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FINAL PROJECT REPORT

EL DORADO COUNTY WATER SYSTEMS ENERGY GENERATION, STORAGE, EFFICIENCY, DEMAND MANAGEMENT & GRID SUPPORT

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- Amador Water Agency

PREFACE

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El Dorado County Water Systems Energy Generation, Storage, Efficiency, Demand Management and Grid Support is the final report for the project (contract number PIR-08-040) conducted by Domenichelli and Associates, Inc. The information from this project contributes to Energy Research and Development Division's Renewable Energy Technologies Program.

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ABSTRACT

The El Dorado County water systems project analyzed opportunities and proposed tools, and strategies for cost-effective measures to integrate energy management and energy generation with water management and provide grid support within El Dorado county water systems. Several specific example cases were chosen, focusing on the El Dorado Irrigation District (EID), which is one of the largest water purveyors in El Dorado County. The project identifed options to upgrade mechanical installations, devise management tools for greater efficiency and potential for incorporating renewable energy into the existing infrastructure, and develop key information that might be used within El Dorado County. This report concludes that there are significant opportunities for renewable energy development and energy efficiency projects within the County water systems, and also identifies certain challenges to implementing these efforts. The information presented this report and in the Technical Memorandums in the Appendix provides potentially useful insights for other water purveyors who might be interested in undertaking similar projects.

Keywords: Energy, Efficiency, Hydroelectric, Solar, Generation, Storage, Demand Management, Grid Support, Renewable, El Dorado County, El Dorado Irrigation District

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EXECUTIVE SUMMARY

Introduction

The El Dorado Irrigation District (EID) is one of the largest energy users in El Dorado County with more than 39,000 water accounts. EID's delivery infrastructure for water includes approximately 1,200 miles of pipeline, 27 miles of ditches, 5 treatment plants, 36 storage reservoirs, and 37 pump stations. EID's water system has a safe yield of approximately 63,550 acre-feet/year (19.7 billion gallons) receiving water from three water supplies. EID, in partnership with other El Dorado County water agencies, seeks to keep pace with environmentally friendly and energy efficient technologies and regulatory and policy changes in an effort to provide customers with high-quality water and cost-effective service.

Under the California's Energy Commission's Renewable Energy Secure Communities Program EID obtained grant funding to analyze its water system and other energy-using facilities to identify energy efficiency opportunities for energy production; energy use and management technologies at existing treated and raw water systems; and integrating energy and water management operations to support the electrical grid.

Project Goal and Purpose

This project identified cost effective and operationally feasible measures to integrate energy management and generation into water management systems to most efficiently support the electric utility grid.

The project identified technical and economic objectives with particular focus on needs, measures, and opportunities within El Dorado County and principally EID:

- Assess the energy demand, storage, efficiency, scheduling and generation aspects of water system operations to identify the "best fit" scenario for energy use and production relative to the electric utility grid;
- Inform agencies of current regulatory and legislative policies, and the potential impacts on current and proposed project development and advancement;
- Quantify the amount and cost of options for load shifting peak period generation, increased energy efficiency, load reduction and new energy storage;
- Quantify the feasibility and costs of integrating system-wide water operations with the electric utility grid load management'
- Quantify energy generation revenue and energy savings that would reduce long-term water system operations costs to the purveyor and their customers;
- Identify sustainable energy incentive programs ; and
- Engage other El Dorado County and regional water organizations to identify and analyze energy management practices and integrate energy saving measures into their existing systems and facilities.

Project Results

The project examined options and opportunities for demand management and energy efficiency improvements; identified short-, medium- and long- term energy efficiency and generation opportunities for specific water purveyors within the EID and nearby purveyors, and developed an updated summary of relevant policies, legislation, permitting and financial regulations, constraints and incentives and issues, with special focus on hydropower and solar projects.

Options for Demand Management to Support the Grid

Demand management is strategies an agency may implement by using existing infrastructure or by making economically reasonable improvements to allow a facility to operate more efficiently, based on the criteria of reduced energy consumption (e.g. lowering energy costs) and increased flexibility to meet water supply demands. Demand management strategies frequently use reduced energy rates ($/kW) that are defined by time of year and time of day and are divided into peak, partial peak, and off peak periods. EID has incorporated several demand management strategies identified in this study into several facility operations and has found them to be effective.

The project concluded that there is potential for demand management strategies within the EID water system, but there also are multiple challenges to identifying and implementing such strategies. A major impediment is the lack of accurate information available for the system. It has been difficult for EID to determine all of the opportunities available for demand management when long-term flow data of supply and demand is not available for all parts of the system. To determine if increased demand management can be achieved EID must determine where additional data collection is necessary in the system and how that information can be gathered. This requires the addition of flow meters and pressure gages at key locations to gather data over time.

It is often difficult to implement operation changes at water agencies, when an existing operation is working with few problems. Typically, once operations staff has a clear understanding of how a new operation strategy can be integrated they are more likely to implement it long term. It is, therefore, important to involve operations staff early and often in the demand management strategy development.

Energy Efficiency Opportunities

Opportunities exist to improve pumping efficiencies at ten existing pump stations in the EID service area. The wide range of elevations within El Dorado County require pumping stations as a vital component to supplying safe and reliable drinking water throughout the county. Pump station energy use potentially represents a sizeable portion of EID's operating costs. Significant cost factors include:

- The consumption of energy based on the efficiency and size of the pumps required.
- Pump use during daily peak (high cost) energy use periods to deliver water on-demand.

Analyses performed in this project found that if all of the pump station upgrades recommended in the study were implemented the potential savings to EID would be up to $6,500 per month or almost $80,000 a year. Potential increases in efficiency can range from 10 percent to 17 percent at given stations, with potential monthly savings as much as $3800 at one station and payback periods ranging from 1.2 to 6.1 years. Considering that the average life of a pump station can be 20-30 years the potential lifetime savings to EID is over $1,500,000. EID operates more than 37 pump stations in their system, many with multiple pumps; this could add up to significant savings over the lifetime of multiple pump stations.

The pump stations evaluated were a sampling of the types of issues that exist in EID's system. A more thorough evaluation of the pump stations including pump station testing to determine the system requirements is recommended throughout the system.

Update to Energy Policy Programs

Associated with assessing the feasibility of opportunities for hydroelectric and solar generation at some area facilities, the project team performed an overview of applicable Federal and State legislation and policy and available financial programs as they existed in 2011.

Hydropower

The project team found that new regulations indirectly promote hydropower through measures designed to limit carbon-based energy [(e.g., the California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms (Cap-and-Trade) program implemented by California Air Resource Board (CARB) to reduce GHG emissions by applying an aggregate GHG allowance)] (CARB 2013a). Expedited permitting [e.g., Federal Energy Regulatory Commission (FERC) and California Environmental Quality Act (CEQA) permit exemptions for existing facilities] and other incentives also are available today for small hydroelectric development and other renewable energy generation at existing water facilities.

The team found that financial incentives are available at state and federal levels for in-conduit hydroelectric units at existing facilities. The project identified two hydroelectric financial programs - Feed-in Tariff with the Electric-Renewable Market Adjusting Tariff (ReMAT) and Local Government Renewable Energy Self-Generation Bill Credit Transfer Tariff (RES-BCT).

Offered by PG&E, ReMAT became effective on July 24, 2013. ReMAT was established by the CPUC to implement Senate Bill (SB) 32, which increased the statewide procurement renewable target from 500 MW to 750 MW (for investor owned utilities and public owned utilities) and increased the eligible project size from 1.5 MW to 3 MW.

The RES-BCT tariff allows local governments to generate electricity at one account and transfer any available excess bill credits (in dollars) to another account owned by the same local government. This tariff allows the project owner to generate a bill credit at a hydroelectric project and apply that credit to up to 50 "benefiting accounts" within the owner's PG&E customer account.*Solar*

The California Solar Initiative (CSI) is the solar rebate program for California consumers that are customers of the primary investor-owned utilities; Pacific Gas & Electric Company,

Southern California Edison, San Diego Gas & Electric. The largest component of the CSI Program is known as the CSI General Market Program. The CSI General Market Program also funds solar PV as well as other solar thermal generating technologies (Go Solar 2014b). This incentive program also provides cash back for solar energy systems of less than one megawatt to existing and new commercial, industrial, government, nonprofit, and agricultural properties.

Hydroelectric Opportunities

In July 2009, EID along with the El Dorado County Water Agency published the El Dorado County Hydroelectric Development Options Study that reviewed more than 100 hydroelectric development opportunities throughout the County. Two of these hydroelectric opportunities were evaluated in this report: the Pleasant Oak Main (POM) Tank 7 In-conduit hydro project and the Oak Ridge Tanks to Bass Lake Tanks Pumped Storage project.

The POM hydroelectric project evaluation concluded that it is economically and hydraulically feasible. In 2013, the final environmental exemptions were completed. On March 10, 2014, the EID Board voted to approve an interconnection agreement with PG&E and the project is expected to bid for construction in late summer 2014. This project will be EID's first in-conduit hydroelectric facility. Lessons learned from this project will be applied to other EID in-conduit hydroelectric projects that are currently being evaluated.

Additionally, EID has filed a Notice of Intent with FERC for the EDM2 PRS 1 Tank 3 Hydroelectric project for the expedited permitting process. In April 2014, FERC agreed with the exemption and opened a public comment period. The priority for this project recently changed with the new reduced regulatory burden of projects on federal lands, which previously made this project infeasible.

EID's 2013 Integrated Water Resources Master Plan concluded that there are significant opportunities in the existing system with proposed facilities to operate by extending the gravity system. This is a change in previous planning, which included more pumping facilities. With the ongoing emphasis of energy efficiency and storage EID has determined that the Oak Ridge Tanks Pump Station is no longer necessary for system operation, and the facility will not be built in the future as previously planned. The analysis provided in the report can be used as an example of how similar facilities can use reoperation for increased energy efficiency.

Solar Generation Opportunities

This study identified four facilities in the EID systems - Bass Lake and Recycled Water Booster Pump Stations, Deer Creek Wastewater Treatment Plant, El Dorado Hills Wastewater Treatment Plant and EID Headquarters - whose attributes suggested that integrating solar may be economically feasible at certain portions of the facilities. Solar opportunities were evaluated on these four facilities including existing grid connection, available area, solar layout and type, optimal size of system, capital cost and generation estimates, environmental constraints and an economic feasibility analysis.

Ten specific potential development projects on floats and ground locations at sites within the four facilities were further evaluated and ranked based on net-present-value which must be

positive, and a payback period of less than 20 years. Due to high capital and financing costs, none of the projects identified and evaluated for the four facilities were found to be economically feasible based on typical financing available to water agencies. While the capital costs of solar technologies have been reduced in recent years these costs are still high, especially when they must be financed, and exceed the potential return on the investment and cause a negative net-present-value for the projects. Projects could be considered economically feastible if they were at 6 percent interest rate over 30 years.

To offset the high capital costs of solar, additional grant programs are necessary. Other grant programs could be modeled after programs currently run by PG&E. A low interest loan program could be modeled after the State Revolving Fund program used by the California Department of Public Health to fund water and wastewater projects. It should be noted that the economic evaluations provided are based on financial programs available in 2009.

Short and Long Term Energy Generation Opportunities in El Dorado County

The project evaluated the near, mid, and long-term energy generation opportunities at multiple agencies and water districts throughout El Dorado County and adjacent areas. The generation types included hydroelectric, solar, wind, biomass, and biogas.Conclusions and Recommendations

While many challenges and impediments towards improving system efficiency and integrating renewable energies exist, there are many energy efficiency opportunities that should be further considered that could improve energy efficiency, reduce energy costs, and align the water and electrical management to the electrical utility grid. Based on the information gained in this project, many of these energy efficiency opportunities are achievable with thorough evaluation and planning, cooperation, and coordination among regulatory agencies and stakeholders, and with better funding mechanisms.

As existing infrastructure continues to age and energy demands continue to increase, the development and enhancement of new and existing infrastructure and equipment presents opportunities to improve system efficiency. Additionally, the environment within California continues to remain positive for integrating renewable energies into system operations.

Regulatory and policy changes impacting energy efficiency and renewable energies continue to evolve allowing many of these opportunities, once considered economically infeasible, to become economically feasible. Funding mechanisms continue to improve that allow capital and improvement costs to be shared or subsidized.

Based on the challenges and impediments confronting energy efficiency improvements and renewable energies, the following solutions are recommended:

- Interconnection regulations and costs must be reduced. Cost negotiations and a partnership with the electric service providers need to be held to make the costs and requirements associated with interconnection more economical.

- Additional incentive and grant programs are needed for energy efficiency, load shifting and grid balancing, and renewable energy projects. For instance, a low interest loan program could be modeled after the State Revolving Fund program used by the California Department of Public Health to fund water and wastewater projects. Grant programs could be modeled after programs currently run by PG&E.
- Energy pricing and regulations need to reflect the differentiating benefits of hydroelectric, solar, and other renewable energy projects.
- Improved data collection of existing systems that would improve system evaluations and identify energy inefficiencies within the system. Agencies are encouraged to add additional flow meters and pressure gages onto their water systems to more accurately estimate potential generation and efficiency improvements.

It is also recommended that water purveyors monitor and implement the following:

- Monitor and continue to lobby for grant programs and other funding mechanisms related to energy efficiency improvements and renewable energies.
- Monitor and lobby for regulation and policy changes that promote renewable energies and water/energy nexus efficiency opportunities.
- Conduct additional investigation on water systems to identify potential operational and efficiency improvements.
- As aging infrastructure is replaced incorporate additional monitoring facilities (flow meters and pressure gauges) in order to allow for additional assessment in the future.
- As aging infrastructure is replaced continue to re-evaluate projects that were not cost effective due to the high costs to replace older facilities. New facilities should also be evaluated for energy generation opportunities and designed to take advantage of these opportunities if financially feasible.

Project Benefits

Water purveyors interested in increasing the energy efficiency of their system can use the methods and actions presented in this report to evaluate cost effective and operationally feasible types of renewable energy and energy management strategies in their systems and take advantage of lessons learned from feasibility evaluations to analyze their systems, and .

CHAPTER 1:
Introduction/Project Background

1.1 Introduction

Water conveyance, treatment, and energy (i.e., hydroelectric) generating systems are technologically mature with most recent developments in water quality processes, however they do not always consider using the most recent energy generation (hydroelectric) technologies. Pumps, storage facilities, and hydropower equipment are durable and proven, and most California water systems are very similar in design and operation.

Recent developments in hydropower, including dual induction motors and regenerative and variable frequency drives, hold promise for adding generation to existing water systems with highly variable flows including potable water, treatment plant and recycled water distribution systems. However, despite the maturity of the water supply industry: 1) most treated water systems operate with limited regard to energy efficiency or use or the demands on the electric grid, 2) considerable potential energy is lost through energy dissipating devices, and new peaking energy (water) storage in gravity systems remains largely unexplored, and 3) the systems operate with little emphasis on optimizing overall energy management.

This project analyzed energy production, use and management technologies at existing treated and raw water systems, and evaluated the ability to integrate energy and water management operations to support electric grid operations.

