

**SACRAMENTO MUNICIPAL UTILITY DISTRICT'S
UPPER AMERICAN RIVER PROJECT
(FERC NO. 2101)**

**SUPPLEMENTAL
PRELIMINARY DRAFT
ENVIRONMENTAL ASSESSMENT**

SECTION 6.0 DEVELOPMENTAL ANALYSIS

Sacramento Municipal Utility District
Sacramento, California

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6.0 DEVELOPMENTAL ANALYSIS

This section compares power generation, Project Dependable Capacity (PDC)¹, economic benefits, and costs of environmental measures between the Agency Alternative, Proposed Action, and the No Action Alternative (baseline conditions). The Agency Alternative and Proposed Action both include the addition of the Iowa Hill Pumped-storage Development to the UARP; however, because Agency Alternative water level restrictions at Slab Creek Reservoir will render the development infeasible, it was not included in the evaluation of benefits derived from the Agency Alternative. As in the License Application, all economic benefits and costs provided in this section are in 2004 U.S. dollars unless otherwise specified and all analyses are predicated on the granting of a new license with a 50-year term.

6.1 Cost of Environmental Measures

Implementation of the Agency Alternative will require the expenditure of capital and one-time costs as well as ongoing annual costs, including O&M costs (see Appendix A to this section). The environmental measures provided in the table are organized by resource area and, when appropriate, measures are grouped to show comparative costs of similar measures that appear in the Agency Alternative and SMUD Proposed Action (e.g., both alternatives contain a Woody Debris Management Plan). In some cases, lack of specificity in the Agency Alternative measures results in uncertainty regarding the cost of measure implementation. These uncertainties and assumptions made in estimating costs are noted in the table footnotes. The bottom of the table contains a summary of all costs associated with the Agency Alternative and the SMUD Proposed Action. Capital and one-time costs were annualized in the table by applying SMUD's 6.25 percent discount rate, assuming a 50-year license term.

Appendix A contains costs for flow-related (e.g., pulse flows, minimum releases) and non-flow-related measures (e.g., recreation developments). Flow-related costs were derived from output of the CHEOPS water balance model, and represent incremental generation value costs from the model Base Case due to modifications to system operations at individual facilities. A series of model runs was prepared with each incremental change (e.g., change in minimum release or addition of pulse flow) as the only deviation from the Base Case and generation results were evaluated. When these incremental changes in generation costs are summed, they do not necessarily equal the change in generation value derived from a model run in which all changes are considered (cumulative effects). This is due to relationships between the modifications that add a second degree of variability to the operation of the UARP. Many of these relationships are non-linear (e.g. reservoir levels decreased by a change in minimum instream flows in addition to pulse flows will cause a linear decrease in operating head for a powerhouse, but will lead to non-

¹ Project Dependable Capacity (PDC) is defined as the ability of a generating unit to generate power for a specified time period. On an annual basis, an October 1st carry-over storage level has been established by SMUD so that even under the most extreme dry period on record, water is available to meet minimum peaking and reliability requirements. The PDC definition also covers multiple day and multiple hour time periods. The inability of the UARP to provide load following, peaking, and system support in any hour due to a constrained release regime will result in a loss of PDC for that hour.

linear decreases in turbine/generator efficiency). These particular modifications will generally lead to an underestimation of cumulative generation impacts when summed as incremental changes.

6.2 Project Power

In this section, the amount of UARP energy produced under each of the three alternatives is described and tabulated. With the No Action Alternative serving as the baseline, the relative generation levels of the Agency Alternative and SMUD's Proposed Action are compared. To evaluate the effect of the Agency Alternative on energy production at the UARP, SMUD ran the CHEOPS model with reservoir releases (pulse, minimum, and whitewater recreation flows) and storage reservoir level restrictions as described in Agency Alternative. Because the Agency Alternative renders the Iowa Hill Development infeasible (see Section 6.3.1 – Water Management Restrictions at Slab Creek Reservoir), this proposed development was excluded from the Agency Alternative model run.

One of the key differences between the Agency Alternative and Proposed Action is the Agency Alternative places absolute mean monthly water level restrictions on the reservoirs (Agency Alternative, p. 87-88), while the Proposed Action, like the No Action Alternative, utilizes monthly desired reservoir levels as a proxy to help guide the optimization of energy production while minimizing spill occurrences. This key difference results in substantial additional energy losses under the Agency Alternative, as well as operational flexibility and dependable capacity loss (capacity loss is discussed in Section 6.3).

To ensure the reservoir level restrictions and other measures of the Agency Alternative are not violated, CHEOPS simulations are utilized to evaluate energy generation impacts. The initial CHEOPS simulations reflected conservative operational practices, resulting in spill events above baseline and diminished energy generation. Upon examination of these results, additional iterative CHEOPS simulations were performed to re-optimize the energy production to maintain the absolute reservoir level restrictions, while minimizing spill occurrences. The simulation results used throughout this document are those reflecting such re-optimization efforts.

Based on the results of CHEOPS simulations, the Agency Alternative results in on-peak energy loss from the Base Case of 90 GWh. This represents the combined effect of minimum releases, pulse flows, boating releases, and storage reservoir restrictions. The off-peak energy loss under the Agency Alternative is 81 GWh. The combined energy loss (on-peak and off-peak) under the Agency Alternative is 171 GWh.

In contrast, the Proposed Action results in an on-peak energy loss from Base Case of 26 GWh and an off-peak gain of 9 GWh. The off-peak gain is the result of the operation of the Iowa Hill Development. In addition, the Iowa Hill Development will result in 961 GWh of super-peak generation. However, the Iowa Hill Development will also require the use of 1,246 GWh of energy for pumping.

6.3 Project Flexibility and Dependable Capacity

As discussed in SMUD's License Application, preservation of the existing UARP's capacity and creation of the additional pumped-storage capacity provided by SMUD's Proposed Action are critical to SMUD given: 1) the daily fluctuation in its existing customer peak demand; 2) the projected steady increases in peak demand for electricity in the Sacramento region throughout the proposed license term and changing climate conditions; 3) SMUD's planned additions of significant wind resources to meet SMUD and California renewable portfolio standard objective; and 4) the anticipated market changes due to the California Independent System Operator (ISO) Market Redesign and Technology Upgrade (MRTU), the ISO's current plan for market design.

Unlike other utilities with a broad customer base in a wide range of geographic and climatic locations, SMUD's customer base is centralized around the Sacramento Valley, where the weather is generally uniform (e.g., during summer months, hot temperatures prevail throughout the entire SMUD territory). While there is a high correlation between temperature and customer peak load, the Sacramento-San Joaquin River Delta breeze is unpredictable and can alter the actual temperature in a given day significantly from the temperature forecasted the previous day. Because of this unique summer weather phenomenon, SMUD has consistently experienced load swings up to plus/minus 500 to 600 MW between the day-ahead power schedule and real time. SMUD's plan to add a significant wind resource in this area to meet a portion of its renewable goals will exaggerate this effect since an unexpected Delta breeze both lowers load and increases wind generation. The opposite occurs when an expected cooling trend due to the breeze is not realized. These unpredictable swings in potential daily load and capacity represent 20% to 25% of SMUD's summer peak load to which SMUD must respond quickly using available capacity resources within its system.

