implemented.

Expected Outcome

The implementation of PM&E Measures WILD-2 and WILD-5 would minimize and/or avoid decommissioning-related impacts resulting from the loss of roosting habitat or individuals during decommissioning of the Kilarc and Cow Creek powerhouses.

E.4.6.5 Potential Impacts to Nesting Birds Associated with Access Road Construction and Improvement

As discussed in Section E.3.6.1, direct impacts could occur to birds nesting in vegetation that must be removed for access road construction or improvement. To address this impact, the following PM&E measures are proposed:

PM&E Measures WILD-1, WILD-2, and WILD-3 will be implemented.

Expected Outcome

The implementation of PM&E Measures WILD-1, WILD-2, and WILD-3 would schedule decommissioning activities to avoid adverse effects on birds.

E.4.6.6 Potential Impacts to Pacific Fisher from Access Road Use

As discussed in Section E.3.6.1, direct impacts could occur to Pacific fisher from traffic related to decommissioning activities. To address this impact, the following PM&E measure is proposed:

PM&E Measure WILD-7: Speed Limit on FERC Project and Temporary Access Roads

The Licensee shall implement a speed limit of 15 miles per hour on FERC Project roads and temporary access roads while decommissioning activities are conducted.

In addition to PM&E Measure WILD-7, PM&E Measure WILD-2 will be implemented.

Expected Outcome

Implementation of WILD-7 and WILD-2 would minimize the risk of injury to Pacific fisher and other wildlife from traffic related to decommissioning activities.

E.4.7 Botanical Resources

This section describes proposed PM&E measures to offset potential impacts on botanical resources as a result of decommissioning activities.

PG&E will monitor riparian and wetland vegetation requiring restoration or mitigation under FERC's jurisdiction for two years following decommissioning. Any additional monitoring may be implemented under the authority of permitting and resource agencies such as the USACE (per the conditions of the CWA 404 permit) and SWRCB, and may extend up to an additional three years.

E.4.7.1 Potential Loss of Vegetation Associated with Decommissioning of Diversions

As discussed in Section E.3.7.1, potential impacts at the Kilarc Main Canal Diversion Dam, the North and South Canyon Creek diversion dams, and the South Cow Creek Diversion Dam include the temporary loss of upland vegetation. Potential impacts at the South Cow Creek Diversion Dam include the potential loss of riparian vegetation. To address these impacts, the following PM&E measures are proposed:

PM&E Measure BOTA-1: Prepare and Implement a Mitigation and Monitoring Plan (MMP)

The Licensee shall prepare and implement a Mitigation and Monitoring Plan (MMP) for impacts to riparian and wetland vegetation as part of the permitting process. The MMP shall be developed in consultation with the USACE, CDFG, and SWRCB. The Licensee's MMP shall include mitigation areas (e.g., South Cow Creek Diversion Dam, Kilarc and Cow Creek forebays), goals, the species to be assessed, as well as methods and performance criteria in the MMP. Riparian and wetland vegetation requiring restoration or mitigation shall be monitored by the Licensee under FERC's authority for two years following decommissioning.

The Licensee shall include restoration of abandoned or temporary roadbeds as part of the MMP, including compaction issues, seeding, mulching, and planting, and shall develop the MMP in consultation with the private landowners, where appropriate. The Licensee shall re-seed other disturbed areas, including temporary work areas, filled and graded areas, and roads requiring rehabilitation, and consult with private landowners, where appropriate. If straw is used for temporary erosion control, it shall be certified weed-free. Native plants shall be used for re-seeding and other revegetation on the Licensee's property, and on private property unless the private landowner specifies the use of other materials. If the use of native seed is intended, but sufficient supplies are not available, then cereal seed shall be used for temporary erosion control. Cereal seed used for erosion control shall be seed for sterile cereal, if available. If seed for sterile cereal is not available, then other cereal seed may be used.

PM&E Measure BOTA-2: Conduct Pre-Construction Surveys

The Licensee shall conduct pre-construction surveys for special-status plants in all areas that will be disturbed by decommissioning activities.