The project area focuses on El Dorado County's largest water purveyors including:

- El Dorado Irrigation District
- Georgetown Divide Public Utility District
- South Tahoe Public Utility District
- Grizzly Flats Community Services District
- Tahoe City Public Utility District

1.2 Project Goals and Objectives

This project identified cost effective and operationally feasible measures to integrate energy management and generation into water management to most efficiently support the electric utility grid. The project also identified the following technical and economic objectives with particular focus on the needs, measures, and opportunities within El Dorado County and principally EID:

1.2.1 Technical and Economic Objectives

- Assess the energy demand, storage, efficiency, scheduling and generation aspects of water system operations to identify the "best fit" scenario for energy use and production relative to the electric utility grid.
- Inform Agencies of current regulatory and legislative policies, and the potential impacts on current and proposed project development and advancement
- Quantify the amount and cost of options for load shifting peak period generation, increased energy efficiency, load reduction and new energy storage
- Quantify the feasibility and costs of integrating system-wide water operations with the electric utility grid load management
- Quantify energy generation revenue and energy savings that would reduce long-term water system operations costs to the purveyor and their customers
- Identify sustainable energy incentive programs
- Engage other El Dorado County and regional water organizations to identify and analyze energy management practices and integrate energy saving measures into their existing systems and facilities.

1.2.2 Study Process

To achieve the objectives and goals listed above several tasks were developed and a series of technical memorandums (TMs) were completed as follows:

- TM#1 – Task 2.1 – Project Descriptions Technical Memorandum
- TM#2 – Task 2.2 – Existing Systems Water and Energy Demands Technical Memorandum
- TM#3 – Task 2.2 – Future Water Demands Technical Memorandum
- TM#4 – Task 2.3 – Identify Options for Demand Management during Utility Peak Periods
- TM#5 – Task 2.4 – Inventory Existing Equipment for Improved Energy Efficiency Technical Memorandum
- TM#6 – Task 2.5 – Hydroelectric Opportunities Technical Memorandum
- TM#7 – Task 2.6 – Solar Opportunities Technical Memorandum
- TM#8 – Task 2.8 – Identify Near, Mid-Term and Long-Term Energy Efficiency and Generation Opportunities
- TM#9 – Task 2.9 – Prepare Preliminary Engineering, Economic and Environmental Analyses of Recommended Near and Mid-Term System Alternatives

The TMs provided detailed analyses and conclusions for each project evaluated. The final versions of applicable TMs that offer additional information and evaluations (beyond what is summarized in the report) are included in the appendix of this report for reference.

This report summarized the tools and analyses used in developing the technical memorandums. Case studies are provided for the various types of energy efficiency, demand management and generation opportunities in El Dorado County. These case studies provide examples and define the tools and information necessary for other water purveyors to use when determining the feasibility of such projects. The case studies focus on the El Dorado Irrigation District (EID), which is one of the largest water purveyors in El Dorado County and the main cost share contributor to the study. Other water purveyors in El Dorado County and adjacent areas were also contacted and County wide opportunities are summarized in this report. Finally conclusions and recommendations are provided.

This report is divided into the following sections (Chapters):

Chapter 1 – Introduction/Project Background – Provides an overview of the project and project goals

Chapter 2 – Options for Demand Management to Support – Provides an example of a demand management strategy previously implemented by EID and the potential to implement the program long term.

Chapter 3 – Energy Efficiency Opportunities – Provides analysis of 10 pump stations identified by EID for potential energy efficiency savings.

Chapter 4 – Update to Energy Policy Programs – This provides an update to legislative and economic programs discussed in previous TMs for hydroelectric and solar generation.

Chapter 5 – Hydroelectric Generation Opportunities – Provides an overview of the opportunities for reoperation of portions of EID's system to optimize hydroelectric generation facilities.

Chapter 6 – Solar Generation Opportunities – Provides an overview of four sites throughout EID's system for possible solar generation facilities including economic evaluations.

Chapter 7 – Short Term and Long Term Efficiency and Energy Generation Opportunities in El Dorado County – Provides an overview of water purveyors in El Dorado County and surrounding areas and a summary of opportunities identified for each purveyor.

Chapter 8 – Conclusions and Recommendations – Provides an overview of the issues, impediments and potential solutions to facilitate implementation of energy efficiency and generation opportunities in El Dorado County.

CHAPTER 2:
Options for Demand Management Strategies

2.1 El Dorado Irrigation District Case Study

The El Dorado Irrigation District (EID) is one of the largest energy users in El Dorado County with over 39,000 water accounts. EID's delivery infrastructure for water includes approximately 1,200 miles of pipeline, 27 miles of ditches, 5 treatment plants, 36 storage reservoirs, and 37 pump stations. EID's water system has a safe yield of approximately 63,550 acre-feet/year (19.7 billion gallons) receiving water from three water supplies. The Western/Eastern[1] area receives water from EID's eastern sources: Project 184 and Jenkinson Lake. The El Dorado Hills (EDH) area receives water from Folsom Reservoir with yearly supplementation from EID's eastern sources by means of the Gold Hill Intertie (GHI) when annual maintenance at the El Dorado Hills Water Treatment Plant (EDHWTP) is performed.

Table 1 summarizes the availability and projected demand of water for EID's two service areas based on the latest information from the 2013 Water Resources and Service Reliability Report.

Table 1: 2013 Water Availability and Demand

El Dorado Hills Service Area	Western/Eastern Service Area
Available Water Supply = 15,163 AF from Folsom Lake with additional supply from the GHI	Available Water Supply = 36,000 AF
Total Potential Demand = 11,554 AF	Total Potential Demand = 34,955 AF

Source: EID Water Resources and Service Reliability Report, 2013.

The analysis provided below was prepared in 2011 and used actual data from the District for 2009 which included 15,163 acre-feet (AF) of available supply and 12,070 acre-feet of potential demand (based on available data). The table above has been updated to include information provided in the 2013 Water Resources and Service Reliability Report.

2.1.1 Overview of Existing and Future Water Supply and Energy Demands

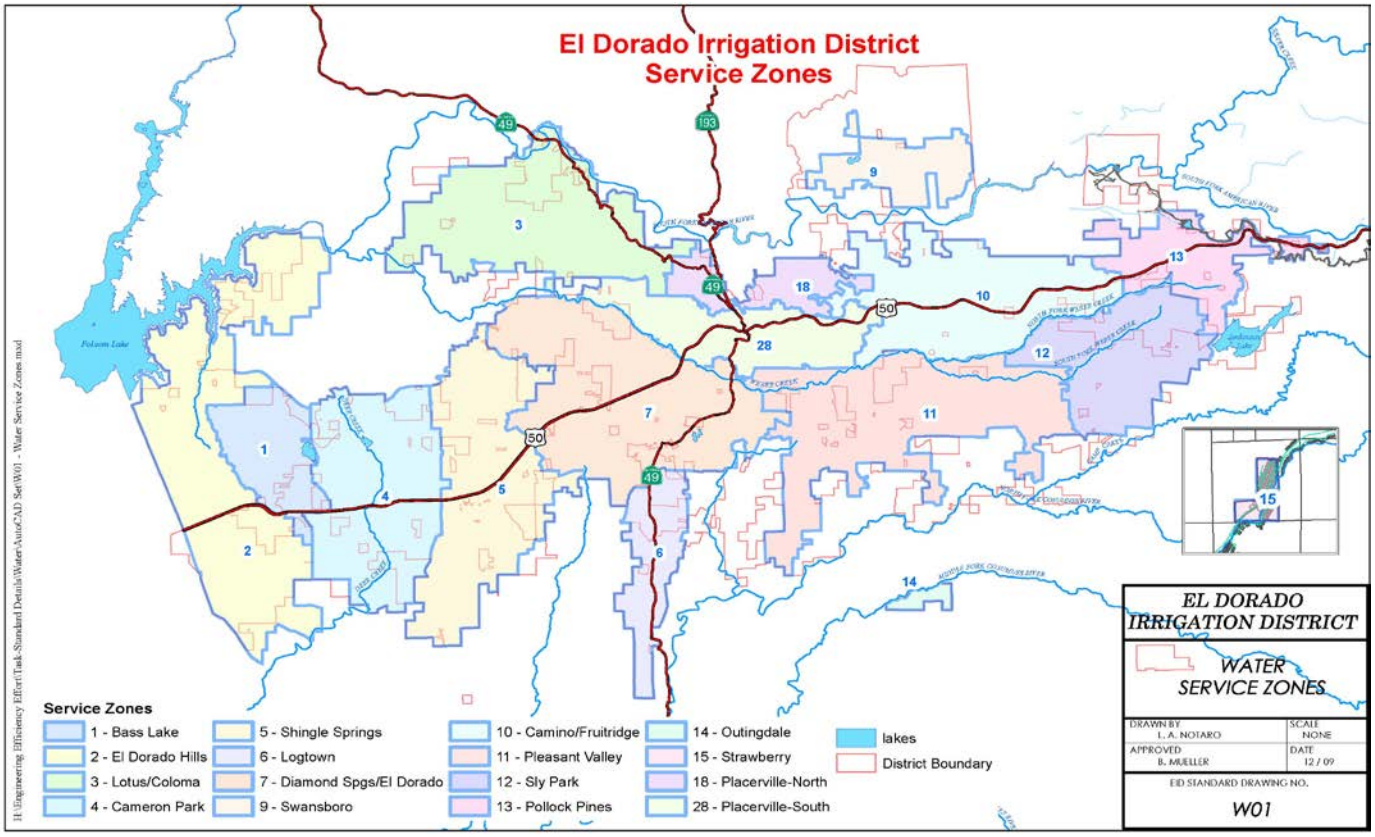
Due to EID's expansive service area, this section focuses only on the existing and future water and energy demands of EDH's service area. The EDH area accounts for nearly twenty-five (25%) percent of the water demand within the EID system and is one of EID's largest energy users.

[1] The Western/Eastern area is comprised of Bass Lake, Cameron Park, Shingle Springs, Logtown, Swansboro, El Dorado, Diamond Springs, Pleasant Valley, Sly Park, Pollock Pines, Camino, Placerville, and Lotus/Coloma.

The EDH service area boundary is defined by Folsom Reservoir and the South Fork American River to the north, Cameron Park to the East, Deer Creek to the South, and Sacramento County to the west. EDH's primary water source is Folsom Reservoir that is treated at the EDHWTP and conveyed to the 820 and 960 pressure zones[2]. A portion of the EDH service area, specifically the upper Serrano development, is served by the Bass Lake Tanks by means of the GHI.

[2] 820 Pressure Zone consists of three water tanks: Promontory, Salmon Falls, and Monte Vista. 960 Pressure Zone consists of five water tanks: Highland View, Oak Ridge (2 tanks), Ridgeview, and Lower Valley View.

Figure 1: El Dorado Hills Schematic for Existing System



To keep pace with anticipated growth and development, EID has made capital improvements to the Folsom Lake Intake Pump Station (FLIPS) and EDHWTP increasing capacity from 19.5 MGD to 26 MGD, and have constructed one additional water supply tanks, Upper Valley View Tank (0.84 MG). Table 2 lists the water supply tanks that are in-service with a combined capacity of approximately 25 MG. Table 3 shows anticipated annual water demands based on projections from EID's 2013 Integrated Water Resources Management Plan (IRWMP).

Table 2: El Dorado Hills Service Area Tanks and Capacity

Tank	Current Capacity	
	Acre-Feet	MG
Monte Vista	0.40	0.13
Salmon Falls	6.14	2.0
Promontory	7.98	2.6
Valley View Tank Lower	6.14	2.0
Valley View Tank Upper	2.58	0.84
Oak Ridge (2 Tanks)	24.55	8.0
Ridgeview	3.07	1.0
Bass Lake (2 Tanks)	25.17	8.2
Total	76.03	24.77

Source: EID Final Integrated Water Resources Management Plan, 2013.

Table 3: El Dorado Hills Projected Annual Water Demands

Source of Demand	Annual Demand	
	Acre-Feet	MG
Existing Demand[3]	13,468	4,387
Buildout Demand	26,578	8,657

Source: EID Final Integrated Water Resources Management Plan, 2013.

[3] The existing annual water demands are based on 2013 data included in the IRWMP (projections for 2015).

2.2 Demand Management Strategies

In recent years, the EID has incorporated demand management strategies into several facility operations. This report defines demand management as strategies an agency may implement by utilizing existing infrastructure or making economically reasonable improvements at a facility that allow the facility to operate more efficiently as assessed by reduced energy consumption (e.g. lowering energy costs) and increased flexibility to meet water supply demands. Demand management strategies frequently utilize reduced energy rates ($/kW) that are defined by time of year and time of day and divided into three periods: peak, partial peak, and off peak. The following represent demand management strategies EID has recently implemented.

In 2010, EID implemented demand management strategies at both the FLIPS and EDHWTP facilities that included the FLIPS delivering a steady flow rate to the EDHWTP and allowing the EDHWTP to regulate the treatment processing speed by adjusting the filtration process and adjusting the set points within the clear well. These strategies increased the EDHWTP operational flexibility by utilizing its existing process controls allowing small incremental adjustments without significantly affecting the FLIPS facility. Additionally, demand management strategies presented EID an opportunity to suspend the FLIPS pumping operations during the energy peak period (12 PM – 6 PM) and utilize system storage facilities to provide a reliable water supply during this period. EID also set operation pump control points to gradually ramp pumps to a steady state allowing the pumps to operate at best efficiency and smooth the energy demands.

Participation in PG&E's Peak Day Pricing (PDP)[4] program gave EID financial incentive to conserve and shift energy use to off-peak periods when the grid is at or near capacity. Table 4 represents PG&E's Rate Structure defining peak, part peak, and off-peak periods.

[4] Peak Day Pricing (PDP) program is a pricing plan in response to a statewide initiative led by the California Public Utility Commission (CPUC) for the reduction of peak energy demand with the goal being to help stabilize PG&E's power grid to avoid power interruptions and reduce power plant load capacity during high demand periods.

Table 4: PG&E Rate Structure

Summer (May through October)			Winter (November through April)		
Peak	Mon - Fri*	12:00 PM – 6:00 PM	Peak	N/A	N/A
Part Peak	Mon - Fri*	8:30 PM – 12:00 PM 6:00 PM – 9:30 PM	Part Peak	Mon – Fri	8:30 AM – 9:30 PM
Off-Peak	Mon - Fri*	9:30 PM – 8:30 AM	Off-Peak	Mon - Fri	9:30 PM – 8:30 AM
	Sat-Sun	12:00 AM – 12:00 AM		Sat - Sun	12:00 AM – 12:00 AM

*Except Holidays

In 2008/09, energy conservation measures required EID to re-operate the Oak Ridge Pump Station (ORPS) and the Ridgeview Tank. Under the limited re-operations, the Ridgeview Tank received water supply through the Gold Hill Intertie (GHI)[5] with minimal supplemental water supply from the ORPS operations. During this period, EID's Storage Evaluation for Potable Water System Report concluded that the Ridgeview Tank was undersized by 2 million gallons. Increasing the Ridgeview Tank from 1 MG to 3 MG would present EID with another demand management strategy opportunity to utilize existing water supply, reduce pumping and energy demand, and save on energy cost.