In addition to the need to react existing real-time capacity swings, the projected annual load growth in the Sacramento region is expected to remain at about two percent throughout the next decade and beyond. This additional annual load growth of about 60-70 MW in an area with major air quality constraints and siting issues for new transmission interconnections will further challenge SMUD's ability to meet both the absolute peak and load volatility in the future. In addition, changes in the electricity market may further restrict SMUD's available options to meet real time electricity needs. For example, the ISO's current plan for its MRTU market will require the capacity and energy purchased during the real time day to be subject to recall by the ISO, thus exacerbating the need for available capacity on SMUD's system.

The ability of SMUD to meet these real-time electricity needs will be compromised by the Agency Alternative. Constraints placed on water management to meet required reservoir level restrictions at the three storage reservoirs will limit SMUD's capability to utilize the full generating capacity of the UARP in the event of a summer heating event or other strenuous system conditions that continue over an extended period. The most recent such event occur in July 2006, when maximum daily air temperatures in Sacramento exceeded 100°F for 11 days in a row (July 16-26), setting record demand in SMUD's service and control areas. Losses in PDC in summer months associated with storage reservoir water level restrictions are discussed below. In addition, water level restrictions required by the Agency Alternative at other UARP reservoirs

will also impact project flexibility and capacity. The most severe losses in capacity and flexibility will occur at Slab Creek Reservoir, while lesser impacts will occur at Gerle Creek Reservoir.

A sensitivity analysis using historical temperature and operational data was used to quantify the effect the Agency Alternative storage reservoir level restrictions will have during periods in which UARP PDC is required over an extended period to meet system load demands. For example, during the months of July and August 1996, SMUD operators required the use of the UARP PDC to meet system load due to an extended summer period of high loads in the Sacramento region. The sensitivity analysis conducted for this period revealed the Agency Alternative will restrict SMUD's ability to use its UARP PDC by up to 470 MW. This was determined by first limiting the energy available from the UARP to the amount allowable under the Agency Alternative reservoir level restrictions (Agency Alternative, p. 88-89). Starting in July 1996 and progressing through the historic data, the remaining daily available energy was calculated. Using this approach, the UARP was able to meet system load under the Agency Alternative reservoir restriction through August 7, 1996. For the remainder of August, average daily generation from the UARP was calculated to be limited to 3,121 MWh per day, in accordance with the constraints place on the project from the Agency Alternative reservoir level restrictions, minimum streamflow releases, and rafting flow requirements below Chili Bar Dam for the remainder of August. However, a parallel calculation revealed, over this same period (August 8 through 31), an average of 4,843 MWh of energy per day was required to meet SMUD's system capacity and energy needs. During the same time period, SMUD experienced approximately eight days requiring energy in excess of the 4,843 MWh daily average, with the highest day requiring more than 10,000 MWh. The capacity loss for all eight days ranged from 222 MW to 470 MW. Based on this sensitivity analysis, the Agency Alternative created an average 1,722 MWh per day energy shortfall and reduced UARP PDC by up to 470 MW during this July and August 1996 historic period.

6.3.1 Water Management Restrictions at Slab Creek Reservoir

The Agency Alternative requires SMUD to maintain the Slab Creek Reservoir water levels above 1,830 feet in elevation during daylight hours and also restricts daily fluctuations to less than 6 feet per day during daylight hours. These proposed elevation restrictions will significantly impair current operations of the 224 MW White Rock Powerhouse. They will also impair operation of the proposed Iowa Hill Development severely enough to render construction and operation of the Iowa Hill Development economically infeasible.

Slab Creek Reservoir was designed as a regulating reservoir to attenuate flows into and out of the water body over short periods of time (e.g., hours or days). Figures B3.2.1-5 and B3.2.1-6 of SMUD's License Application demonstrate daily fluctuations during daylight hours with the Iowa Hill Development will be as much as 12 feet during summer months and 10 feet during winter months. Under current operations, water levels at Slab Creek Reservoir are ramped up and down to optimize power generation at the White Rock Powerhouse. Significant levels of operational flexibility of the Slab Creek Reservoir are key to optimizing the White Rock Powerhouse resource, which provides operating reserves, regulation, load following, peaking capacity, and

local generation when system reliability needs or market conditions dictate. Current levels of operational flexibility are important to minimize spills at Slab Creek Dam.

Slab Creek Reservoir receives unregulated inflow from the South Fork American River; therefore, SMUD only has partial control of the elevation changes in this reservoir. This wide range of fluctuation in the daily water surface elevations at Slab Creek Reservoir under baseline is depicted in Figure 5.3.1-1 of Section 5.3.1 (Water Resources, Water Quantity), which shows actual elevations of the reservoir from both from SMUD-directed operations and unregulated river inflow. Under baseline conditions, Slab Creek Reservoir levels generally stays above 1,830 feet. However, elevations in the reservoir drop well below 1,830 feet at times as operators attempt to reduce storage in anticipation of a major runoff event. These storage reduction events are attempts to avoid spilling at Slab Creek Dam. Despite these efforts, the reservoir often spills. Under the Agency Alternative, there will be a higher incidence of spill, which will result in additional lost power generation at White Rock Powerhouse.

Another important aspect of Slab Creek Reservoir operation is associated with power generation at the UARP during periods of powerhouse maintenance outages. As is typical for hydroelectric projects, SMUD generally schedules planned outages at specific powerhouses during October-December. However, SMUD also experiences unplanned outages at powerhouses that can occur at any time of the year. During a planned or unplanned outage of a powerhouse upstream of Slab Creek Reservoir, SMUD manages the water in Slab Creek Reservoir to maintain needed power generation at White Rock Powerhouse. In these instances, the water elevation of Slab Creek Reservoir gradually declines during the outage period because no water enters the reservoir from Camino Powerhouse. This flexibility at Slab Creek Reservoir is essential to meeting SMUD's load requirements during these outage periods. The loss of operational flexibility associated with the Slab Creek Reservoir restrictions in the Agency Alternative will severely reduce this present capability.

Relative to the proposed Iowa Hill Development, the two measures are grossly incompatible with necessary operational parameters. The use of the Iowa Hill Development will vary day-to-day depending upon a variety of factors. There will be times when the development is not in use, times when the pumping/generation cycle is heavily used, and a variety of in-between cases representing moderate levels of daily use. Under the "heavy use" scenario of operation, water elevations in Slab Creek Reservoir will exhibit an average daily increase then decrease of nine to 15 feet (maximum of 30 feet). Figure B.3.2.1-5 of the SMUD License Application clearly shows a typical elevation change during daylight hours of about 12 feet, twice the Agency Alternative minimum elevation change. As stated above, atypical elevation changes could be greater, up to 30 feet per day.

The water level restriction of the Agency Alternative will also limit water management between the upper reservoir and Slab Creek Reservoir and overall operational UARP flexibility. As seen in Figure B3.9.2-3 of the License Application, the usable volume of Slab Creek Reservoir between full pool and 1,830 feet is approximately 4,000 acre-feet. The usable capacity of the upper reservoir will be 6,400 acre-feet. This discrepancy between the usable volumes of the two reservoirs will limit water transfer to the upper reservoir. For example, there may be a desire on

the part of UARP operators to pump 3,000 acre-feet into the upper reservoir during daylight hours, but Slab Creek Reservoir has only 2,000 acre-feet of usable volume available, based on the Agency Alternative restriction. The only options available to SMUD in this type of situation would be to limit pumping to the restricted volume of usable water or release water from Union Valley Reservoir to keep Slab Creek Reservoir from falling below 1,830 feet. Both options represent a loss in UARP flexibility.