PM&E Measure BOTA-3: Avoid Special-Status Plants to the Extent Possible and Restore Habitat Conditions

The Licensee shall avoid any identified populations of special-status plants to the extent practical. If decommissioning activities will result in temporary disturbance to part of a population, the Licensee shall stockpile the top 10 inches of soil from the disturbed area, protect the soil from exposure to weed seeds, and replace the soil when the decommissioning activities are complete.

Expected Outcome

The implementation of PM&E Measures BOTA-1, BOTA-2, and BOTA-3 would result in preserving special-status plant species and riparian habitat during and after deconstruction where practicable, preventing net loss in the health of riparian and aquatic habitat areas where practicable, and facilitating revegetation of disturbed areas.

E.4.7.2 Potential Loss of Vegetation Associated with Decommissioning of Forebays, Intake Structures and Spillways

As discussed in Section E.3.7.1, potential impacts at the Kilarc and Cow Creek forebays, intake structures, and spillways include temporary impacts to upland vegetation and loss of small areas of freshwater marsh rooted below the ordinary high water lines. Potential impacts at Hooten Gulch include a possible reduction in the extent of the riparian vegetation due to the discontinuation of the augmented flow downstream from the Cow Creek Powerhouse. To address these impacts, the following PM&E measures are proposed:

PM&E Measures BOTA-1, BOTA-2, and BOTA-3 will be implemented at the Kilarc and Cow Creek forebays, intake structures, spillways, and Hooten Gulch because riparian and wetland vegetation would be impacted.

Expected Outcome

The implementation of PM&E Measures BOTA-1, BOTA-2, and BOTA-3 would result in preserving special-status plant species and riparian habitat during and after deconstruction wherever possible, preventing net loss in the health of riparian and aquatic habitat areas where practicable, and facilitating revegetation of disturbed areas.

E.4.7.3 Potential Loss of Vegetation Associated with Decommissioning of Canals, Tunnels, Flumes, and Siphons

As discussed in Section E.3.7.1, potential impacts at the canals include temporary impacts to upland vegetation at both the Kilarc development (i.e., Kilarc Main and North and South Canyon Creek canals, siphons, flumes, and tunnels) and the Cow Creek development (i.e., Mill and South Cow Creek Main canals and tunnel) and permanent impacts to two small seeps adjacent to the Kilarc Main Canal. Loss of two stems of the special-status mountain lady slipper adjacent to the Kilarc Main Canal is likely unavoidable, but the loss of a few individuals of a watch list species is not considered an adverse impact. These plants are perched in a precarious location that is not considered sustainable, even if the canal is not altered during deconstruction. To address the identified impacts, the following PM&E measures are proposed:

PM&E Measures BOTA-1, BOTA-2, and BOTA-3 will be implemented at the canals, tunnels, flumes, and siphons.

Expected Outcome

Implementation PM&E Measures BOTA-1, BOTA-2, and BOTA-3 would result in preserving special-status plant species, preventing the net loss of riparian and wetland habitat, and facilitating natural revegetation.

E.4.7.4 Potential Loss of Vegetation Associated with Decommissioning of the Powerhouses and Penstocks

As discussed in Section E.3.7.1, potential impacts to riparian vegetation and to a seep may occur at the Kilarc Powerhouse. Minimal impacts to vegetation would occur at the Kilarc and Cow Creek penstocks, at the head of the penstock located at the forebay, and at the end where the penstock would be plugged. Decommissioning of the Kilarc and Cow Creek powerhouses would not substantially affect upland vegetation types. To address the identified impacts, the following PM&E measures are proposed:

PM&E Measure BOTA-1, BOTA-2, and BOTA-3 will be implemented.

Expected Outcome

Implementation PM&E Measures BOTA-1, BOTA-2, and BOTA-3 would result in preserving special-status plant species, preventing the net loss of riparian and wetland habitat, and facilitating natural revegetation.

E.4.7.5 Potential Loss of Vegetation Associated with Access Road Construction and Improvement

As discussed in Section E.3.7.1, potential impacts at the access roads include temporary impacts to upland vegetation. Potential impacts at access roads within the Cow Creek Development include possible filling of part of a vernal swale and possible loss of individuals of big-scale balsamroot. To address these impacts, the following PM&E measures are proposed

PM&E Measures BOTA-1, BOTA-2, and BOTA-3 will be implemented at disturbance areas for access roads.