Improved utilization of EID's existing gravity systems during utility peak periods, specifically the GHI, have shown a significant decrease in energy consumption and increased energy cost savings. Provided that water supply is available, the operations of the gravity system have been extended during the low demand period between November and April, and the FLIPS and EDHWTP are able to remain off-line. Table 5 shows the potential energy savings through utilizing the GHI gravity feed system to serve the El Dorado Hills service area and keeping the FLIPS and EDHWTP off-line.

[5] A large (18″ to 24″) diameter gravity pipeline that travels from EID's eastern service area and enters through pressure regulating station 6.5 at the Bass Lake Tanks.

Table 5: Potential Energy Savings Due to Extended Shutdown of FLIPS and EDHWTP

PRS 6.5 Offline	FLIPS		EDHWTP	
	Part Peak kWh	Off Peak kWh	Part Peak kWh	Off Peak kWh
Nov 08	72,815	208,414	44,629	123,032
Dec 08	64,157	139,631	47,743	96,593
Jan 08	42,497	94,574	24,980	59,841
Feb (Avg.)	46,187	81,033	31,872	60,003
Mar 09	49,876	67,492	38,764	60,165
Apr 09	64,634	118.102	50,834	91,743
Subtotal		1,049,412		730,199
Total kWh				1,779,611 kWh
Total Savings				$208,165

2.3 Demand Management Strategies Conclusion

Based on the available information, extending the pump system's shutdown schedule is favorable. Extending the shutdown to six months could save 1,779,611 kWh of energy which would result in a cost savings of $208,165. Based on recommendations from the TM EID has analyzed the system in additional detail and concluded that the EDH service area can be supplied by the GHI for the six month period in question. As mentioned previously this demand management strategy is continuing to be implemented when water supply is available.

It has been difficult for EID to determine all of the opportunities available for demand management when long term supply and demand data is not available for all parts of the system. In order to determine if demand management can be achieved, EID would need to determine where additional information is necessary in the system and how that information can be gathered. This would require the addition of flow meters and pressure gages at key locations to gather data over time.

Additionally, it is often difficult to implement changes in operation at water agencies. Operations staff is hesitant to make changes to an existing operation that is working with few problems. The demand management strategy listed above was necessary which facilitated its implementation. Typically, once staff has a clear understanding of how a new operation strategy can be integrated they are more likely to implement it long term. It is important to involve operations staff early and often in the demand management strategy development.

CHAPTER 3:
Pump Station Energy Efficiency Opportunities

3.1 El Dorado Irrigation District Case Study

The purpose of this study was to identify opportunities to improve pumping efficiencies within several existing pump stations located in the EID service area. Pumping systems are a vital component to supplying safe and reliable drinking water in El Dorado County due to the wide range of elevations. As a result, pump station energy use has the potential to represent a sizeable portion of EID's operating costs. Significant cost factors include:

- The consumption of large amounts of energy based on the efficiency and size of the pumps required.
- The use of pumps during daily peak (high cost) energy use periods to deliver water on-demand.

These energy use factors are based on system demand and available supply conditions that are difficult and costly to alter. Therefore, it is important to utilize pumps with high efficiency ratings and to use them as efficiently as possible to keep energy costs to a minimum. This study focuses on summarizing each pump station's energy use, efficiency and making recommendations for potential energy savings.

3.2 Pump Stations Identified

3.2.1 Overview

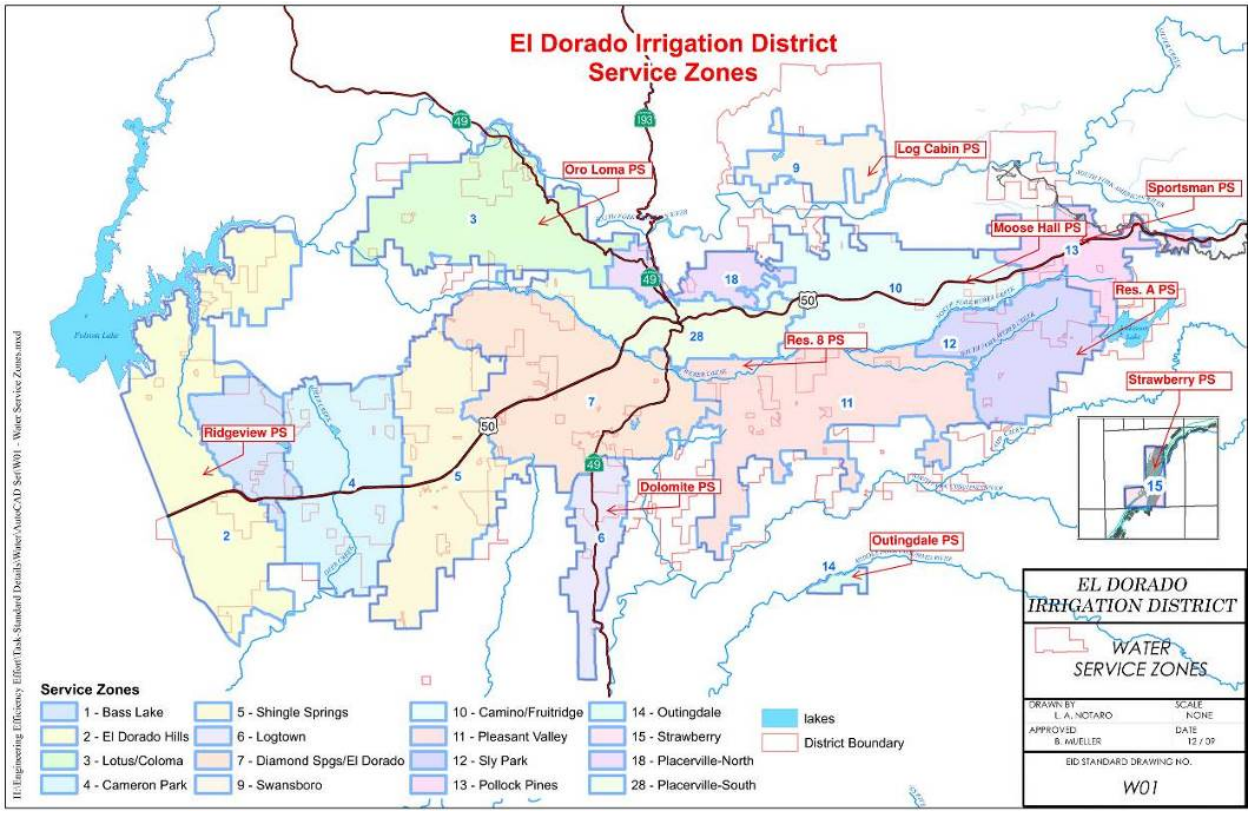
EID identified the following ten pump stations (shown in Figure 2) to be evaluated for possible energy efficiency improvements.

1. Dolomite Pump Station
2. Moosehall Pump Station
3. Oro Loma Pump Station
4. Outingdale Recycled Water Pump Station
5. Reservoir 8 Pump Station
6. Reservoir A Pump Station
7. Strawberry Recycled Water Pump Station
8. Log Cabin Pump Station
9. Ridgeview Pump Station
10. Sportsman Pump Station

A pump station evaluation form was completed for each location by EID staff which included approximated operating points where available. These ten stations utilize pumps ranging from 5 horsepower (HP) to 200 HP. The following assumptions have been made in order to conduct the evaluation:

- All pumps still operate on their published performance curve. This assumption is necessary due to the minimal amount of data (flows with a corresponding head values) available to produce an updated performance curve.
- All Pumps operate at a constant set point (one flow and corresponding head value), thus maintaining the same pump efficiency throughout the entire pump cycle.
- New pumps for replacement are estimated to have a minimum efficiency rating of 70%.
- 2010 energy usage information was provided by EID for economic analysis and it is assumed that energy usage per pump station has not changed substantially (See Attachment B).
- Based on conversations with local pump suppliers, in general, as pumps approach the end of its service life, typically 15 to 20 years, efficiency gradually reduces by 10% to 20%.
- Pump replacement costs do not include labor, electrical or controls changes and are approximate. It is assumed that replacement work would be done as maintenance and be included within EID's Operations and Maintenance (O&M) budget.
- Payback periods are approximated based on recent energy usage data and assumes no finance costs for replacement (payback equals cost of new pump divided by yearly savings)

Figure 2: Location of Pump Stations Selected by EID for Evaluation



The following briefly summarizes background and economic analyses for each of the pump stations evaluated for which the economic evaluation determined that replacement or improvements to the system would yield an increase in efficiency. Sufficient data was not available for Reservoir 8 and Ridgeview Pump Stations therefore their write-ups are not included here. Additionally, Reservoir A was found to operate at the designed efficiency point resulting in no recommendations for improvements. Additional detail on all of the pump stations evaluated along with the individual pump station evaluation forms completed are included in the final TM#5 provided in Appendix A.

3.2.2 Dolomite Pump Station

Dolomite Pump Station is a small, two-pump station that receives water from an adjacent covered reservoir and serves a small community.

The lead pump has been replaced recently and EID staff has noted that this pump appears to be larger than required by the system. The stand-by pump does not alternate with the lead pump and only turns on if the pressure in the system cannot be maintained by the lead pump alone.

Converting the station to a lead-lag pump operating strategy would minimize maintenance and wear. This will better utilize the available equipment and extend the life of the pumps.

Figure 3: Dolomite Pumps

Photo Credit: Domenichelli and Associates, 2013.

3.2.2.1 Economic Analysis:

Replacement of the existing pumps would result in an efficiency increase of 19% and an approximate monthly savings of $109. The approximate cost for an appropriate new pump is $1,570 which equates to a payback period of approximately 1.2 years.

3.2.2.2 Recommendations:

Even though the Goulds pump operates at a non-optimal efficiency rating it is not recommended at this time to replace the pump since it was recently purchased and installed. However, if the District can use this pump elsewhere in the system, both pumps could be replaced and maximum efficiency can be achieved.

If the District does not want to remove the recently installed Goulds pump, the lag pump, is estimated to be more than 15 years old. It is recommended that it be replaced with a higher efficiency pump which better fits the system. It would serve as the lead pump and operate at a higher efficiency. Doing so results an optimal use of energy in the pump station while keeping capital costs to a minimum.

3.2.3 Moosehall Pump Station

Moosehall Pump Station is operated during the winter months when the Main Ditch, which is the normal gravity water supply, is out of service. The normal gravity feed to the station has a head of approximately 380 feet (165 psi) due to elevation change. The high head from the gravity feed is reduced at the station by the use of a pair of 12-inch Bailey sleeve valves.

It is a relatively large pump station (1000 gpm) and is used as an in-line booster station to transfer water from EID's southern water sources to the north. To accomplish this transfer, the pumps must pump back through the sleeve valves whose purpose it is to reduce pressure. The District is concerned the pumps are running inefficiently and would like to investigate a possible bypass around the valves for the pumping operation.

This station has a two turbine pump configuration (1 duty and 1 standby) and utilizes 200 HP, 7 stage vertical turbine pumps. These turbine pumps have a maximum efficiency rating of 83.5% which is in the typical range for multi-stage turbine pumps. Existing flow and pressure conditions allow the pumps to operate close to that value (82%).

Figure 4: Moosehall Pumps

Photo Credit: Domenichelli and Associates, 2013.

3.2.3.1 Economic Analysis:

Converting horsepower to kilowatts and estimating that the pumps will be running 24 hours per day for the months they operate, an estimate of monthly savings can be obtained. Assuming a new pump system is 10% more efficient yields a savings of approximately $3,800 per month. A 20% more efficient system yields approximately $7,000 per month in savings.

3.2.3.2 Recommendations:

Given the assumptions and reasoning above, it would be in the best interest of the District to replace the pumps rather than consider a bypass construction project.

The existing vertical turbine pumps appear to be operating at an acceptable efficiency point which is near the maximum efficiency possible for these pumps. However, EID staff has noted that these pumps have been in service for more than 20 years. As a turbine pump ages, efficiency can reduce by as much as 20%.

Due to the relatively long service history of these turbine pumps, they are considered ready for replacement. New pumps would restore the efficiency and reliability of the station. This will aid in lessening energy and maintenance costs during their seasonal operation.

3.2.4 Oro Loma Pump Station

Oro Loma Pump Station is categorized as a mid-size station. The station uses four pumps of varying sizes to accommodate a range of flows. The 7.5 HP pump runs nearly constantly and was assumed to operate at its maximum efficiency of 54% for the economic analysis. The 50 HP pump does not need to be considered for replacement as it has an acceptable efficiency rating and operates as a fire flow pump only. The remaining two pumps are both 25 HP and have a maximum efficiency of 62%.

Figure 5: 25 HP Oro Loma Pump

Photo Credit: Domenichelli and Associates, 2013.

3.2.4.1 Economic Analysis:

The following assumptions were used for the economic analysis:

1. Only the 7.5 HP pump operates during Off-Peak periods
2. The 7.5 HP and 25 HP (2) pumps operate 50% and 25% of the Partial-Peak period, respectively
3. The 25 HP (2) pumps each operate 50% of the Peak-Period
4. The 50 HP pump is a standby pump for extreme flow events such as fire suppression

Replacement of the 7.5 HP and two 25 HP pumps would result in an efficiency increase of 16% and 14%, respectively and approximate total monthly savings of $86. The approximate cost for a new 7.5 HP and two 25 HP pumps is $2,301 and $6,281 ($3,141 each), respectively, which equates to a payback period of 8.3 years.

3.2.4.2 Recommendations:

During the site visit it was noted that the 25 HP pumps were cycling frequently. The pumps standby period was approximately 4 minutes and the runtime was approximately 4 minutes.

The 7.5 HP pump ran constantly. This was at about 9:30AM when water usage should be tapering off. This suggests that the 7.5 HP pump cannot meet demands at any time other than lowest demand period.

The frequent start/stop operation of the 25 HP pumps means the motor startup current is being drawn from the electrical supply many times per day. Startup current is typically 3 times the running current for a particular motor causing a brief spike in energy usage. If it were only starting a few times per day, this would not be an issue, however per EID staff this occurs for a large part of the day.

If the 7.5 HP pump were taken out of service and a larger, variable frequency drive controlled pump were used in its place, the start/stop frequency would be lessened greatly. It may even be possible to place one of the 25 HP pumps on VFD control and eliminate the smaller pump altogether.

The incoming pressure to this station is around 55psi. It was noted there are pressure reducing valves (PRV) on both the small feed line to pump No. 4 and the larger line feeding pumps nos. 1, 2 and 3. Energy is being expended through the valves needlessly when pumps that better fit the system are required.

It is recommended that two new pumps be installed to replace the existing 7.5 HP & two 25 HP pumps. The new pumps should be controlled by variable frequency drives to allow for the most efficient use of energy.

3.2.5. Outingdale Recycled Water Pump Station

Outingdale Recycled Water Pump Station is a small station that consists of three 10 HP pumps. Existing conditions allow the pumps to run near their maximum efficiency ratings, however, these pumps only have a maximum efficiency rating of 54%.