Certain aspects of future operation of the Iowa Hill Development will require maximum flexibility of Slab Creek Reservoir. For example, as SMUD operators begin to use the Iowa Hill Development to support increased operating reserves, regulation, and load following, reservoir elevation fluctuation at Slab Creek Reservoir will likely become more dynamic than baseline conditions. These challenges will be particularly pronounced once SMUD begins managing wind and other non-dispatchable resources. This is best explained by example. The typical operation envisioned for the Iowa Hill Development is to pump at night and generate during the day, which equates to a rising Slab Creek Reservoir during daylight hours and a falling reservoir at night. However, on any given day, the wind associated with the “Delta breeze” may unexpectedly reduce forecasted temperatures and subsequently electric load below forecasted load levels. In this scenario, SMUD operators could switch from a generating operation at the Iowa Hill Development to a neutral or pumping operation to help manage changing system conditions. With the Agency Alternative restrictions in place, SMUD will lose the instantaneous ability to switch from generation to pumping mode in the daytime, thereby diminishing the ability of the Iowa Hill Development to support operating reserves, regulation, and load following, and regulate non-dispatchable renewable generation resources.

6.3.2 Water Management Restrictions at Gerle Creek Reservoir

With regard to Gerle Creek Reservoir, the Agency Alternative requires water levels to be maintained within two feet of full pool between May 1 and September 10 for recreation purposes. It also requires a minimum reservoir level within three feet below full pool between August 1 and October 31 for fish passage purposes. While the Agency Alternative allows for some relief from the recreation-based restriction, it does not offer relief for the fish passage restriction. The fish passage restriction at Gerle Creek Reservoir is unnecessary, as discussed in Section 5.3.3 (Aquatic Resources) of this document. In addition, both restrictions have the potential to restrict UARP operations. Requiring SMUD, for example, to consult with the resource agencies whenever Gerle Creek Reservoir is expected to drop two feet below full pool between May 1 and September 10 is infeasible from an operational perspective.

Water flowing into Gerle Creek Reservoir comes from the Loon Lake Powerhouse tailrace and inflow from Gerle Creek. The volume of inflow from Gerle Creek is dependent on releases from Loon Lake Reservoir and accretion from numerous tributaries along the 8.5-mile project reach. The Loon Lake Powerhouse is used for power regulating and peaking capabilities; operation of the powerhouse is coordinated with the operation of the Robbs Peak Powerhouse. Water is managed in this hydrologically-linked pair of powerhouses to maintain high water surface elevation in Gerle Creek Reservoir and to convey water through the 1.9-mile Gerle Canal. To a large degree, the management of water in this two-powerhouse system is dependent on and

constrained by the hydraulics of Gerle Canal. Requiring SMUD to maintain Gerle Creek Reservoir within a 2-foot range will add another constraint on the use of the two powerhouses. To maintain the reservoir between 5,228 and 5,231 feet will primarily constrain the operation of Loon Lake Powerhouse. To maintain a tight band of water level in the reservoir, SMUD will have to carefully ramp the volume of water passing through Loon Lake Powerhouse up and down to more closely mimic the hydraulic movement of water through the canal. This careful ramping and smoothing of the water through Loon Lake Powerhouse will reduce the regulating and peaking capacity of the powerhouse and may affect PDC.

6.4 Changes in UARP Value

As discussed in the Exhibit D of the License Application, SMUD utilizes FERC's current cost valuation approach by applying 2004 historic market pricing information whenever possible. Energy and capacity prices are highly variable; values in effect in 2004 do not necessarily apply to other years. Using the 2004 Dow Jones NP15 daily Electricity Price Index as a source, the 2004 on-peak and off-peak energy prices were \$54.4/MWh and \$42.0/MWh, respectively. The 2004 capacity value estimates were 75.1/Kw-yr. Both energy and capacity value will change over the course of the license term.

Under baseline conditions, the UARP provides an average annual net benefit to SMUD of \$86.2 million. This accrues from a \$30 million value of the 688 MW-capacity plus a \$93.1 million value of an average annual generation of 1,835 GWh, minus \$36.9 million in annual costs (see Table 6.2.4-1 of the PDEA). This baseline net annual benefit derived from the UARP will be significantly reduced under the Agency Alternative (Table 6.4-1).

The Agency Alternative will result in significant reductions in annual capacity and energy value, as well as a significant increase in annual costs due to non-flow-related environmental measures. Energy losses associated with the Agency Alternative will reduce net annual benefits by \$8.3 million. Additional costs will accrue to SMUD associated with the loss of up to 470 MW of PDC at the existing UARP facilities and the loss of an additional 400 MW capacity that would have been provided by the proposed Iowa Hill Development. The reduction in annual UARP value associated with losing up to 470 MW of PDC is \$15.9 million. This assessment is based on the need to replace the lost capacity by constructing a combustion turbine peaker plant in the Sacramento region, assuming there are sufficient stationary air quality offsets. Using the 2004 capacity value of \$75.1/kW-year², the 470 MW capacity replacement cost is \$35.3 million. However, because the peaker plant would not be utilized at all times to replace the lost UARP capacity, the full replacement cost is discounted to reflect benefits that would be derived from operating the plant during periods when it is not used to replace lost capacity. The first such circumstance is the non-summer months, when the Agency Alternative does not impose reservoir level restrictions with attendant capacity losses. In these months, the construction costs could be offset by using the peaker plant to sell capacity into the market, primarily the Northwest market at an assumed sales price that is 50 percent of the cost to construct a peaker plant in the Northwest (i.e., 50 percent of \$52.4/kW-year, or \$26.2/kW-year). Secondly, because the peaker

² From SMUD's License Application filed at the Federal Energy Commission July 15, 2005 in Exhibit D footnote 1 in Table D4.2-1.

plant would not operate full time each summer to replace the lost capacity, it would be used to sell real-time ancillary services into the California market when not used to make up the capacity loss. Using the 2004 California ISO non-spin ancillary services market prices, produces an additional construction cost offset of \$15.2/kW-year. Subtracting the two offset values from the capacity replacement costs yields a net UARP value loss of \$33.8/kW-year, or annual reduction in UARP capacity benefit of \$15.9 million.

The non-flow-related environmental measures required by the Agency Alternative will further reduce net annual UARP benefit by \$6.2 million, with additional losses potentially resulting from adaptive management measures that may be required on the basis of the Agency Alternative adaptive management program. Construction of a fish screen on the South Fork Rubicon River above Robbs Peak Reservoir, for example, would further reduce UARP benefit by associated with one-time construction of a \$10-20 million and unknown annual O&M costs. Building a fence along both sides of the 1.9-mile Gerle Canal will cost approximately \$4.8 million.

Finally, the Agency Alternative will result in the loss of all energy, capacity, and strategic benefits provided by the Iowa Hill Development. Collectively, the impacts to the various aspects of UARP value under this alternative will result in a \$30.4 million loss in annual net benefits compared to baseline conditions, i.e., \$8.3 in energy loss, \$15.9 million in capacity loss, and \$6.2 million in additional costs.

The Proposed Action, by contrast will increase the net benefit of the UARP above baseline conditions. With the Proposed Action, the net annual benefit of the UARP will increase by \$8.2 million to \$94.4 million, entirely as a result of the benefits accruing from the Iowa Hill Development. This increase in annual benefit will occur despite energy value losses associated with increases in minimum releases at eight of ten project reservoirs under the Proposed Action (see UARP-only Alternative economics in Exhibit D of the License Application). Capacity value will rise by \$30 million, energy value will rise by \$9.5 million, but non-environmental costs will also rise by \$30.3 million. The non-flow-related environmental measures of the Proposed Action will cost \$1 million.