Expected Outcome

Implementation of PM&E Measures BOTA-1, BOTA-2, and BOTA-3 would result in preserving special-status plant species and riparian and wetland habitat during and after deconstruction wherever possible, preventing net loss of riparian and wetland habitat, and facilitating natural revegetation.

E.4.8 Historical Resources

This section describes proposed PM&E measures to offset Project impacts on architectural and historical resources as a result of decommissioning activities.

As described in Section E.3.8, Project decommissioning activities would impact the Kilarc and Cow Creek Powerhouses, eligible for listing in the NRHP and the CRHR. To address this impact, the following PM&E measures are proposed:

PM&E Measure HIST-1: Documentation

The Licensee shall prepare a Memorandum of Agreement (MOA) to address the unanticipated discovery of human remains and the long-term management and treatment of the architecturally and historically significant powerhouses. As will be stipulated in the MOA, the Licensee shall prepare photographic, architectural and written documentation that meets Historic American Building Survey (HABS) and Historic American Engineering Record (HAER) standards prior to commencing decommissioning activities.

PM&E Measure HIST-2: Securing Buildings

The Licensee shall secure the two powerhouse structures from unwanted entry, provide adequate ventilation to the interiors, shut down or modify the existing utilities and mechanical systems, and employ maintenance and monitoring measures for the buildings.

Expected Outcome

The implementation of PM&E Measures HIST-1 and HIST-2 would minimize any decommissioning-related impacts to the Kilarc and Cow Creek powerhouses and preserve the historic buildings.

E.4.9 Archaeological Resources

This section describes proposed PM&E measures to offset potential impacts on archaeological resources as a result of decommissioning activities.

As described in Section E.3.9, Project decommissioning activities have the potential to impact five identified archaeological sites that have not been evaluated for NRHP and CRHR eligibility. To address these possible impacts, the following PM&E measures are proposed:

PM&E Measure ARCH-1: Archaeological Resources Summary

The Licensee shall avoid all ground disturbing activities in the vicinity of the five archaeological sites.[13] A qualified Licensee or consulting archaeologist shall monitor Project activities if they occur within 50 feet of these identified resources. If the Licensee cannot avoid ground disturbing activities at or near the five sites, the Licensee shall conduct formal evaluations of the sites' eligibility for listing in the NRHP and CRHR.

PM&E Measure ARCH-2: Unanticipated Archaeological Sites

If archaeological resources are accidentally disturbed during decommissioning activities, the Licensee shall stop all work within the immediate vicinity until a qualified Licensee or consulting archaeologist can evaluate the discovery and provide recommendations, if an archaeological monitor is not already present. Table E.4.9-1 summarizes recommendations for archeological resources identified within the APE.

PM&E Measure ARCH-3: Encountering Human Remains

If human remains are encountered as a result of decommissioning activities, the Licensee shall stop all work in the vicinity and immediately contact the County Coroner. In addition, a qualified Licensee or consulting archaeologist shall be contacted immediately to evaluate the discovery, if a monitor is not already present. If the human remains are Native American in origin, then the Licensee shall request that the Coroner notify the NAHC within 24 hours of this identification.

Expected Outcome

The implementation of PM&E Measures ARCH-1, ARCH-2 and ARCH-3 would minimize any decommissioning-related impacts to potentially NRHP- and CRHR-eligible sites and any unknown archeological resources by reducing the extent of impacts and by following proper state or federal (NHPA Section 106) procedures for recovery of archaeological resources or human remains.

[13] The five archaeological resources that have a prehistoric archaeological component within the APE are 482-12-03/H, -04, -05/H, -08/H, and -11/H, and one historical archaeological site 482-12-03H.