Figure 6: Outingdale Pumps

Photo Credit: Domenichelli and Associates, 2013.

3.2.5.1 Economic Analysis:

The economic analysis assumes that only one pump is operating at any given time. The peak hour flow condition was neglected due to the short amount of time the lag pump would operate to provide assistance. The replacement of each pump would increase efficiency by 17% per pump, resulting in an approximate total monthly savings of $103. The approximate cost for three new 10 HP pumps is $7,583 ($2,528 each) which equates to a payback period of 6.1 years.

3.2.5.2 Recommendations:

It is recommended that the three existing pumps (10 HP) be replaced with new pumps to address the low efficiency as well as the low net postivie suction head (NSPH).

3.2.6 Strawberry Recycled Water Pump Station

Strawberry Recycled Water Pump Station is a small station that consists of three 5 HP pumps. EID staff has noted that these pumps are 20+ years old and have maintenance issues including the requirement to continually operate, as these pumps are not self–priming. Additional problems noted were; impellers break off the shafts, excessive vibrations, cavitation, pumping prime is often lost, and the pumps cannot deliver enough flow to the plant. These pumps have a maximum efficiency of 48%, but operate around 34%.

Figure 7: Strawberry Pump

Photo Credit: Domenichelli and Associates, 2013.

3.2.6.1 Economic Analysis:

Replacement of these pumps would increase efficiency by approximately 56% resulting in a monthly savings of $1,249. The approximate cost for three new 5 HP pumps is $4,716 ($1,572 each) which equates to a payback period of 3.8 years. New pumps selected for service here may need to be larger, as the existing pumps are unable to handle the existing demand.

3.2.6.2 Recommendations:

These pumps have poor efficiency ratings and numerous maintenance issues. It is recommended that these pumps be replaced with higher efficiency pumps that can operate

under the existing operating conditions. The pumps have passed the 20 year service mark, so their efficiency may have been reduced by as much as 20%. Therefore the current pumps could be operating at 14% efficiency.

3.2.7 Log Cabin Pump Station

Log Cabin Pump Station is categorized as a mid-size pump station. It has a two-pump configuration with equally sized pumps. Existing operating conditions were not available to determine each pump's operating efficiency rating.

Figure 8: Log Cabin Pumps

Photo Credit: Domenichelli and Associates, 2013.

3.2.7.1 Economic Analysis:

The pumps have been estimated to be between 15 and 20 years old, thus affecting their reliability and potentially reducing their efficiency. If the pumps were assumed to operate at their maximum efficiency (77%) minus the reduction due to age (20%), replacement of these pumps would result in an approximate monthly savings of $67. The approximate cost for two new 20 HP pumps is $5,872 ($2,936 each) which equates to a payback period of 7.3 years.

3.2.7.2 Recommendations:

Recommendations for improving efficiency cannot be made due to the lack of flow and head values. A pump test could be performed to determine operating conditions including efficiency. It is recommended these pumps be replace based on age.

3.2.8 Sportsman Pump Station

Sportsman Pump Station is a large size station that delivers water into the surrounding distribution system. The station has a three vertical turbine pumps consisting of two 200 HP

and one 100 HP pump. A performance curve for the 100 HP turbine pump was unavailable during the evaluation. The maximum efficiency for the 200 HP turbine pumps is 80% and operates around 78%. The turbine pumps operate at an acceptable efficiency rating but are estimated to be 20+ years old.

Figure 9: Sportsman Pumps

Photo Credit: Domenichelli and Associates, 2013.

3.2.8.1 Economic Analysis:

The following assumptions were used based on conversations with EID staff:

1. During the Off-Peak period the 200 HP pumps operate 50% of the total period and the 100 HP pump operates the remaining time.
2. The Partial-Peak period operation is the same as the Off-peak period
3. During the Peak-Period only the 200 HP pumps operate

The replacement of these two turbine pumps (200 HP) would increase pump efficiency by 12% and result in an approximate monthly savings of $1,102. The approximate cost for two new 200 HP turbine pumps is $30,000 ($15,000 each) which equates to a payback period of 2.3 years.

3.2.8.2 Recommendations:

The 100 HP pump is estimated to also operate at a reduced efficiency due to its age, so it is recommended that a pump test be performed to determine its existing conditions and potential savings with replacement.

EID staff has noted that these pumps have been in service for 20+ years, potentially reducing efficiency to 58% for the 200 HP pumps. It is recommended that EID run performance testing and plan for the replacement of these turbine pumps based upon the results of those tests.

3.3 Pump Station Efficiency Opportunities Recommendations

Preliminary evaluation of each pump station determined that 8 of the 10 pump stations require additional analysis or action. The following table (Table 6) provides a ranking of each pump station based on EID staff comments and estimated payback period. EID staff concerns took precedence because of the operational issues associated with each pump station. Based on results, it is recommended that Moosehall PS be upgraded as a priority as these pumps are the only source of water for the northern section of the service area during the winter months and reliability is a concern. The Reservoir 8, Dolomite and Outingdale pump stations should be upgraded next as these seem to have the most to gain in efficiency.

Table 6: Summary Table

	Summary of Recommendations and Approximate Paybacks and Costs				
Rank	**Site**	**Recommendation**	**Pay Back (yr)**	**Cost**	**Comments**
1	Moosehall	Plan for replacement	Unknown	Unknown	Pumps 20+ years old
2	Reservoir 8	Replace 2 of 3 pumps	2.5	$3,144	None
3	Dolomite	Replace 1 or 2 pumps	1.2	$1,572	None
4	Outingdale RW	Replace 3 of 3 pumps	6.1	$7,583	Staff Concerns
5	Strawberry RW	Replace 3 of 3 pumps	3.8	$4,716	Staff Concerns
6	Oro Loma	Replace 3 of 3 pumps	8.3	$8,582	None
7	Log Cabin	Perform pump test	7.3	$5,872	Pump test needed
8	Sportsman	Replace 2 of 3 pumps	2.3	$30,000	None
9	Ridgeview	Replace 3 of 3 pumps	5.6	$6,281	Staff Concerns
10	Reservoir A	None	None	None	None

3.4 Pump Station Efficiency Opportunities Conclusions

Table 7 below provides a breakdown of the potential efficiency increase, potential monthly savings and payback determined for each pump station. Additional detail on all of the pump stations evaluated along with the individual pump station evaluation forms completed are included in the final TM#5 provided in Appendix A.

Table 7: Overview of Potential Energy Savings

Pump Station	Potential Efficiency Increase	Potential Monthly Savings	Payback (years)
Dolomite	19%	$109	1.2
Moosehall	10%	$3800	Unknown
Oro Loma	14-16%	$86	8.3
Outingdale	17%	$103	6.1
Reservoir 8	10%	Data not available	
Reservoir A	N/A (pumps function at design efficiency)	N/A	N/A
Strawberry	56%	$1249	3.8
Log Cabin	20%	$67	7.3
Ridgeview	10%	Data not available	
Sportsman	12%	$1,102	2.3

Based on the data provided by EID and the analyses above the potential savings to EID each month if all of the pump station upgrades recommended were implemented would be up to $6,500. That equates to almost $80,000 a year. With an average pump station lifecycle between 20-30 years the potential lifetime energy savings to EID is over $1,500,000. The 10 pump stations evaluated were just a sampling of the EID's system. A more thorough evaluation of the pump stations, including pump station testing, to determine the system requirements is recommended throughout the system.

A major impediment to implementing these types of projects is the lack of data available. Additional flow meters and pressure gages are recommended at key locations throughout EID's system to better identify pump stations that do not operate at their optimum efficiency.

CHAPTER 4:
Update to Energy Policy Programs

Contributing factors enabling the renewable energy sector to be feasible, both economically and permitting wise, are the Federal and State legislation and policy. This section provides an update to the 2011 Federal and State legislation and policy associated with the hydroelectric and solar renewable energies identified and discussed in TM #6 and #7 provided in Appendix A. The intent of this chapter is to provide an overview of the latest energy policies and financial programs available for both hydroelectric and solar generation projects.

4.1 Hydroelectric – Legislative and Policy

4.1.1 Energy Policies Supporting Hydroelectric Generation

California and national energy policies and regulations have changed significantly over the past several years, and are expected to change even more dramatically over the next decade. The changes stem from growing scientific community consensus on global climate change, the recognized increasing public health costs of fossil fuel effects on air quality and water quality, recurring petroleum shortages and volatile fossil fuel prices, geopolitical and national security issues related to foreign energy dependence, and political support for California leading the nation toward a "clean energy economy".

4.1.2 Current Energy Policy Direction

Hydropower at existing facilities is being directly promoted (e.g., financial incentives for in-conduit hydro units) on state and federal levels as a renewable energy resource. New regulations also are indirectly promoting hydropower through measures designed to limit carbon-based energy [(e.g., the California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms (Cap-and-Trade) program implemented by CARB to reduce GHG emissions by applying an aggregate GHG allowance)] (CARB 2013a). Hydropower facilities have some distinct advantages over other renewable energy developments. For example, the technology has a very long economic life (i.e., 40 years plus) relative to other forms of renewable energy (e.g., solar and wind that have 15- to 20-year economic lives), has low maintenance costs, is reliable and can be dispatched when needed, and is well established so that planning, construction and operations are more predictable and less vulnerable to unknown factors.

Expedited permitting [e.g., Federal Energy Regulatory Commission (FERC), and California Environmental Quality Act (CEQA) permit exemptions for existing facilities] and other incentives also are available today for small hydroelectric development and other renewable energy generation at existing water facilities. The goals of the incentives for hydropower and other renewable energy resources are to help reduce GHG emissions to 1990 levels by the year 2020. Overall, the program goals are to promote renewable energy resources (including hydro power development), increase the value of non-carbon (e.g., hydropower) energy generation to make it competitive with fossil fuels, and improve water system energy use efficiencies and load demand management.

4.1.2.1 Governor's Clean Energy Jobs Program (12,000 MW of Distributed Renewable Energy Generation Capacity by 2020)

Governor Brown's Clean Energy Jobs Plan sets a goal of 20,000 new MW of renewable energy capacity by 2020 (Office of Governor 2011). Of this, 12,000 MW are to come from distributed (local customer-side) renewable energy generation from smaller systems of up to 20 MW capacity. The Office of Planning and Research (OPR) indicates that local renewable energy generation has the greatest value for the electric system when it is located in areas where capacity to meet existing electricity demand is constrained (OPR 2011).

4.1.2.2 California Energy Commission Integrated Energy Policy Report

The California Energy Commission (CEC) conducts assessments and forecasts of all aspects of energy industry supply, production, transportation, delivery and distribution, demand, and prices. The results of these assessments are provided in the Integrated Energy Policy Report (IEPR). The CEC adopts an IEPR every two years and an update every other year (CEC 2013a).

The CEC states that, to help ensure progress toward its 2050 GHG reduction goals, California needs to determine what the electricity system should look like in 2030 as an interim target, as well as assess and plan for the potential effects of climate change on the energy sector itself, such as increased electricity demand, decreased power plant efficiency, and changes in the availability of existing large hydropower because of less precipitation and earlier runoff. The CEC also notes that climate change could also affect electric system reliability because of increased risk of wildfires that can damage power lines and cause flooding of coastal power plants due to rising sea levels (CEC 2013a).

Major differences should be noted between the large, traditional hydroelectric power projects that are located on unregulated streams and rivers, and small hydroelectric power projects that are located at existing dams, in existing pressurized pipelines, or on existing canals. The hydroelectric projects under discussion in this report will be installed to replace existing pressure reduction valves, be added to new pressure pipelines that replace old gravity lines, and that otherwise take advantage of gravity and pressure within existing water and treated wastewater systems. As a result, even during droughts and under the range of climate change scenarios, small hydroelectric installations will be less impacted by climate change and continue to operate so long as water continues to be conveyed through these existing systems to serve water customers.

4.1.2.3 Role of Renewables Portfolio Standard in California's Long-Term GHG Reduction Requirements

In 2002, California established its RPS Program, with the goal of increasing the percentage of renewable energy in the state to 20 percent of retail sales by 2017. The *2003 Integrated Energy Policy Report* recommended accelerating that goal to 20 percent by 2010, and the *2004 Energy Report Update* further recommended increasing the target to 33 percent by 2020. The state's *Energy Action Plan* supported this goal. In 2006, under SB 107, California's 20 percent by 2010 RPS goal was codified. The legislation required retail sellers of electricity to increase renewable energy purchases by at least 1 percent per year with a target of 20 percent renewables by 2010.

Publicly owned utilities [e.g., Sacramento Municipal Utility District (SMUD)] set their own RPS goals recognizing the intent of the legislature to attain the 20 percent by 2010 target (CEC 2013b).

The CPUC and CEC are jointly responsible for implementing the program to reduce greenhouse gas emissions by mandating electric utility acquisition of required levels of renewable energy. According to the CEC, the RPS applies to all electricity retailers in the state, including publicly owned utilities, IOUs, electricity service providers, and community choice aggregators. All of these entities must adopt the new RPS goals of 20 percent of retail sales from renewables by the end of 2013, 25 percent by the end of 2016, and the 33 percent requirement being met by the end of 2020 (CEC 2013c). According to the CPUC, California's RPS is one of the most ambitious renewable energy standards in the country.

4.1.2.4 Federal and State Exemptions for Small Hydroelectric Projects

FERC offers exemptions for small hydroelectric facilities. Please see Section 1.b.v.1 The Hydropower Regulatory Efficiency Act of 2013 for more information.

CEQA includes a "Small Hydroelectric Categorical Exemption" (CEQA Guidelines Section 15328) for projects at existing facilities that meet certain criteria. For example, projects with capacities of 5 MW or less and that do not affect instream flows or special-status species may be eligible for exemption.

4.1.2.4 Sustainable Communities GHG Reduction Goals – Sustainable Communities and Climate Protection Act of 2008

The purpose of California's Sustainable Communities and Climate Protection Act of 2008 (SB 375) is to promote good planning with the goal of more sustainable communities. SB 375 requires CARB to develop regional GHG emission reduction targets for passenger vehicles, and to establish targets for 2020 and 2035 for each region covered by one of California's 18 metropolitan planning organizations (MPOs) ([e.g., Sacramento Area Council of Governments (SACOG)]. Each of the MPOs then prepares a Sustainable Communities Strategy (SCS) that demonstrates how the region will meet its GHG reduction target through integrated land use, housing and transportation planning. Once adopted by the MPO, the SCS will be incorporated into that region's federally enforceable regional transportation plan (CARB 2013b). The activities of MPO SCS planning are related to RPS and distributed energy policies in that land planning, transportation fuels, and community infrastructure (development and redevelopment) will affect the rate and extent to which communities and electric service providers can help achieve RPS targets and other policies such as the Governor's Clean Energy Jobs Program to install 12,000 MW of new "customer-side" renewable energy generation by 2020. Installing renewable energy facilities, interconnecting those facilities with the electric grid, and adding new water storage facilities on existing water systems to create "water as energy" storage and enable load shifting, are examples of the interface with local, regional and state plans and regulatory review.