In summary, the Agency Alternative will reduce net annual UARP benefits from \$86.2 million to \$55.8 million, which represents a 35.3 percent reduction. The Proposed Action will increase net annual UARP benefits from \$86.2 million to \$94.4 million, which represents a 9.5 percent increase. The difference in percentage change in benefits between these two alternatives represents a *significant* strategic value loss to SMUD. In addition, the inability to construct and operate the Iowa Hill Development represents a setback in SMUD's ability to achieve its long-term strategic, reliability, and portfolio planning objectives:

- Meeting State public policy objectives and energy challenges in the Northern California Region;
- More comprehensively developing the waterway for expanding project capabilities without a significant impact on the environment;

- Producing significant local generation in the Sacramento region to maintain system reliability as well as alleviate anticipated voltage and transmission constraints during peak-demand periods;
- Aiding management of greatly increased minute-by-minute load balancing and control area challenges presented by wind and other non-dispatchable generation technologies that are needed to meet SMUD's renewable portfolio standards;
- Shifting energy from low-demand to significantly more valuable peak-demand periods when appropriate;
- Reducing emission burdens by displacing the need for additional thermal peaking power plants in the Sacramento region, which is a air quality non-attainment area;
- Providing generation diversity within SMUD's resource portfolio.

Table 6.4-1. Comparison of long-term average annual net benefits of SMUD's Proposed Action, the Agency Alternative, and the No Action Alternative (baseline), in 2004 Dollars.			
	Proposed Action	Agency Alternative	No Action Alternative/Baseline
CAPACITY			
Installed Capacity – MW	1,088	218	688
Average Capacity – MW ¹	288	218	288
Unloaded Capacity – MW ¹	800	0	400
Capacity Benefits	\$60,000,000	\$14,100,000	\$30,000,000
TOTAL 2004 DOLLARS	\$60,000,000	\$14,100,000	\$30,000,000
ENERGY			
Annual Generation – MWh	2,779,000	1,664,000	1,835,000
Super-Peak ²	961,000	0	0
On-Peak	1,261,000	1,197,000	1,287,000
Off-Peak	557,000	467,000	548,000
Pumping	-1,246,000	0	0
Energy Benefits			
Super-Peak Energy – Iowa Hill ²	\$62,800,000	\$0	\$0
On-Peak Energy – UARP	\$68,700,000	\$65,200,000	\$70,100,000
Off-Peak Energy	\$23,400,000	\$19,600,000	\$23,000,000
Pumping Costs	-\$52,300,000	\$0	\$0
TOTAL 2004 DOLLARS	\$102,600,000	\$84,800,000	\$93,100,000
Total Gross Benefits	\$162,600,000	\$98,900,000	\$123,100,000
COST			
Average Annual Cost			
Non-Environmental (see Table 6.2.4-1 of the PDEA)	\$67,200,000	\$36,900,000	\$36,900,000
Environmental (Table 6.0-1)	\$1,000,000	\$6,200,000	\$0
TOTAL 2004 DOLLARS	\$68,200,000	\$43,100,000	\$36,900,000
LONG-TERM ANNUAL AVERAGE NET BENEFITS			
TOTAL 2004 DOLLARS	\$94,400,000	\$55,800,000	\$86,200,000

¹ The \$75.1/kW-yr capacity value assumes local construction of a peaking power plant with a new high-pressure gas pipeline; but would require no additional 230kV transmission interconnection. See Section 6.3.1.1 – Capacity. This capacity value is applied to the unloaded capacity only.

² This value assumes that the 961,000 MWh of annual average super-peak generation is priced 20% higher than the annual average on-peak generation. See Section 6.3.1.2 – Energy Generation.

**APPENDIX A
TO SECTION 6.0
DEVELOPMENTAL ANALYSIS**

**ESTIMATED COSTS OF ENVIRONMENTAL
MEASURES CONTAINED IN THE SMUD PROPOSED
ACTION AND THE AGENCY ALTERNATIVE
(APPENDICES A AND C), IN 2004 DOLLARS.**

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Environmental Measure	Entity	Capital & One-time Costs	Annual Costs, including O&M	Average Annual Costs^a	Reduction in Annual Energy Benefits^b
Water Resources					
Determine water year type each year based on unimpaired flows into Folsom Reservoir. Provide 5-year record to FERC annually.	SMUD	\$0	\$5,000	\$5,000	\$0
Perform study to determine if geomorphic pulse flows are needed below Loon Lake Reservoir.	SMUD	\$120,000	\$0 ^c	\$7,900	\$0
Implement geomorphic pulse flows below Loon Lake Dam, with ramping (Perform site sensitivity investigation and test releases prior to implementation).	Agency Alternative	\$250,000	\$500	\$16,900	\$74,000
Develop and implement stream channel stabilization plan in Loon Lake Dam Reach. ^d	Agency Alternative	\$100,000	\$0	\$6,600	\$0
Implement pulse flows below Rubicon Dam, with ramping; capital costs are for physical modifications needed to facilitate pulse flows. ^e	Agency Alternative	\$10,000,000	\$1,400	\$658,000	\$334,000
Implement geomorphic pulse flows below Ice House Dam, with ramping.	Agency Alternative	\$0	\$500	\$500	\$157,000
Develop and implement a streamflow and reservoir elevation gaging plan. ^f	Agency Alternative	\$500,000	\$15,000	\$47,800	\$0
Develop and implement a plan to evaluate canal and penstock emergency and maintenance release points.	Agency Alternative	\$20,000	\$0	\$1,300	\$0
Develop with Chili Bar Project licensee a	SMUD	\$30,000	\$10,000	\$12,000	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Coordinated Operations Plan, and implement plan.					
Coordinate operations with the licensee of the Chili Bar Project in order to comply with flow related measures.	Agency Alternative	\$30,000	\$10,000	\$12,000	\$0
Implement plan to pass woody debris at all UARP reservoirs, except Brush Creek, Gerle Creek and Iowa Hill reservoirs.	SMUD	\$20,000	\$100,000	\$101,300	\$0
Implement plan to pass large woody debris downstream at Robbs Peak, Junction, Camino and Slab Creek dams, and supplement from log deck at Slab Creek Dam.	Agency Alternative	\$20,000	\$15,000	\$16,300	\$0
Install continuous water temperature monitor at downstream end of Ice House Dam Reach, and monitor. Increase minimum flow release from Ice House Dam if mean daily water temperature exceeds 20°C for 3 consecutive days.	SMUD	\$100,000	\$5,000	\$11,600	\$0
Maintain 12°C or higher temperatures during June, July and August in SFAR reach below Mosquito Bridge (Iowa Hill Development measure). ^g	Agency Alternative	\$120,000	\$10,000	\$17,900	\$0
Prepare and implement long-term monitoring plan for geomorphology. ^h	Agency Alternative	\$10,000	\$16,000	\$16,700	\$0
Prepare and implement long-term monitoring plan for water temperature. ⁱ	Agency Alternative	\$10,000	\$37,500	\$38,200	\$0
Prepare and implement long-term monitoring plan for physical water quality. ^j	Agency Alternative	\$10,000	\$100,000	\$100,700	\$0
Prepare and implement long-term monitoring plan chemistry water quality. ^k	Agency Alternative	\$10,000	\$50,000	\$50,700	\$0
Prepare and implement long-term monitoring plan for bacterial water quality. ^l	Agency Alternative	\$10,000	\$14,200	\$14,900	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Prepare and implement long-term monitoring plan for metals bioaccumulation in fish. ^m	Agency Alternative	\$10,000	\$5,000	\$5,700	\$0
Meet annually with resource agencies to review results of implementing all ecological measures, and prepare and share a project O&M plan for that year.	Agency Alternative	\$0	\$20,000	\$20,000	\$0
Develop and implement an Erosion and Sedimentation Control Plan for construction of Iowa Hill Development.	SMUD	\$10,000 ⁿ	\$0	\$700	\$0
Develop and implement a Storm Water Pollution Prevention Plan for construction of Iowa Hill Development.	SMUD and Agency Alternative	\$10,000 ^o	\$0	\$700	\$0
Allow for no seepage of groundwater into or out of Iowa Hill Development water conveyance tunnels. ^p	Agency Alternative	--	--	--	--
Aquatic Resources					
Implement daily minimum reservoir release schedule, and provide compliance documentation to FERC annually.	SMUD and Agency Alternative	\$0	\$5,000	\$5,000	\$0
Minimum release at Rubicon Dam; installation of larger valve required.	Agency Alternative	\$250,000	\$4,400 ^q	\$20,800	\$441,000
Minimum release at Buck Island Dam.	Agency Alternative	\$0	\$4,400	\$4,400	\$67,000
Minimum release at Loon Lake Dam.	SMUD	\$0	\$0 ^r	\$0	\$142,000
Minimum release at Loon Lake Dam.	Agency Alternative	\$0	\$1,600	\$1,600	\$531,000
Combined minimum release at Gerle Creek Dam and Robbs Peak Dam.	SMUD	\$0	\$0	\$0	\$403,000
Combined minimum release at Gerle Creek Dam	Agency Alternative	\$0	\$3,200	\$3,200	\$901,000