Table E.4.9-1.Recommendations for Archaeological Resources Identified within the APE

Temporary Number	State Number	Period of Significance	NRHP/CRHR Eligible	Recommendation
482-12-03H	None	Historic	Potentially eligible, unevaluated	PG&E should not impact this area, no ground disturbing activities
482-12-04	None	Prehistoric	Prehistoric component is potentially eligible under NRHP Criterion D; CRHR Criterion 4; unevaluated	PG&E should not impact this area, no ground disturbing activities
482-12-05/H	None	Multi-component	Prehistoric component is potentially eligible under NRHP Criterion D; CRHR Criterion 4; unevaluated	PG&E should not impact this area, no ground disturbing activities
482-12-08/H	None	Multi-component	Prehistoric component is potentially eligible under NRHP Criterion D; CRHR Criterion 4; unevaluated	PG&E should not impact this area, no ground disturbing activities
482-12-11/H	No record	Multi-component	Prehistoric component is potentially eligible under NRHP Criterion D; CRHR Criterion 4; unevaluated	PG&E should not impact this area, no ground disturbing activities

Notes:

NRHP Criterion D: A property has yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

CRHR Criterion 4: A historical resource has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation (14 CCR 4852[a]).

E.4.10 Recreation

This section describes proposed PM&E measures to offset potential impacts to recreational resources as a result of decommissioning activities.

E.4.10.1 Loss of Kilarc Forebay and Day Use Area for Recreational Use

There are comparable recreation locations in the surrounding region, and the site use is low at Kilarc Forebay and Day Use Area in comparison to visitation to surrounding recreational areas.

As described in Section E.3.10, Project decommissioning activities would only minimally impact regional recreational resources by affecting Kilarc Forebay and Day Use Area. No PM&E measures are recommended.

E.4.10.2 Loss of Kilarc Powerhouse for Recreational Use

As described in Section E.3.10, the public use of the Kilarc Powerhouse site for fishing and other activities would not be restricted as a result of the decommissioning. In addition, there are comparable recreation locations in the region, and the site use is very low at Kilarc Powerhouse in comparison to site usage at surrounding state and federal recreational areas. No PM&E measures are recommended.

E.4.11 Aesthetics

This section describes proposed PM&E measures to offset potential impacts to aesthetic resources as a result of decommissioning activities.

E.4.11.1 Decommissioning the Kilarc and Cow Creek Powerhouses

As described in Section 3.11.1, decommissioning activities would have a minimal aesthetic impact on the Kilarc and Cow Creek Powerhouse building structures. However, with implementation of PM&E Measure HIST-2, these structures will be secured and access to the interior of the buildings will be restricted. These securing procedures would not cause an aesthetic impact because the structures are not highly visible to the public and they would constitute a weak contrast with the existing condition. Therefore, no additional PM&E measures are recommended to reduce the aesthetic impacts of securing these structures.

E.4.12 Land Use

This section describes proposed PM&E measures to offset potential impacts on land use as a result of decommissioning activities.

As described in Section 3.12, decommissioning would not impact current land uses or management. Therefore, no PM&E measures are proposed.

E.4.12.1 Conflicts with CAL FIRE's Fire and Resource Assessment Program

As described in Section 3.12.3, decommissioning activities could conflict with CAL FIRE's Fire and Resource Assessment Program by piling cleared vegetative materials onsite or using equipment with internal combustion engines, gasoline powered tools, and equipment or tools that produce a spark, fire, or flame in an area of Very High fire hazard. To address this impact, the following PM&E measures are proposed:

PM&E Measure FIRE-1: Spark Arrestors

The Licensee shall equip earthmoving and portable equipment with internal combustion engines with a spark arrestor to reduce the potential for igniting a wildland fire.

PM&E Measure FIRE-2: Fire Suppression Equipment

The Licensee shall maintain appropriate fire suppression equipment during the highest fire danger period – from April 1 to December 1.

PM&E Measure FIRE-3: Flammable Materials

On days when a burning permit is required, the Licensee shall remove flammable materials to a distance of 10 feet from any equipment that could produce a spark, fire, or flame, and the Licensee shall maintain the appropriate fire suppression equipment.

PM&E Measure FIRE-4: Portable Gas-Powered Tools

On days when a burning permit is required, the Licensee shall not use portable tools powered by gasoline fueled internal combustion engines within 25 feet of any flammable materials.

Expected Outcome

Implementation of PM&E Measures FIRE-1, FIRE-2, FIRE-3, and FIRE-4 would reduce the risk that decommissioining activities would expose people or structures to a significant risk of loss, injury, or death involving fires.

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EXHIBIT E: ENVIRONMENTAL REPORT

E.5 Literature Cited

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