CARB's Technical Evaluation of the GHG Emission Reduction Quantification for SACOG's SB 375 Sustainable Communities Strategy affirms that SACOG's adopted SCS demonstrates that, if

implemented, the region will achieve a 9 percent per capita greenhouse gas reduction in 2020, and a 16 percent reduction in 2035. These reductions meet the targets established for SACOG of 7 percent and 16 percent GHG per capita reduction from 2005 for the years 2020 and 2035, respectively (CARB 2012). While not specifically set forth as a strategy, the promotion of customer-side distributed generation through water purveyors and existing water and wastewater systems will further contribute to SB 375 goals and objectives.

4.2.2.4 Hydroelectric Energy Regulatory and Legislative Considerations

Listed below are regulatory and legislative considerations relating to hydroelectric energy.

Federal Legislation

The Hydropower Regulatory Efficiency Act of 2013

On August 9, 2013, the Hydropower Regulatory Efficiency Act was signed into law. FERC notes that hydropower is the largest source of clean, renewable electricity in the United States, and provides nearly 7 percent of the nation's electricity and about 100,000 MW of the nation's electric capacity. In section 2 of the act, Congress finds that there is substantial potential for adding hydropower generation to non-powered dams, since only 3 percent of the 80,000 dams in the United States generate electricity (FERC 2013).

The act affects hydropower development in four ways:

1. For projects at existing dams that qualify for a small hydropower exemption, the act increases the maximum allowable capacity for such projects from 5 MW to 10 MW.
2. The act provides that conduit hydropower facilities with an installed capacity that does not exceed 5 MW and that meet the act's other qualifying criteria are not required to be licensed under the Federal Power Act. It also increases the maximum installed capacity from 15 MW to 40 MW for a privately developed hydropower facility that qualifies for a conduit exemption. Previously, the 40-MW maximum was available only to municipal projects.
3. The act provides the Commission with the authority to extend preliminary permits for up to 2 additional years beyond the 3 years previously allowed under the Federal Power Act.
4. Lastly, the act requires FERC to investigate the feasibility of a 2-year licensing process for hydropower development at non-powered dams and closed-loop pumped storage projects (FERC 2013).

The Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act

The *Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act* (H.R. 678 Tipton) was signed into law on August 9, 2013. The act is designed to create new American jobs and expand production of clean, renewable hydropower. Because hydropower is one of the cheapest and cleanest forms of electricity, expanding development will help lower energy costs for American families and small businesses while protecting the environment. The bill

authorizes hydropower development, streamlines the regulatory process, and reduces administrative costs for small canal and pipeline hydropower development projects (CNR 2013).

New hydropower development would only take place on existing Bureau of Reclamation canals and pipes. Such man-made facilities are already on disturbed ground, have no environmental impact and have already gone through environmental review. This legislation could help facilitate hydropower development in at least 373 of the federal agency's canals and pipelines, as identified in a Bureau of Reclamation March 2012 report (CNR 2013).

The non-partisan Congressional Budget Office estimates the bill will generate federal revenue over 10 years through increased hydropower production at no expense to American taxpayers. Additionally, the bill protects water users by reaffirming supply and delivery as the first priority, and it ensures that there will be no financial or operational impacts to existing water and power users (CNR 2013).

State Legislation

CARB AB 32 Scoping Plan Measures for Water, Electricity, and Other Sectors (December 2013 Update)

In 2006, AB 32 required CARB to develop a Scoping Plan that describes the approach California will take to reduce greenhouse gases to achieve the goal of reducing emissions to 1990 levels by 2020. The Scoping Plan was first approved by CARB in 2008 and must be updated every five years to evaluate AB 32 policies to ensure that California is on track to achieve the 2020 GHG reduction goal (CARB 2013c).

A Proposed First Update to California's Climate Change Scoping Plan was released on February 10, 2014. The Update defines CARB's climate change priorities for the next five years; lays the groundwork to reach post-2020 GHG goals; highlights California's progress toward meeting the near-term 2020 GHG emission reduction goals defined in the original Scoping Plan; and, evaluates how to align the State's longer-term GHG reduction strategies with other State policy priorities, such as for water, waste, natural resources, clean energy and transportation, and land use (CARB 2013c).

To address the State's near-term and longer-term GHG goals, the update has both a 2020 element and post-2020 element. The 2020 element focuses on State, regional, and local initiatives that are being implemented now to assist in meeting the 2020 goal. The post-2020 element provides a high level view of a long-term strategy for meeting the 2050 GHG goal of 80% below 1990 levels by 2050 (CARB 2014a).

California Renewable Portfolio Standard

Established in 2002 under Senate Bill 1078, accelerated in 2006 under Senate Bill 107 and expanded in 2011 under Senate Bill 2, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to

increase procurement from eligible renewable energy resources to 33% of total procurement by 2020.

AB 1014 and SB 43 - Renewable Energy Self-Generation Program

This 2013 program, introduced by Williams, would allow homeowners and business owners who are not able to use solar panels, to participate in an optional program that would allow them to access renewable energy while receiving a credit on their energy costs. Part of the intent for this program is to further the Governor's Clean Energy Jobs Plan. AB 1014 passed in the House and was referred to the Committee on Rules on June 13, 2013. SB 43 was approved and chaptered on September 28, 2013 (Leginfo 2014).

4.3 California Environmental Quality Act Categorical Exemption

CEQA allows for a "Small Hydroelectric Categorical Exemption" (Section 15328) [2], and applies to projects at existing facilities that meet certain criteria (listed verbatim):

- The capacity of the generating facilities is five megawatts or less;
- Operation of the generating facilities will not change the flow regime in the affected stream, canal, or pipeline including but not limited to:
    - Rate and volume of flow,
    - Temperature,
    - Amounts of dissolved oxygen to a degree that could adversely affect aquatic life, and
    - Timing of release;
- New power lines to connect the generating facilities to existing power lines will not exceed one mile in length if located on a new right-of-way and will not be located adjacent to a wild or scenic river;
- Repair or reconstruction of the diversion structure will not raise the normal maximum surface elevation of the impoundment;
- There will be no significant upstream or downstream passage of fish affected by the project;
- The discharge from the power house will not be located more than three hundred feet from the toe of the diversion structure;
- The project will not cause violations of applicable state or federal water quality standards;
- The project will not entail any construction on or alteration of a site included in or eligible for inclusion in the National Register of Historic Places; and construction will not occur in the vicinity of any rare or endangered species.

To meet CEQA's requirements for the exemption, an Environmental Checklist document needs to be prepared, signed by the project Owner, and posted with the County Clerk and State Clearinghouse within the Governor's Office of Planning and Research. If no comments are received during the 30-day posting period, then no further CEQA review requirements apply to the project.

4.4 Hydroelectric Financial Programs Available

4.4.1 Feed-in-Tariff (ReMAT)

PG&E's Feed-in Tariff with the Electric-Renewable Market Adjusting Tariff (E-ReMAT) became effective on July 24, 2013. E-ReMAT was established by CPUC Decisions (D.) 12-05-035 and D.13-05-034 to implement Senate Bill (SB) 32, which increased the statewide procurement renewable target from 500 MW to 750 MW (applicable to both investor owned utilities and public owned utilities) and increased the eligible project size from 1.5 MW to 3 MW. Program Participation Requests (PPRs) could be submitted beginning on October 1, 2013, and the first ReMAT Program Period began on November 1, 2013.

Product Types & Pricing: There are three Product Types: "As-Available, Peaking," "As-Available, Non-Peaking," and "Baseload." The Contract Price for all three Product Types will begin at $89.23/MWh on November 1, 2013, when the first ReMAT Program Period begins (Period 1). The Contract price for each Product Type will adjust independently (increase or decrease $0.004/kWh), based on market subscription in that Product Type, in each subsequent bi-monthly Program Period.

Characteristics of the Tariff:

- Projects may be sized up to three (3) MWs,
- Fixed contract terms of either 10, 15 or 20 years,
- Estimated bid starting price is $89 per MWh ($0.089 per kWh) on November 1, 2013,
- After the initial bids are accepted, there is no guaranteed price
- Bi-monthly price adjustments will be made with each Period solicitation.
- Prices will change monthly based upon participation in each months' solicitation,
- $12/MWh cap on monthly price changes,
- Five (5) MW solicitation for each group bi-monthly,
- 24 months for the project to come online, plus six (6) months additional if necessary,
- Damages to be paid if project doesn't come online in the allotted time,
- $25,000/year cap on CEC compliance costs,
- $20/kW collateral required,

- Must be self-certified as a Qualifying Facility (FERC Form 556),
- May use Rule 21 interconnection application.

4.4.2 Local Government Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) Tariff

The RES-BCT tariff allows local governments to generate electricity at one account and transfer any available excess bill credits (in dollars) to another account owned by the same local government. This tariff allows the project owner to generate a bill credit at a hydroelectric project and apply that credit to up to 50 "benefiting accounts" within the owner's PG&E customer account. At the moment, the electric utilities and their clients are contesting the interpretation of this tariff. The electric utilities are attempting to apply departing load charges to this tariff, which would make this tariff not viable from a financial perspective. Depending on the final interpretation and implementation of this tariff, this could increase the financial attributes of projects identified.

4.5 Energy Policy Effects on the Water Sector

Historically, California water policies and regulations focused on water supply, water conservation, and water quality, and have been largely independent of energy policies and regulations. However, because the water industry (including conveyance, treatment, and distribution) uses approximately one-fifth (19 percent) of electricity and 30 percent of non-power plant natural gas in the State (CARB 2014b), the water sector is being targeted from a different angle – namely, energy as it relates to water use efficiency, water recycling, water system energy efficiency, and energy recovery/renewable energy production.

The changing energy policies require new thinking about water supply, conveyance, treatment, distribution, and hydroelectric generation within existing water systems in topographically diverse regions such as El Dorado County. How much and what type of energy is used, when energy is used to treat and deliver water, efficiency of conveyance and treatment of current water sources, energy requirements to convey and treat additional water sources, storage for load shifting and electric grid balancing, and energy recovery are becoming increasingly emphasized.

4.6 Solar - Legislative and Policy

4.6.1 Energy Regulatory and Legislative Considerations

4.6.1.1 Current Energy Policy Direction

California and national energy policies and regulations have changed significantly over the past several years, and are expected to change even more dramatically over the next decade. The changes stem from growing scientific community consensus on global climate change, the recognized increasing public health costs of fossil fuel effects on air quality and water quality, recurring petroleum shortages and volatile fossil fuel prices, geopolitical and national security issues related to foreign energy dependence, and political support for California leading the nation toward a "clean energy economy".

Governor's Clean Energy Jobs Program (12,000 MW of Distributed – i.e., 'Customer Side' aka 'Behind the Meter' – Renewable Energy Generation by 2020)

See section 4.1.2.1

California Energy Commission Integrated Energy Policy Report

In the *2011 IEPR* proceeding, the CEC evaluated its method of analyzing and estimating future generation costs, and for the *2013 IEPR* used the refined methods to prepare updated estimates of generation costs from a developer's perspective for new generation. Solar photovoltaic technologies are expected to continue a rapid decline in costs, while solar thermal technologies are expected to see cost reductions as improvements are made by developers and manufacturers (CEC 2013a).

4.6.2 Sustainable Communities GHG Reduction Goals

See section 4.1.2.4

4.6.3 Solar Energy Regulatory and Legislative Considerations

4.6.3.1 Federal Legislation

Federal Business Energy Investment Tax Credit (ITC)

The federal business energy investment tax credit available under 26 USC § 48 was expanded significantly by the Energy Improvement and Extension Act of 2008 (H.R. 1424), enacted in October 2008. This law extended the duration -- by eight years -- of the existing credits for solar energy, fuel cells and microturbines; increased the credit amount for fuel cells; established new credits for small wind-energy systems, geothermal heat pumps, and combined heat and power (CHP) systems; allowed utilities to use the credits; and allowed taxpayers to take the credit against the alternative minimum tax (AMT), subject to certain limitations. The credit was further expanded by the American Recovery and Reinvestment Act of 2009, enacted in February 2009.

Solar ITC: The credit is equal to 30% of expenditures, with no maximum credit. Eligible solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. Hybrid solar lighting systems, which use solar energy to illuminate the inside of a structure using fiber-optic distributed sunlight, are eligible. Passive solar systems and solar pool-heating systems are not eligible. The credit for equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat will decrease from 30% to 10% after December 31, 2016 (DSIRE 2014).

4.6.3.2 State Legislation

CARB AB 32 Scoping Plan Measures for Water, Electricity, and Other Sectors (December 2013 Update)

See section 4.2.2.4.

4.6.3.3 California Renewable Portfolio Standard

Established in 2002 under Senate Bill 1078, accelerated in 2006 under Senate Bill 107 and expanded in 2011 under Senate Bill 2, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33% of total procurement by 2020.

4.6.3.4 Senate Bill 1 (Murray, Chapter 132, Statutes of 2006)

Senate Bill 1 enacts Governor Schwarzenegger's Million Solar Roofs Initiative and expands upon the current California Solar Initiative and the CEC's New Solar Homes Partnership.

The statute adds sections to the Public Resource Code that require building projects applying for ratepayer-funded incentives for photovoltaic (PV) systems to meet minimum energy efficiency levels and recommends that PV system components and installations meet rating standards and specific performance requirements.

Senate Bill 1 states three specific expectations to be met to qualify for the ratepayer-funded incentives made available through the bill:

- High-quality, solar energy systems with maximum system performance to promote the highest energy production per ratepayer dollar.
- Optimal system performance during periods of peak demand.
- Appropriate energy efficiency improvements in new and existing homes, or in commercial structures where solar energy systems are installed.

Senate Bill 1 is an extensive, multi-faceted legislation that covers many other matters besides the eligibility criteria, conditions for incentives and rating standards.

4.6.4 Solar Energy Purchase Programs and Economic Incentives

4.6.4.1 California Solar Initiative

The California Solar Initiative (CSI) is the solar rebate program for California consumers that are customers of the primary investor-owned utilities - Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E). The largest component of the CSI Program is known as the CSI General Market Program. Through the CSI General Market Program, consumers can earn cash rebates for every watt of solar energy installed on homes, businesses, farms, schools, and government and non-profit organization buildings (Go Solar 2014a).

The California Public Utilities Commission's (CPUC's) California Solar Initiative (CPUC ruling - R.04-03-017) moved the consumer renewable energy rebate program for existing homes from the Energy Commission to the utility companies under the direction of the CPUC. This

incentive program also provides cash back for solar energy systems of less than one megawatt to existing and new commercial, industrial, government, nonprofit, and agricultural properties.

The CSI General Market Program funds solar PV as well as other solar thermal generating technologies (Go Solar 2014b). The General Market Program aims to install 1,750 MW of rooftop solar energy with an incentive budget initially set at $1.75 billion under Decision 06-12-033, and later increased to $1.95 billion under Decision 11-12-019 (Go Solar 2014a). The CSI has a goal to reach 1,940 MW of installed solar capacity by 2016. Further information on the current CSI program can be found at http://www.cpuc.ca.gov/PUC/energy/Solar/

CHAPTER 5:
Hydroelectric Generation Opportunities

5.1 El Dorado Irrigation District Case Study

The natural topography throughout El Dorado County and numerous other counties throughout California makes in-conduit hydroelectric power generation suitable and a low impact opportunity. In July 2009, EID along with the El Dorado County Water Agency (EDCWA) published the El Dorado County Hydroelectric Development Option Study that looked at over 100 hydroelectric development opportunities throughout the County. Of the 100 opportunities evaluated, detailed economic and financial analyses were performed on the "top 10" hydroelectric opportunities.