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
and Robbs Peak Dam.					
Minimum release at Ice House Dam.	SMUD	\$0	\$0	\$0	\$158,000
Minimum release at Ice House Dam; installation of larger valve required.	Agency Alternative	\$250,000	\$1,600	\$18,000	\$373,000
Minimum release at Junction Dam.	SMUD	\$0	\$0	\$0	\$311,000
Minimum release at Junction Dam; installation of larger valve required.	Agency Alternative	\$150,000	\$1,600	\$11,400	\$722,000
Minimum release at Camino Dam.	SMUD	\$0	\$0	\$0	\$207,000
Minimum release at Camino Dam, with ramping; installation of larger valve required.	Agency Alternative	\$150,000	\$1,600	\$11,400	\$482,000
Minimum release at Brush Creek Dam.	SMUD	\$0	\$0	\$0	\$1,300
Minimum release at Brush Creek Dam.	Agency Alternative	\$0	\$1,600	\$1,600	\$2,000
Minimum release at Slab Creek Dam.	SMUD	\$0	\$0	\$0	\$856,000
Minimum release at Slab Creek Dam, with ramping; installation of larger valve required to implement releases.	Agency Alternative	\$1,900,000	\$1,600	\$126,400	\$1,912,000
Maintain minimum elevation of 5,228 feet at Gerle Creek Reservoir for brown trout passage into Gerle Creek.	Agency Alternative	\$0	\$0	\$0	-- ^s
Prepare and implement long-term monitoring plan for trout populations. ^t	Agency Alternative	\$10,000	\$48,000	\$48,700	\$0
Prepare and implement long-term monitoring plan for hardhead populations. ^u	Agency Alternative	\$10,000	\$8,700	\$9,400	\$0
Prepare and implement long-term monitoring plan for aquatic macroinvertebrates. ^v	Agency Alternative	\$10,000	\$20,000	\$20,700	\$0
Prepare and implement long-term monitoring plan for foothill yellow-legged frogs. ^w	Agency Alternative	\$10,000	\$35,000	\$35,700	\$0
Prepare and implement long-term monitoring plan	Agency Alternative	\$10,000	\$19,000	\$19,700	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
for mountain yellow-legged frogs. ^x					
Prepare and implement two-year monitoring plan for fish entrainment at Robbs Peak Powerhouse.	Agency Alternative	\$275,000	\$0	\$18,100	\$0
Monitor hardhead populations in Slab Creek Reservoir two years before and two years after construction of Iowa Hill Development.	Agency Alternative	\$350,000	\$0	\$23,000	\$0
Monitor temperatures in shallow water areas of Slab Creek Reservoir to determine Iowa Hill Development is affected hardhead distribution. ^y	Agency Alternative	\$0	\$2,400	\$2,400	\$0
Botanical & Wildlife Resources					
Implement protection and enhancement measures for special-status species (Annual Employee Environmental Awareness Program).	SMUD	\$10,000	\$20,000	\$20,700	\$0
Annually monitor for deer or wildlife in Gerle Canal.	Agency Alternative	\$0	\$3,000	\$3,000	\$0
Ensure a biological evaluation is completed before conducting any new construction or maintenance.	Agency Alternative	\$0	\$0	\$0	\$0
If FS sensitive plants or wildlife are detected during operations or O&M, notify the FS and FWS. FS may require plan to protect species.	Agency Alternative	\$0	\$0	\$0	\$0
Consult with agencies before conducting any O&M under transmission lines within the Pine Hill Pare Plant Preserve.	Agency Alternative	\$0	\$0	\$0	\$0
Retrofit all transmission lines to meet design and sighting standards to reduce bird electrocutions and collisions.	Agency Alternative	\$2,500,000	\$0	\$164,100	\$0
Conduct annual review of special-status species	SMUD	\$0	\$7,000	\$7,000	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
lists, and prepare study plan and perform study, if necessary. ^z					
Develop and implement Vegetation Management Plan for ENF lands within the FERC Project Boundary.	SMUD	\$40,000	\$3,000	\$5,600	\$0
Develop and implement a Vegetation Management Plan.	Agency Alternative	\$40,000	\$3,000	\$5,600	\$0
Develop and implement an Invasive Weeds Management Plan for ENF lands within the FERC Project Boundary.	SMUD	\$10,000	\$55,000	\$55,700	\$0
Develop and implement a Noxious Weeds Management Plan for ENF lands, and monitor annually.	Agency Alternative	\$10,000	\$55,000	\$55,700	\$0
Prepare and implement long-term monitoring plan for riparian vegetation. ^{aa}	Agency Alternative	\$10,000	\$23,000	\$23,700	\$0
Prepare and implement long-term monitoring plan for bears. ^{bb}	Agency Alternative	\$10,000	\$20,000	\$20,700	\$0
Prepare and implement long-term monitoring plan for bald eagles.	Agency Alternative	\$10,000	\$30,000	\$30,700	\$0
Develop and implement a Revegetation Plan and Noxious Weed Management Plan for construction of the Iowa Hill Development.	SMUD	\$130,000	\$0	\$8,500	\$0
Develop and implement a Wildlife Protection Plan for construction of the Iowa Hill Development.	SMUD	\$130,000	\$0	\$8,500	\$0
Purchase equivalent land or conservation easement for wildlife habitat due to Iowa Hill Development.	Agency Alternative	\$500,000 ^{cc}	\$15,000	\$47,800	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Cultural Resources					
Develop and implement the Heritage Properties Management Plan, and suspend work or operations in the event heritage resources are discovered.	SMUD and Agency Alternative	\$0	\$20,000	\$20,000	\$0
Recreational Resources					
Implement the proposed Recreation Plan. The plan would include the development of a Recreation Facility Reconstruction and New Construction Schedule, funding up to \$1,000,000 every 4 years for facility construction; reimbursing the ENF for engineering and design; and annually contributing to the ENF up to \$211,000 for facility O&M and for administration of recreation within the FERC project boundary.	SMUD	\$25,000	\$486,000	\$487,600	\$0
Develop Recreation Implementation Plan, and update every six years.	Agency Alternative	\$0	\$10,000	\$10,000	\$0
Conduct recreation survey and prepare Recreation Report every six years. ^{dd}	Agency Alternative	\$0	\$63,000	\$63,000	\$0
Provide a Forest Service liaison.	Agency Alternative	\$0	\$30,000	\$30,000	\$0
Review recreation facilities every six years.	Agency Alternative	\$0	\$20,000	\$20,000	\$0
Develop motorized camping area at Buck Island Reservoir.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Improve hiking trails at Buck Island Reservoir.	Agency Alternative	\$10,000	\$0	\$700	\$0
Improve hiking trails to Spider Lake.	Agency Alternative	\$30,000	\$0	\$2,000	\$0
Reconstruct Rubicon Hiking Trail.	Agency Alternative	\$1,500,000	\$0	\$98,500	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Reconstruct hiking trail at Pleasant Campground.	Agency Alternative	\$10,000	\$0	\$700	\$0
Improve Ellis Creek OHV Tie and Staging Area.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Prepare and implement a Loon Lake Recreation Plan to address impacts to the lakeshore zone and islands from unmanaged recreation.	Agency Alternative	\$339,000	\$0	\$22,300	\$0
Reconstruct Pleasant Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Expand and upgrade Northshore RV Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Reconstruct Loon Lake Campground (including Equestrian Loop).	Agency Alternative	\$950,000	\$0	\$62,400	\$0
Upgrade Loon Lake Group Campgrounds.	Agency Alternative	\$90,000	\$0	\$5,900	\$0
Reconstruct Loon Lake Group Equestrian Campground.	Agency Alternative	\$70,000	\$0	\$4,600	\$0
Upgrade Loon Lake Boat Launch and Day Use Area.	Agency Alternative	\$20,000	\$0	\$1,300	\$0
Upgrade Red Fir Group Campground.	Agency Alternative	\$70,000	\$0	\$4,600	\$0
Upgrade Loon Lake Chalet.	Agency Alternative	\$400,000	\$0	\$26,000	\$0
Upgrade Loon Lake Sanitation Station.	Agency Alternative	\$15,000	\$0	\$1,000	\$0
Upgrade Loon Lake Trailhead facility.	Agency Alternative	\$15,000	\$0	\$1,000	\$0
Construct a new campground on the south shore of Loon Lake Reservoir.	Agency Alternative	\$900,000	\$0	\$59,100	\$0
Prepare and implement a Gerle Creek Recreation Plan to address impacts to the Gerle Creek and Airport Flat areas from unmanaged recreation.	Agency Alternative	\$70,000	\$0	\$4,600	\$0
Reconstruct Gerle Creek Campground.	Agency Alternative	\$415,000	\$0	\$27,200	\$0
Upgrade Gerle Creek Day Use Area.	Agency Alternative	\$25,000	\$0	\$1,600	\$0
Upgrade Angel Creek Day Use Area.	Agency Alternative	\$50,000	\$0	\$3,200	\$0
Upgrade Airport Flat Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Extend Angel Creek Trail (to loop the Gerle Creek	Agency Alternative	\$500,000	\$0	\$32,800	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Reservoir).					
Upgrade Summer Harvest Trail.	Agency Alternative	\$25,000	\$0	\$1,600	\$0
Prepare and implement a Union Valley Reservoir Area Recreation Plan to address impacts to the Union Valley area from unmanaged recreation.	Agency Alternative	\$120,000	\$0	\$7,900	\$0
Prepare and implement a Union Valley Reservoir Boating Management Plan.	Agency Alternative	\$25,000	\$0	\$1,600	\$0
Upgrade Azalea Cove Campground.	Agency Alternative	\$100,000	\$0	\$6,600	\$0
Upgrade Big Silver Group Campground.	Agency Alternative	\$100,000	\$0	\$6,600	\$0
Upgrade Camino Cove Campground.	Agency Alternative	\$400,000	\$0	\$26,300	\$0
Upgrade Fashoda Campground.	Agency Alternative	\$500,000	\$0	\$32,800	\$0
Upgrade Fashoda Day Use Area.	Agency Alternative	\$15,000	\$0	\$1,000	\$0
Upgrade Jones Fork Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Lone Rock Campground.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Reconstruct Sunset Campground.	Agency Alternative	\$900,000	\$0	\$59,100	\$0
Upgrade Sunset Boat Launch.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Reconstruct Wench Creek Campground.	Agency Alternative	\$800,000	\$0	\$52,500	\$0
Reconstruct Wench Creek Group Campground.	Agency Alternative	\$200,000	\$0	\$13,100	\$0
Upgrade West Point Campground.	Agency Alternative	\$415,000	\$0	\$27,200	\$0
Upgrade West Point Boat Launch.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Upgrade Wolf Creek Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Wolf Creek Group Campground.	Agency Alternative	\$80,000	\$0	\$5,300	\$0
Reconstruct Yellowjacket Campground.	Agency Alternative	\$415,000	\$0	\$27,200	\$0
Upgrade Yellowjacket Boat Launch and extend boat ramp.	Agency Alternative	\$100,000	\$0	\$6,600	\$0
Extend the Union Valley Reservoir bike trail (to loop the reservoir).	Agency Alternative	\$1,500,000	\$0	\$98,500	\$0
Construct access trails and restore areas on north	Agency Alternative	\$415,000	\$0	\$27,200	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
side of Union Valley Reservoir.					
Prepare and implement an Ice House Reservoir Area Recreation Plan to address impacts to the Ice House area from unmanaged recreation.	Agency Alternative	\$220,000	\$0	\$14,400	\$0
Site and construct a new small boat-in camping area.	Agency Alternative	\$50,000	\$0	\$3,200	\$0
Reconstruct Ice House Campground.	Agency Alternative	\$500,000 ^{ee}	\$0	\$32,800	\$0
Reconstruct Ice House Day Use Area.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Northwind Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Strawberry Point Campground.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Ice House Boat Launch.	Agency Alternative	\$20,000	\$0	\$1,300	\$0
Reconstruct Ice House Sanitation Station.	Agency Alternative	\$50,000	\$0	\$3,200	\$0
Construct access trails and restoration along Lakeshore Road.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Construct a new day use facility (Highland Point).	Agency Alternative	\$415,000	\$0	\$27,200	\$0
Construct a new day use facility (Upper Silver Creek/Ice House Reservoir).	Agency Alternative	\$415,000	\$0	\$27,200	\$0
Extend the Ice House Mountain Bike Trail (to loop the reservoir) and add connector trail to Union Valley Reservoir bike trail.	Agency Alternative	\$580,000	\$0	\$38,100	\$0
Upgrade the Crystal Basin Work Center and Information Station.	Agency Alternative	\$175,000	\$0	\$11,500	\$0
Upgrade Big Hill Overlook facility.	Agency Alternative	\$10,000	\$0	\$700	\$0
Upgrade Cleveland Corral Information Station.	Agency Alternative	\$40,000	\$0	\$2,600	\$0
Reconstruct Silver Creek Campground.	Agency Alternative	\$225,000	\$0	\$14,800	\$0
Improve the informal boat launch at Junction Reservoir.	Agency Alternative	\$100,000	\$0	\$6,600	\$0
Improve the access area at Bryant Springs Road	Agency Alternative	\$25,000	\$0	\$1,600	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
and SF Silver Creek.					
Develop and implement plan to improve access at Brush Creek Reservoir.	Agency Alternative	\$120,000	\$0	\$7,900	\$0
Develop and implement plan for boating access at Slab Creek Reservoir (upstream end). ^{ff}	Agency Alternative	\$140,000	\$0	\$9,200	\$0
Develop and implement plan to improve boating access at Slab Creek Reservoir (near Dam). ^{gg}	Agency Alternative	\$190,000	\$0	\$12,500	\$0
Develop and implement a whitewater boating management plan, including access facilities, for Slab Creek Dam Reach. ^{hh}	Agency Alternative	\$450,000	\$0	\$29,500	\$0
Complete necessary heavy maintenance as determined via six-year recreation facility review. ⁱⁱ	Agency Alternative	\$0	\$100,000	\$100,000	\$0
Pay the FS annually for recreation O&M and administration.	Agency Alternative	\$0	\$741,805	\$741,805	\$0
Pay the FS annually for streamflow O&M and administration (whitewater boating river rangers).	Agency Alternative	\$0	\$48,000	\$48,000	\$0
Pay the FS annually for high country patrols.	Agency Alternative	\$0	\$53,000	\$53,000	\$0
Pay the FS annually for dispersed area (Zone 3) patrols.	Agency Alternative	\$0	\$88,000	\$88,000	\$0
In Wet and Above Normal water years, in September after Labor Day provide 3 consecutive weekends of 400 cfs flow from Ice House Dam for whitewater boating, with ramping.	SMUD	\$0	\$5,000	\$5,000	\$66,200
In all water years, provide up to 20 days of various flows from Ice House Dam for whitewater boating, with ramping.	Agency Alternative	\$0	\$17,400	\$17,400	\$108,400
In all water years, provide up to 36 days of various flows from Slab Creek Dam for whitewater boating, with ramping; capital costs are for	Agency Alternative	\$8,900,000	\$32,200	\$616,600	\$542,000

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
physical modifications needed to facilitate boating flows. ^{jj}					
Pay the FS annually for public information services.	Agency Alternative	\$0	\$114,288	\$114,288	\$0
Make project information (streamflow, reservoir levels, brochure/map) available to the public.	Agency Alternative	\$0	\$125,000	\$125,000	\$0
Develop and implement an interpretive, education and public information plan.	Agency Alternative	\$100,000	\$10,000	\$16,600	\$0
Provide 50,000 pounds of fish per year in the three storage reservoirs.	Agency Alternative	\$0	\$200,000	\$200,000	\$0
Visual Resources					
Maintain Ice House, Loon Lake and Union Valley reservoir water surface elevations as high as possible, consistent with power generation needs, and assure at least one boat launch is usable, from June 1 through Labor Day weekend.	SMUD	\$0	\$0	\$0	\$0
Meet specific, summer monthly reservoir levels at Loon Lake, Union Valley, & Ice House reservoirs.	Agency Alternative	\$0	\$0	\$0	-- ^{kk}
Maintain Rubicon and Buck Island reservoir water surface elevations as high as possible from June 1 through September 30.	SMUD	\$0	\$0	\$0	\$0
Maintain Rubicon and Buck Island reservoir water surface elevations as high as possible from May 1 to September 10.	Agency Alternative	\$0	\$0	\$0	minimal
Maintain Gerle Creek Reservoir water surface elevations as high as possible from May 1 through September 10, and do not drawdown in excess of	Agency Alternative	\$0	\$0	\$0	-- ^{ll}