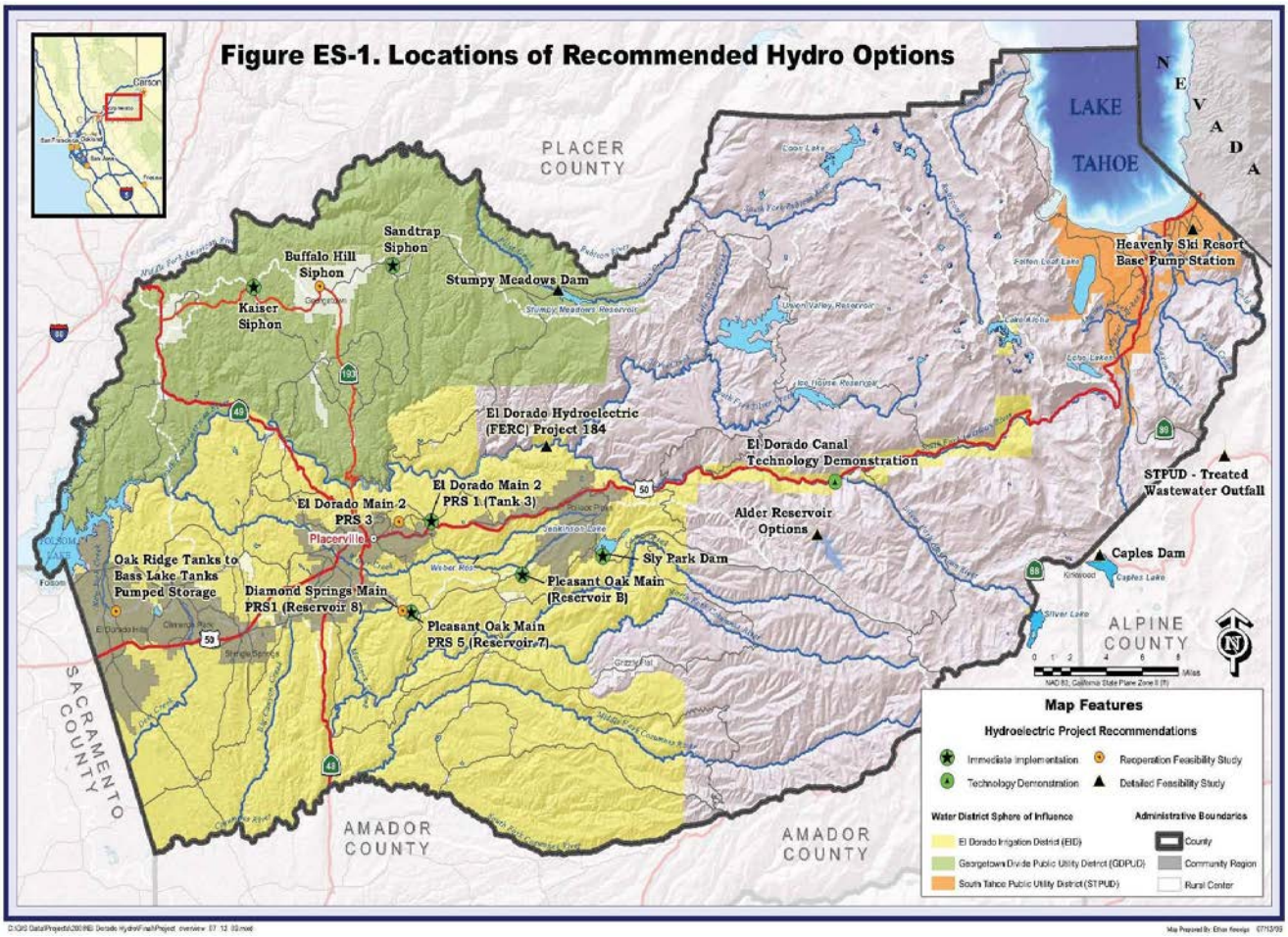
The purpose of this study was to evaluate the potential to optimize hydroelectric power generation opportunities within the EID system. Additionally, this report will make recommendations for the need for future programs to make hydroelectric generation more feasible. The following projects were identified for additional detailed analysis.

- EID – Reoperation of POM for Tank 7 in-conduit project optimization

EID – Oak Ridge Tank to Bass Lake Tank pumped storage projectAdditionally, TM#6 included an evaluation of the Georgetown Divide Public Utility District (GDPUD) – Reoperation at the Buckeye and Tunnel Hill hydro project. The analysis for the GDPUD reoperation found that the potential is limited due to the fact that GDPUD operates its water supply system to maximize water supply availability and reliability. The analysis for GDPUD can be found in TM#6 provided in Appendix A.

The analyses for EID's reoperation to optimize the Tank 7 Hydroelectric and Oak Ridge Tank to Bass Lake Tank pump storage projects are provided below.

Figure 10: Location of the top hydroelectric projects identified in the previous study



5.2 Tank 7 Hydroelectric Project Status Update

Potential reoperation of Tank 7 to optimize hydroelectric potential was evaluated as part of TM#6 which is provided in Appendix A. The project has undergone revaluation several times since the TM was completed in 2011. An update to the project status and economic evaluation is provided below followed by an overview of the reoperation potential evaluation.

5.2.1 Project Status and Final Economic Evaluation

The final environmental exemptions for the project were completed in 2013. Most recently on March 10, 2014 EID voted to approve an interconnection agreement with PG&E and the project is expected to bid for construction in late summer 2014. EID had previously gone through the FERC exemption process in 2010 and an extension on the exemption was granted in 2012. The following provides the final economic evaluation performed for the project based on the final design and generation calculations.

The final economic evaluation is summarized below in Tables 8 and 9 which assume the use of the RES-BCT program and the Feed-In-Tariff (ReMAT) program respectively.

Table 8: Financial Summary with RES-BCT program

Description	With Incurred Costs	Without Incurred Costs
Annual Generation in kWh	1,765,000	1,765,000
Net Cost	$1,662,000	$1,262,000
Annual Cost	$16,384	$16,384
Annual Generation Revenue	$119,000	$119,000
30-year Projected Revenue	$3,429,000	$4,034,000
30-year NPV	$1,317,000	$1,727,000
Payback Period in years	17 - 18	14 - 15

Table 9: Financial Summary with ReMAT program

Description	With Incurred Costs	Without Incurred Costs
Annual Generation in kWh	1,765,000	1,765,000
Net Cost	$1,662,000	$1,262,000
Annual Cost	$21,384	$21,384
Annual Generation Revenue	$159,000	$159,000
30-year Projected Revenue	$1,500,000	$2,104,000
30-year NPV	$638,000	$1,048,000
Payback Period in years	18 - 19	13 - 14

Additionally, the project has received a Proposition 84 grant in the amount of $380,000. On February 25th, 2014 the Proposition 84 grant agreement was received by The Sierra Fund from the Department of Water Resources which is administering the grant. EID is working with The Sierra Fund to execute the agreement in March, 2014 to make the funds available prior to the start of construction.

Based on the favorable economic evaluation as provided above the project is planned to bid and start construction in 2014.

5.2.2 Reoperation Potential for In-conduit Hydroelectric Project at Tank 7

The following summarizes the reoperation analysis performed in TM#6.

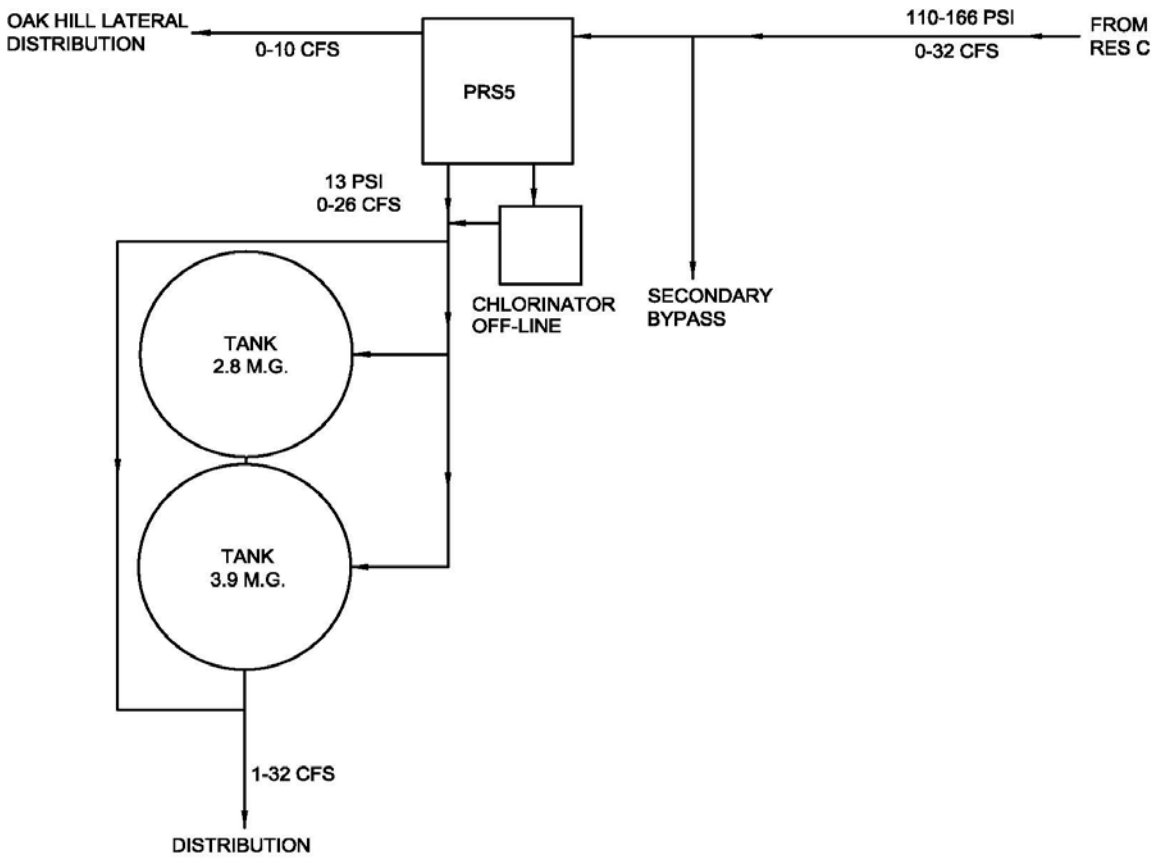
The Pleasant Oak Main (POM) at the Tank 7 hydroelectric station would be within the El Dorado Irrigation District (EID) potable water system, located off of Pleasant Valley Road between Placerville and Pleasant Valley, CA (see Figure 1). The system is fed from the Reservoir A Water Treatment Plant. Based on a preliminary feasibility analysis of potentially adding in-conduit hydroelectric facilities at each of the PR stations (Reservoir B, C and Tank 7) showed that a facility at Tank 7 was the preferred of the three, yielding the greatest power generation and would provide the most feasible location for the plant, based on existing data.

5.2.2.1 Tank 7 Facility Improvements

The proposed station would be constructed in the north-east corner of the property near the facility entrance. The hydroelectric station would be located on the existing 24-inch pipeline upstream of the existing PRS-5 and would consist of pumps as turbines (PATs) potentially operating at variable speed with regenerative power converters. The facilities would be housed in a masonry building approximately 1,100 square feet in area. Associated fencing and security features would be included in the design. The station would receive power from an existing three-phase electrical service located on-site.

A schematic of the new hydroelectric station in relation to the existing piping system is shown below (Figure 11). Flow off of the main line would be diverted through the hydroelectric station. Flows that are too low or high for the station would continue through the existing PRS-5. Additionally, flow to the Oak Hill lateral and minor flows used at the facility would continue through the existing mainline.

Figure 11: Schematic layout of Tank 7 Hydroelectric Facilities



The hydroelectric station would include flow control in addition to the turbine units to regulate the plant operation. The existing PRS-5 system would operate as a bypass to allow continuous flow in the EID system during an emergency and while the hydro station is off line. The station would rely on a programmable control system for regulating flows to the hydro station. The controller would split flow to the individual turbine units based on pressure and flow readings from the system.

Three-phase PG&E transmission lines are located along Pleasant Valley Road less than 50 feet from the site. Power generated from the project would be transmitted to the grid at this location and sold to PG&E

5.2.2.2 Turbine Selection, Control and Operational Scenarios

EID obtained proposals from equipment suppliers and considered two different types of technologies. The more conventional fixed speed PATs can provide sufficient generation to allow for an estimated payback period of 18-20+ years however there are several operational considerations. The turbines have an optimal flow range of operation that does not completely overlap with each other. Consequently, not every desired flow set point can be obtained through the turbine or combination of turbines. Under this operating scenario a portion of flow will be bypassed (approximately 10% of the total flow).

The second option being considered would apply regenerative drives to allow for variable speed operation to turbines. The addition of Regenerative VFDs to the system would further reduce the fluctuations by increasing the operational range of the turbines. Less flow would need to be bypassed and more power could be captured. Wear and tear on the valves and other components at the hydro station would be reduced by minimizing cycling. The station would be simpler to operate with wider flow ranges and have an estimated payback period 19-20+ years. Due to the immaturity of this technology and commercially operated facilities, EID determined it would not pursue this technology at this time.

5.2.2.3 Estimated Energy Production

Based on the conventional fixed speed turbine generator without cycling the turbines, the project will generate approximately 1,641 MWh per year. The following Table 10 provides project design and energy production data (based on 2009 data).

Table 10: Facility design criteria

Design Criteria	Value
Design Head	340ft at 5cfs 220ft at 25cfs
Design Flow	25cfs max 5cfs min
Nameplate Capacity	350 (kW)
Estimated Annual Generation (see below)	1,585 (MWh)

5.2.2.4 Estimated Generation with current operation

Flow records were examined to determine typical flow that would be available for hydropower generation at the Pleasant Oak Main PRS 5 at Tank 7. Average power generation at the powerhouse is estimated based on available water, head, efficiency, loss estimates and typical operation. The average monthly and annual powerhouse generation expected to be available are shown below in Table 11.

Table 11: Pleasant Oak Main PRS 5 (Tank 7) Powerhouse Generation

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Projected Average Power Generation of Pleasant Oak Main PRS 5 @ Tank 7													
MWh	162	96	59	58	52	64	115	122	180	226	224	227	1,585

5.2.2.5 Short Term (Current) POM System Options

In order to evaluate the options for potential re-operation of the system, an H2ONet model of the existing system was developed using profile and flow data supplied by EID. Using the model and varying the flow to the hydro project, several scenarios were analyzed to relate generation potential to time of day, and rate of flows to deliver the same demands from the Tank 7 site to downstream users.