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
two feet below full pool.					
Maintain Slab Creek Reservoir elevation above 1,830 feet during daylight hours, and restrict daily fluctuations to less than six feet during daylight hours.	Agency Alternative	\$0	\$0	\$0	-- ^{mm}
Maintain the seasonal reservoir levels at Junction and Brush Creek reservoirs within historical levels.	Agency Alternative	\$0	\$0	\$0	minimal
Meet with the FS every five years and review opportunities to better blend project features with landscape. ⁿⁿ	Agency Alternative	\$0	\$3,000	\$3,000	\$0
Improve visual quality of Robbs Powerhouse and Jones Fork Penstock. ^{oo}	Agency Alternative	\$0	\$0	\$0	\$0
Improve visual quality of fencing at Union Valley Dam Switchyard.	Agency Alternative	\$330,000	\$0	\$21,700	\$0
Improve visual quality of weather stations.	Agency Alternative	\$440,000	\$0	\$28,900	\$0
Improve visual quality of several other project features.	Agency Alternative	\$250,000	\$0	\$16,400	\$0
Develop and implement a Visual Resource Protection Plan for construction of the Iowa Hill Development.	SMUD and Agency Alternative	\$20,000	\$0	\$1,300	\$0
Land Use and Socioeconomic					
Implement the Road Maintenance Plan for roads on ENF lands, which includes a Snow Plowing Plan.	SMUD	\$0	\$250,000	\$250,000	\$0
Develop and implement Transportation System Management Plan, including a Snow Plowing Plan.	Agency Alternative	\$75,000	\$250,000	\$254,900	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Reconstruct and/or pave several FS roads.	Agency Alternative	\$8,300,000 PP	\$0	\$545,000	\$0
Develop and implement a Trails System Management Plan.	Agency Alternative	\$50,000	\$0	\$3,200	\$0
Develop and implement a Facility Management Plan; update every five years.	Agency Alternative	\$30,000	\$2,000	\$3,900	\$0
Develop and implement a Fire Prevention Plan. ^{qq}	Agency Alternative	\$20,000	\$20,000	\$21,300	\$0
Pay the FS annually for law enforcement, including response to fires, search and rescue, and administration and planning.	Agency Alternative	\$0	\$147,746	\$147,746	\$0
Develop and implement a Fire Risk and Protection Plan for construction of the Iowa Hill Development.	SMUD	\$15,000	\$0	\$1,000	\$0
Develop and implement a Noise Attenuation Plan for construction of the Iowa Hill Development.	SMUD and Agency Alternative	\$15,000	\$0	\$1,000	\$0
Develop and implement a Transportation Management Plan for construction of the Iowa Hill Development.	SMUD	\$15,000	\$0	\$1,000	\$0
Obtain a FS special use permit for the Iowa Hill Development's use of NFS lands.	Agency Alternative	\$20,000	\$0	\$1,300	\$0
Obtain a FS road-use permit and spoils disposal permits for the Iowa Hill Development.	Agency Alternative	\$15,000	\$0	\$1,000	\$0
Maintain a surety bond to guarantee NFS resources are protected in the event Iowa Hill Development measures are not carried out.	Agency Alternative	--	--	--	--
Air Quality Resources					
Develop and implement a Dust and Exhaust	SMUD	\$15,000	\$0	\$1,000	\$0

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.					
Emissions Abatement Plan for construction of the Iowa Hill Development.					

Estimated costs of environmental measures contained in the SMUD Proposed Action and the Agency Alternative (Appendices A and C), in 2004 dollars.				
Measure	Capital & One-time Costs	Annual Costs, including O&M	Average Annual Costs	Reduction in Annual Energy Benefits
SMUD Proposed Action	715,000	971,000	1,018,100	
Agency Alternative (Appendices A and C)	53,419,000	2,699,200	6,207,100	

^a Annualized costs for one-time and capital costs determined as actual costs over a 50 year license term with 6.25 percent SMUD discount rate.