The current operation at Tank 7 is to measure a demand for a given day and to reproduce the same amount the following day. The tanks would adjust (fill and empty) for the diurnal changes. Due to the large amount of storage (6.5MG) at the two (Tank 7) tanks, the amount of storage used (especially during the low use months) is relatively low.

Re-operation through holding back flow during off peak and delivering higher flow during peak demand hours would generate more energy during the high energy use periods and also deliver more flow during the peak water use hours. With the current storage at the Tank 7 tanks, this mode of operation could significantly increase the peak hour energy output of the proposed hydro plant.

The issues with the above re-operation scheme are the:

1. Upstream storage available to hold back the flows
2. Desire to treat water at the Reservoir A treatment plant at a relatively continuous and constant rate for as long as possible.

The POM has three upstream storage facilities at Res A, Res B, and Res C. These storage facilities are in-line covered reservoirs each with considerably less volume than at the Tank 7 location. Table 12 shows the relative existing storage for each facility. These upstream reservoirs would have to be controlled to deliver the re-operated diurnal flows to Tank 7. The lack of storage at these facilities, in particular at Res C (next reservoir upstream of Tank 7), limits the amount of flow to be held back during the off peak hours.

Table 12: Existing Pleasant Oak Main (POM) Storage Facilities

Location	Existing Storage (million gallons)
Reservoir A (at the treatment plant)	2.28
Reservoir B	1.5
Reservoir C	1.5
Tank 7 (at the proposed hydro plant)	6.5

Reservoir C with 1.5 MG of storage has at most approximately 500,000 gallons of storage available to hold back flow to Tank 7. This would be less than one hour of storage during the summer average day flows and only 3 hours during the lowest winter months. Reducing instead of stopping flow during off-peak and increasing flow during peak periods could be optimized with the available storage, but this would create significantly increased complexity to the operation of each of the reservoirs with only minimal benefit. Using the H2ONet model and varying (optimizing) flow in a minimum 6-hour interval generated only 5% increase in power generation. This was not considered a viable approach relative to the difficulties in operation and the wear on the equipment due to multiple on-off sequencing of the turbines.

Due to the limitations on storage in the POM upstream of Tank 7, re-operation other than adding the new hydro plant will not be recommended at this time. Minor operational changes may be attempted by operations staff during early implementation of the project.

5.2.2.6 Long Term (Current) POM System Options

The long term plan for the POM system includes adding storage at Res B and Res C per a recent master plan of storage for EID. The plan also includes replacing the covered reservoirs with above ground storage tanks. Enough storage can be added to accommodate smoother operation of the entire POM system as well as the proposed hydro plant at Tank 7. The current size and capacity of the Tank 7 hydro plant will not change, but the added upstream storage could

accommodate the hydro plant energy peaking. Based on the anticipated storage increases at the POM sites, the hydro plant could see up to 30% more generation by adding 1 million gallons of storage above what is needed per the master plan for local demands at each location. Table 13 below shows proposed future storage based on the *2002 Storage Evaluation for Potable Water System by Owen Engineering*.

Table 13: Proposed Pleasant Oak Main (POM) Storage Facilities

Location	Future Storage (million gallons)
Reservoir A (at the treatment plant)	2.28 (no change)
Reservoir B	4.0
Reservoir C	2.2
Tank 7 (at the proposed hydro plant)	6.5 (no change)

Added storage at the reservoir locations will accommodate peak energy production as well as provide smoother operation of the system. Increased generation during peak hours is 1.2 (winter peak) to 2 (summer peak) times the value of generation during non-peak hours under PG&E's Feed-In-Tariff contract. The reduced fluctuations in flow will reduce the need to change (switch over) the turbines that are on line at any given time.

Another benefit of adding storage within the POM system will be the potential to add at least two more hydro plants on the POM; one at Res C and another at Res B. Each Reservoir has a pressure reducing station just upstream similar to Tank 7. These stations have flows similar to Tank 7 but each has a lower head available. Another factor that made this less desirable than the Tank 7 site was that a three phase tie-in will require nearly ½ of a mile of transmission lines at each location. With the addition of storage and related re-operation to achieve peak production, these two marginal projects may become economically feasible in the future.

5.2.2.7 Estimated Generation with revised operation and additional storage alternatives

Based on the available storage and potential for reoperation, Table 14 below shows the effects of the proposed reoperation.

Table 14: Pleasant Oak Main PRS 5 (Tank 7) Powerhouse Generation with reoperation

Reoperation Scenario	Estimated Generation (MWh)
None (existing operation)	1,585
Short Term Reoperation	1,755
Long Term Reoperation	2,060

5.2.2.8 Future Opportunities for Tank 7 Reoperation

Based on the generation estimates provided above, the potential increase in generation anticipated during short term operation does not appear to be significant enough to warrant the changes in operation necessary. Operations staff was consulted during the process of developing reoperation scenarios. The difficulties associated with short term reoperation include potential problems with the existing floating covers on Res B and C as more fluctuation in water level occurs and additional operation staff time to balance the system. Therefore, short term reoperation is not recommended.

In the future, the covered reservoirs will be replaced with tanks that can be better utilized to re-operate the system. It is recommended to increase the storage at Res B and C above what is currently planned by approximately 500,000 to 1,000,000 gallons each at the time of installation to increase flexibility in the system. The added cost of the additional storage would be much less significant if done at the same time proposed improvements are made. Potential increases in power generation would be used to pay for the increased storage. It is recommended that EID consider increasing proposed storage to allow for additional flexibility in operation to maximize energy generation.

5.2.3 Tank 7 Hydroelectric Project Conclusions

This project demonstrates that a combination of the correct financing, grant programs and revenue agreement with PG&E can make a project economically feasible. The main differences between the final financial analysis and the initial one provided in past analyses include the following:

- Final turbine selection and more detailed generation calculation provided an increase in the generation estimates
- Project construction costs were optimized during final design to reduce costs
- A Prop 84 grant provided a decrease in the project costs of almost 30%
- Financing for the project was lower at 4.3% then the originally estimated 6% rate
- Final FIT pricing negotiations with PG&E yielded a price that was favorable to the project

This project will be EID's first in-conduit hydroelectric facility. Lessons learned from this project will be applied to other EID in-conduit hydroelectric projects that are currently being evaluated.

5.3 Oak Ridge Tanks to Bass Lake Tanks Pumped Storage

EID's recent completion of their IWRMP in 2013 concluded that there are significant opportunities in the existing system along with proposed facilities to operate utilizing more of the gravity system. This is a change in previous policy for EID which integrated more pumping facilities. With the ongoing emphasis of energy efficiency and storage EID has determined that the Oak Ridge Tanks Pump Station is no longer necessary for their operation. Therefore the facility will not be built in the future as previously planned. The following analysis can be used as an example of how similar facilities can utilize reoperation for increased energy efficiency.

5.3.1 Background

This project was at a pumping station that had been planned at the Oak Ridge storage facilities in the community of El Dorado Hills. The project would have pumped flow from the Oak Ridge Tanks which serve the El Dorado Hills area, up to the Bass Lake Tanks to serve the Cameron Park area. The reoperation project would convert the design to a pumped storage project, pumping flow from the Oak Ridge storage tanks to Bass Lake storage tanks during off-peak hours then generating power at the Oak Ridge tanks site during peak energy demand periods. The hydro station will consist of one PAT or could simply be one of the pumps at the station running in reverse. The facilities will be housed in the pump station masonry building or in a separate building approximately 200 square feet in area. Access and distance to power grid are good. Whether or not the existing storage is sufficient for feasible operations is an important component to the future implementation of this hydro option.

The Gold Hill Intertie conveys flow to the Bass Lake tanks (8.2MG). The pipeline also connects the Bass Lake tanks to the Oak Ridge tanks (8 MG), which supply the El Dorado Hills area. The Oak Ridge tanks are also connected to and fed from the El Dorado Hills Water Treatment Plant (EDHWTP). The Bass Lake tanks serve the Cameron Park and El Dorado Hills area and have been sized for build out conditions. To augment the flow to the Bass Lake tanks for future needs in the Cameron Park area, the pump station upgrade is currently under design that would send flow from the Oak Ridge tanks to the Bass Lake tanks.

5.3.2 Project Facilities and Operation

This hydro option would be a pumped storage project, pumping flow from the Oak Ridge storage tanks to Bass Lake storage tanks during off-peak hours, then generating power back at the Oak Ridge site during peak energy demand periods. The concept of pumped storage can be achieved while there is excess storage available at the Bass Lake tanks. As the Cameron Park/El Dorado Hills area water usage increases over time, the volume of storage available for hydro generation will decrease.

Under current conditions, the Cameron Park area is not built out and there is excess storage available to store and deliver flows through the proposed hydro turbine. However, much of the El Dorado Hills area served by the Oak Ridge tanks is built out and during the higher water use

(corresponding to the peak energy use) periods, there is limited excess volume at the Oak Ridge tanks. Allowing the Oak Ridge Tanks to empty during the filling of the Bass Lake tanks is not recommended. If sufficient water can be pumped to and through the Oak Ridge tank station to Bass Lake during off peak hours, a large portion of the return demands in El Dorado Hills during peak hours can be supplied from the Bass Lake tanks and through the hydro turbine. Estimates of current demands and excess storage available at the Bass Lake and Oak Ridge tanks are shown in Table 15.

Table 15: Bass Lake and Oak Ridge Tanks Monthly Demands and Available Storage

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Bass Lake Demand (MGD)	4.3	4.7	4.1	4.5	4.5	4.5	5.2	4.2	5.3	6.6	6.4	6.1
Available Storage	3.9	3.5	4.1	3.7	3.7	3.7	3.0	4.0	2.9	1.6	1.8	2.1
Oak Ridge Demand (MGD)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Available Storage	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

Based on EID staff input, the Bass Lake service area demand was estimated to be equal to the flow that passes through Pressure Regulating Station No. 6.5 (PRS 6.5). PRS 6.5 is located near Bass Lake Tanks and provides water via the Gold Hill Intertie. Data for the past two and a half years was collected to determine an average daily demand for each month. The values for Bass Lake Demand in Table 15 also include additional water required for emergency storage, equalization storage, and fire suppression. Similar data for Oak Ridge Tanks was not available due to system's piping configuration. The pipeline that delivers water from EDHWTP to Oak Ridge Tanks has several laterals that use water for other service areas in the system. Therefore, it was difficult to estimate actual demand for the Oak Ridge service area and the number of parcels within the service area was used to calculate an average daily demand. Just as before, this value was added to the additional storage requirements to determine the excess amount of storage available.

Excess storage in the Bass Lake tanks can be used to supply the Oak Ridge service area or to keep the Oak Ridge tanks full by passing flow through the proposed turbine. Assuming the current excess storage values above, Table 15 provides the potential energy production in MW for the proposed turbine. The turbine head is approximately 465 feet based on the elevation difference and losses through the 20,000 feet of pipe. The average flow rate would be approximately 8.65 CFS for 6 hours each day during the summer months. The turbine would be a 250 kW unit. An alternative would be using a variable speed unit that would add flexibility in duration and flow rates through the turbine. However this type of unit will add cost to the installation and would be considered in the preliminary design efforts.

Table 16: Estimated Daily Energy Production, Daily Pump Energy, and Monthly Income for Oak Ridge

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Generation (kW/day)	1,520	-	-	-	-	-	-	1,520	1,520	1,520	1,520	1,520	9,120
Revenue ($/day)	358							358	358	358	358	358	358
Pump Energy (kW/day)	2,990							2,990	2,990	2,990	2,990	2,990	1,794
Pump Cost ($/day)	239							239	239	239	239	239	239
Net Income ($/month)	2,495	-	-	-	-	-	-	2,376	2,495	2,614	2,614	2,495	15,089

Assumptions: no generation on weekends and holidays, pumping cost = .08 $/kW, revenue = .2357 $/kW

Energy production during the winter months is unfeasible due to PG&E current rate schedule. The price for energy production is less than the cost of energy use to pump the water uphill to Bass Lake Tanks. Therefore, attempting to use the turbine during the winter months will produce a negative net income for those months. The income values in Table 16 take into consideration the cost to pump water uphill during the off-peak period. With conservative estimations for capital and maintenance costs, the payback period exceeds 20 years.

5.3.3 Future Opportunities for the Oak Ridge Tanks to Bass Lake Tanks Pumped Storage

With increased water demands anticipated in the Cameron Park area, the existing excess storage available for generation at the Oak Ridge site will diminish. In order to continue to use the system as a pump storage facility, storage would have to be added in the Cameron Park zone to serve the added demands in that area or to augment for future demands in the El Dorado Hills area. Because the Bass Lake and Oak Ridge tanks have been sized for build out conditions, it is unlikely that more storage would be added if the only benefit would be for energy production at a relatively small hydro-electric facility.

Installation of a pumped storage facility at the Oak Ridge Tanks pump station would provide only a temporary benefit for the enhancement of renewable energy production by the District, therefore, this project should not be pursued further unless projected water demands and planned means of supply are altered in the future. For example, the District may decide to increase future supplies to the El Dorado Hills area from the Gold Hill Intertie system, which would increase the net generation at the Oak Ridge Tanks pump station.

5.4 Hydroelectric Opportunities Conclusions

Based on the analyses shown above the potential for reoperation in the water system exists to increase hydroelectric power generation. However, as the water purveyor main goal is to provide reliable water service, changes in operation do not appear feasible at this time. It should be noted that future planning of the system, including increases in storage facilities, has the potential to take power generation into consideration. Increasing the proposed storage by approximately 20-30% could provide increased flexibility in the system from an operational point of view and also allow operation to maximize hydroelectric generation.

This analysis also points to the need for somewhat higher FIT energy payment rates and expanding the definition of qualified renewable energy resources to incentivize EID and other water purveyors to add small hydroelectric generation with their water system operations. For the top six small hydro projects identified by the 2009 Hydroelectric Development Options Study, either FIT rates need to increase by about 25%, or low-interest, fixed rate bond financing in the range of 2% to 3% will be needed before EID can proceed with the top few projects. Additionally, grant opportunities such as the Proposition 84 grant obtained by EID for the Tank 7 project can help to offset the construction costs by up to 30%.

The hydroelectric facility at Tank 7 is a clear example of how the right combination of financing, agreement with PG&E and grant opportunities can make a project economically feasible. The new RES-BCT program allowing power generation to offset the power usage at several other facilities is a step in the right direction for rate policies. Also, the new FERC expedited process reduces regulatory burdens on projects located on Federal lands. This will help make projects such as EID's EDM 2 PRS 1 Tank 3 Small Hydroelectric project, which is partially located on US Forest Service managed land, more feasible. Projects should be continually reexamined as these regulations are updated to streamline the process.

Even with these options for financing and streamlined processes, a few of the projects (e.g., GDPUD's Stumpy Meadows Dam and EID's Sly Park Dam) will still face regulatory hurdles of added federal agency consultations, permits and substantial costs because of their location at existing dams. This and the need for increased energy storage on the grid as discussed above should be factored into regulatory and qualifying renewable resource rule changes if the State's policymakers wish to encourage water purveyors to broaden the mission of their operations and contribute substantially to the Governor's Renewable Portfolio Standard (RPS) goal of 33% by 2020.