^b Net reduction in annual project benefit determined by CHEOPS model simulations, evaluating individual Agency Alternative or SMUD Proposed Action measures (see discussion in Section 6.1).

^c Annual costs and/or one-time capital costs associated with this measure are unknown at this time since the study has not been performed or the plan has not been developed.

^d Includes one-time cost of developing study plan to investigate stream stabilization throughout 8.5-mile Loon Lake Dam Reach and performing the field investigation (stream stability was not studied throughout Loon Lake Dam Reach during relicensing). Implementing any remedial actions is an unknown future cost and not included in the table.

^e Capital and one-time costs based on construction of road and above-ground powerline a distance of roughly seven miles from Loon Lake Campground to Rubicon Lake.

^f One-time and capital cost is for adding new gaging sites below Gerle Creek Dam and Robbs Forebay Dam; annual cost is for one additional streamflow monitoring site to be added to compliance program, assuming gaging site downstream of Gerle Creek/South Fork Rubicon River will be discontinued.

^g One-time and capital costs includes the assumption that SMUD will contract with PG&E to install power lines along approximately 2,000 feet of Mosquito Bridge Road to operate real-time monitoring and tele-communication system. Implementation costs are unknown at this time, because frequency of temperatures falling below 12C at Mosquito Bridge are not known, and means by which SMUD will raise temperatures have not been examined (e.g., lower releases or spill warm water from surface of Slab Creek Reservoir)

^h Annual cost based on \$80,000 per year of sampling at 8 sites, performed every 5 years throughout license term. Yearly geomorphology sampling cost determined from relicensing studies.

ⁱ Annual cost based on \$37,500 per year of sampling, performed every year of license term. Yearly temperature monitoring at 16 sites is based on costs to perform water temperature monitoring during relicensing studies. Four of the sites will require helicopter transport. Monitoring may be expanded by up to 5 new sites, increasing annual costs.

^j Annual cost based on \$100,000 per year of sampling, performed every year of license term. Yearly physical monitoring at 7 project reservoirs (two seasons/year) and multiple stream sites (four seasons/year) above and below project reservoirs based on costs to perform similar sampling during relicensing in 2002-2003. High elevation reservoirs and several stream sites will require helicopter transport.

^k Annual cost based on \$250,000 per year of sampling, performed every five years of license term. Yearly water chemistry monitoring at all project reservoirs (four seasons/year) and multiple stream sites above and below project reservoirs based on high costs (e.g., laboratory costs for total and dissolved metals at very low detection levels) to perform similar sampling during relicensing in 2002-2003. High elevation reservoirs and several stream sites will require helicopter transport.

^l Annual cost based on \$25,000 per year of sampling at 9 sites, performed every year the first 5 years then every other year through the term of the license. Yearly sampling based on relicensing study costs. Monitoring results may lead to sampling every year, which will increase annual costs.

^m Annual cost based on \$25,000 per year of sampling at 6 reservoirs, performed every five years throughout the license term. Yearly sampling based on relicensing study costs.

ⁿ Ultimate costs associated with this measure are unknown at this time.

^o Ibid.

^p Eliminating all groundwater from entering and exiting the water conveyance tunnels of the Iowa Hill Development is infeasible.

^q Annual cost based on substantial increase in frequency of dam visits to adjust valves to implement Agency Alternative monthly release schedule.

^r Proposed Action release schedule will increase frequency of dam visits to adjust valves minimally.

^s Reservoir restrictions at Gerle Creek for brown trout outmigration have the potential to impact project flexibility, but impacts to power generation at Loon Lake Powerhouse are uncertain.

^t Annual cost based on \$130,000 per year of trout sampling at 13 sites, performed every 2 years out of 5 throughout license term. Yearly trout sampling cost based on relicensing study costs 2002-2004. Four of the sites will require helicopter transport.

^u Annual cost based on \$20,000 per year of hardhead sampling, performed every 2 years out of 5 throughout license term.

^v Annual cost based on \$50,000 per year of benthic macroinvertebrate at 10 sites, performed every 2 years out of 5 throughout license term. Yearly BMI sampling based on relicensing study costs 2002-2004. One of the sites will require helicopter transport.

^w Annual cost based on \$75,000 per year of foothill yellow-legged frog sampling at 6 sites in three project reaches, performed at variable frequencies depending on project reach. Yearly sampling based on relicensing studies and PG&E survey protocols, which call for repeat visits to sampling sites. Monitoring results may lead to expansion of monitoring program and higher costs.

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- ^x Annual cost based on 50,000 per year of mountain yellow-legged frog sampling at Rubicon Reservoir, Rockbound Lake, and Buck Island Reservoir (spring/summer surveys). Yearly sampling based on relicensing studies and PG&E survey protocols, which call for periodic visits to sampling sites. Studies performed by CDFG may result in reduced monitoring costs.
- ^y Annual costs based on assumption of need to place 6-8 temperature sensors throughout Slab Creek Reservoir annually for period of 10 years to “Demonstrate that temperatures in shallow water areas of Slab Creek Reservoir are not affecting hardhead distribution by pump discharge”.
- ^z Annual costs associated with performing periodic studies for plant species added to special-status species lists unknown since species unknown at this time. A total cost of \$350,000 is assumed, distributed equally over the 50-year license term.
- ^{aa} Annual cost based on \$115,000 per year for aerial photograph mapping and intensive greenline sampling at 15 sites, performed every 5 years through license term. Yearly riparian sampling cost based on relicensing study costs of 2003. Three of the sites will require helicopter transport.
- ^{bb} One time and/or annual costs could increase under the adaptive management plan depending on results of monitoring plan.
- ^{cc} Land purchase in rural Sierra Nevada foothill area could be significantly higher than \$500,000.
- ^{dd} Annual cost based on \$215,000 for recreation survey and \$100,000 for recreation report per year, performed every 6 years through license term.
- ^{ee} Excludes costs associated with providing electricity.
- ^{ff} Actual costs may be significantly greater due to steep topography and bend in river; boat launch may be infeasible.
- ^{gg} Actual costs may be significantly greater due to steep topography.
- ^{hh} Excludes any costs associated with private property issues.
- ⁱⁱ Actual costs may vary significantly from year to year.
- ^{jj} Capital cost is based on reconfiguring White Rock Tunnel Adit to serve as release point for boating flows. The feasibility of penetrating Slab Creek Dam and installing new valve for whitewater boating flow releases is highly uncertain given dam stability concerns.
- ^{kk} Impacts of water surface elevation on UARP capacity value is discussed in Sections 6.3 and 6.4.
- ^{ll} Reservoir restrictions at Gerle Creek for recreation have the potential to impact project flexibility, but impacts to power generation at Loon Lake Powerhouse are uncertain.
- ^{mmm} Reduction in UARP value associated with loss of project flexibility and impacts to Iowa Hill Development are discussed in Section 6.3.
- ⁿⁿ Annual meetings with Forest Service are likely to lead to increased costs to blend project facilities into surrounding landscape.
- ^{oo} \$900,000 cost to paint powerhouse and penstock not included as SMUD will incur these costs as part of regular maintenance activities during the license term.
- ^{pp} One-time cost of paving roads based on \$6,000,000 for 5.3 miles of north shore road at Union Valley Reservoir (reconfiguration of existing road required before paving); \$800,000 for approximately one mile of Ice House Road; \$1,000,000 for 1.3 miles of north shore road at Ice House Reservoir; \$500,000 for Wright’s Lake tie-in.
- ^{qq} Costs may be significantly greater if SMUD is required to address areas unrelated to UARP facilities.