CHAPTER 6:
Solar Generation Opportunities

6.1 El Dorado Irrigation District Case Study

The purpose of this study was to evaluate solar power generation opportunities within the El Dorado Irrigation District (EID) system. Additionally, this report will make recommendations to the California Energy Commission for the need for future programs to make solar more feasible.

It should be noted that the economic evaluations provided in the following and in TM#7 are based on financial programs available when the report was finalized in 2011. The current FIT rates are lower than those used and California Solar Initiative (CSI) programs are no longer available. Although, these changes would decrease the final economic analyses for each of the projects, the overall project rankings and conclusions would not be affected by the changes.

6.2 EID Solar Background

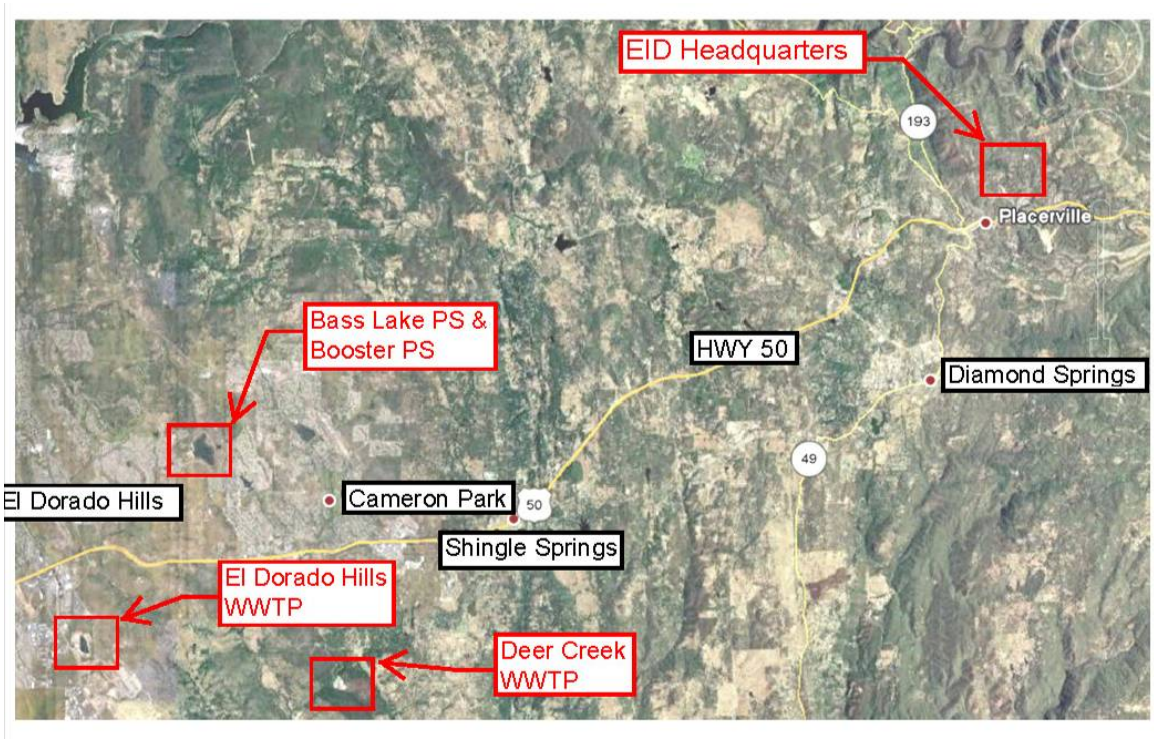
EID has an existing solar system in operation at their El Dorado Hills Waste Water Treatment Plant (EDHWWTP). The system is a 1MW ground mounted system that is located adjacent to the existing plant. The system currently offsets the energy usage at the plant saving EID nearly $300,000 annually. Figure 12 shows a view of the existing solar plant at EDHWWTP.

A study was previously conducted by Black & Vetch (BV) in 2007, which evaluated solar possibilities at multiple sites and found few opportunities. However, due to changes in technology, EID has continued their interest in solar power and to update the BV study for four (4) prospective sites. The four (4) sites evaluated were the Bass Lake Facility, Deer Creek Wastewater Treatment Plant (DCWWTP), EDHWWTP, and EID Headquarters. Figure 13 shows the approximate location of each site.

Figure 12: View of existing solar plant located at the EDHWWTP

Photo Credit: Domenichelli and Associates, 2009.

Figure 13: Site vicinity map



6.3 EID Facilities Evaluated

A brief overview of each of the sites evaluated is provided below. The potential opportunities at each site are described and along with the costs and potential generation calculated. The final economic evaluation is present in a later section. Additional detail on the assumptions made for determining the potential generation and the economic analysis can be found in TM#7 provided in Appendix A.

6.3.1 Bass Lake Facility

The Bass Lake and Recycled Water Booster Pump Stations are located outside of Cameron Park to the west of Bass Lake and to the north of the intersection of Bass Lake Road and Serrano Parkway.

6.3.1.1 Electrical Load Present

Bass Lake has three (3) utility meters. Two of them are small services for the buildings on the north side of the property. One meter is a single phase 120/240 vac meter that has a 200A main breaker. The second meter is 3 phase 120/240 vac that has a 200A main breaker.

The third meter services the Recycled Water Booster Pump Station and the Bass Lake Pump Station. This meter is 3 phase, 480 vac and 200A. Consequently, this service supports the largest load on the property and is typically used in the summer months when recycled water demands are the highest. It is unknown how much this service will be used in the future, which may affect the feasibility.

6.3.1.2 Available Area

It should be noted that EID has future plans for a water treatment plant at the Bass Lake site. As sites are pursued for solar opportunities they should be coordinated with other EID departments in order to not interfere with future plans.

Three (3) areas on the property were considered. The first site in located near the sports field and is a flat area approximately 20,000 square feet in size. It is hidden from the main roadway; however it is within 100 feet of the sports field, which leaves the solar project susceptible to vandalism or accidental damage.

Figure 14: View of open area near the sports field

Photo Credit: Domenichelli and Associates, 2009.

The second site is located on the water surface or on the north side of the lake. The panels could be ground mounted and have the lake water rise and fall below the panels. The land area is quite large measuring approximately 250,000 square feet but is located somewhat remote to the yard and would require extension of the PG&E service. Another option would be to float the panels on the water.

Figure 15: View of Bass Lake

Photo Credit: Domenichelli and Associates, 2009.

The third area is located near the Recycled Water Booster Pump Station building and is located between Bass Lake Road and the Pump Station. This area is level and flat and does not contain any trees. The site measures approximately 70,000 square feet.

Figure 16: View of open area near the Recycled Water Booster Pump Station

Photo Credit: Domenichelli and Associates, 2009.

See Appendix A for an aerial showing the potential solar locations at the site.

6.3.1.3 Layout

The layout of the PV system would be similar to EDHWWTP for ground mounted solar panels. Optionally, automated tracker style panels should be considered for increased production. Additionally, floating arrays are being considered for installation on the lake.

6.3.1.4 Optimal Size of System

The optimal size of the system depended on the metered service selected and the type of panels installed. Static inclined panels will be sized differently from automated tracker panels.

Small PV installations similar to residential size (10~20 kW) could be installed behind either of the two smaller meters with the 3 phase service being the first choice of the two.

If panels were to be installed on the lake or on the north side of the lake, a fairly large system (>2MW) could be installed with the main limitation being the installation cost.

However, the service for the Recycled Water Booster Pump Station is large enough to support a 750kW system without any significant utility modifications. The system would be connected below the existing utility meter but above the existing main breaker. This would enable the connection to offset meter usage from the largest energy user on the property.

6.3.1.5 Capital Cost and Generation Estimates

The feasibility of each of the possibilities is good with the site next to the Recycled Water Booster Pump Station standing out as the simplest installation. The only concern with that site is the close proximity to Bass Lake Road and the visual impacts this may cause (see environmental section of this report).

Cost for ground based installation can be approximated by using an average cost of $6,500/kW. This estimate includes additional site grading and preparation costs. The ground that would be utilized is flat and level in the vicinity of the Recycled Water Pump Station which already has a sizeable utility connection. This area is a candidate for the lowest possible installation cost.

If the floating based installation option is chosen, its cost can be approximated by using an average cost of $8,000/kW given that additional structure or floating rafts would be needed for each panel.

A summary of the estimated capital costs for each project option can be found in Table 17 below.

Table 17: Bass Lake – Capital Cost and Estimated power generation for potential projects

Type of System	Potential System Size	Average Cost ($/kW)	Total Estimated Capital Cost (1)	Potential Power Generation (2)
Ground Mounted (near Recycled Water PS)	750 kW	$6,500	$4.875 Million	1,185,000 kW
Ground Mounted on north side of Lake	>2MW	$6,000	$12 Million	3,160,000 kW
Floating Arrays	1-2MW	$8,000	$8-16 Million	1,580,000 kW – 3,160,000 kW

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.3.2 Deer Creek WWTP

The DCWWTP is located southeast of Cameron Park. Deer Creek Road is the main access road to the treatment plant. Deer Creek is located to the southeast of the treatment plant.

6.3.2.1 Electrical Load Present

The DCWWTP has two utility services. One feeds the older portion of the plant (aeration basins, etc.) and is rated 300A at 480vac. The actual load varies daily but based on the utility information, the peak usage is approximately 500kW.

The meter that feeds the newer portion of the plant (UV disinfection, etc.) has a main service size of 200A at 480vac. The actual load varies daily and by season, but based on the utility information, the peak usage is approximately 500kW during the summer months.

6.3.2.2 Available Area

The slope to the North East of the plant faces South West and could work well for fixed mounted solar. The slope incline is approximately 30% and measures approximately 600,000 square feet. As can be seen in Figure 17 the slope is heavily vegetated. This area would require significant clearing and grading to terrace the slope prior to installation of the ground mounted arrays. The additional work required at this site is reflected in the capital costs estimated.

Figure 17: View of sloped area that could be used for solar

Photo Credit: Domenichelli and Associates, 2009.

See Appendix A for an aerial showing the potential solar locations at the site.

6.3.2.3 Layout

The layout of the PV system would be similar to the EDHWWTP for ground mounted solar panels. Optionally, automated tracker style panels could be considered. Additionally, roof mounted arrays were originally considered for this site. However, due to the limited area available for this use and the potential costs this option was eliminated from further review.

6.3.2.4 Optimal Size of System

The optimal size of the system depended on the metered service selected and the type of panels installed. Static inclined panels will be sized differently from automated tracker panels.

While it is possible to feed solar power behind each utility meter and offset usage, it may be more prudent to combine the services and feed behind a single utility meter that is large enough to handle the entire solar installation.

If the size of the system exceeds the capacity of one or the combined total of the existing services, the only way to offset usage and to exceed present capacity is to combine the services together into a single 12 kV service and obtain a metered service at that voltage.

If the entire slope is utilized, a 6MW system could be installed. That size would far exceed the plants total peak usage of 1MW and would require a 12 kV service. If only a smaller portion of the slope is used, and the existing services were to remain, each service could support about a 1.25MW system each. PG&E would need to be contacted to confirm the transformer sizing at each existing meter.

6.3.2.5 Capital Cost and Generation Estimates

The feasibility of utilizing the northeast slope is good. A small system of 1MW or less would be connected to the old existing meter service only. A medium system of up to 2MW would be connected to both existing meters. A large system, greater than 2MW, would require a new 12kv meter installation and would be the least cost per watt to install.

The ground that would be utilized is sloped and would require clearing and terracing prior to use increasing the costs for site improvements. Cost for ground based installation can be approximated by using an average cost of $8,000/kW. This rate should be sufficient for the installation to 1MW. If the size of the project is larger, the cost per watt may be lower (~$6,000/kW) due to economy of scale.

A summary of the estimated capital costs for each project option can be found in Table 18 below.

Table 18: DCWWTP – Capital Cost and Estimated power generation for potential projects

Type of System	Potential System Size	Average Cost ($/kW)	Total Estimated Capital Cost (1)	Potential Power Generation (2)
Ground Mounted (on sloped area up to 1 MW)	1 MW	$8,000	$8 Million	1,580,000 kW
Ground Mounted (on sloped area up to 6 MW)	6 MW	$6,000	$36 Million	9,480,000 kW

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.3.3 El Dorado Hills WWTP

The EDHWWTP is located within El Dorado Hills on the south side of Highway 50. The main access to the treatment plant is off of Latrobe Road.

6.3.3.1 Electrical Load Present

The EDHWWTP has three (3) utility services. One feeds the older portion and two (2) feed the newer portion of the plant that is currently under construction.

The service that feeds the older portion of the plant and is rated 4000A at 480vac. It is presently connected to the existing 1MW solar system.

The meter that feeds the remaining newer portion of the plant (Headworks Equalization, etc.) has a main service size of 2000A at 480vac. The system is in construction and usage information is not available yet.

The meter that feeds the newer portion of the plant (UV disinfection, etc.) has a main service size of 2000A at 480vac. The system is in construction and usage information is not available yet. It is assumed that these new portions of the plant could handle a load similar to the existing 1MW solar system.

6.3.3.2 Available Area

The existing storage reservoir on site was considered for potential floating arrays. As previously mentioned the manufacturers will design the floating arrays to allow the reservoir to be completely emptied therefore the size of usable area will be equivalent to the bottom area of the reservoir (approximately 200,000 square-feet).

Figure 18: View of pond at EDHWWTP (evaluated for solar potential)

Photo Credit: Domenichelli and Associates, 2009.

Two other areas are available on site, one to the north of the existing PV panel area and the second south of the existing PV panel area. The area to the north measures approximately 250,000 square feet. The area to the south measures approximately 230,000 square feet.

Figure 19: View of area adjacent to the existing solar arrays at the EDH WWTP

Photo Credit: Domenichelli and Associates, 2009.

These areas are fairly flat and would require minimal grading. The site would require some improvements to the existing drainage in order to accommodate the new system. Currently a drainage swale runs to the south of the existing solar array system. This drainage swale would need to be improved or potentially piped. These improvements will add to the overall cost of the system.

See Appendix A for a plan of the site showing the potential solar locations.

6.3.3.3 Layout

The layout of the PV system would be similar to the existing panels at the EDHWWTP for ground mounted solar panels. Optionally, automated tracker style panels could be considered.

6.3.3.4 Optimal Size of System

The optimal size of the system depended on the metered service selected and the type of panels installed. Static inclined panels will be sized differently from automated tracker panels.

If the north area is utilized, another 1MW system could be installed similar to the existing system. If the south area is utilized it could also receive approximately 1MW of PV panels. The north system could feed to the headworks service and the south system could feed to the UV service.

If the floating arrays were used this could also support a 1MW system.

6.3.3.5 Capital Cost and Generation Estimates

The feasibility of these systems is good since they would be similar to the existing system and connected in similar fashion to the existing PV panels.

The ground that would be utilized is flat and level East of the recycled water storage reservoir and would require some improvements to the existing drainage swale. This area is a candidate for one of the lowest possible installation costs. Cost for ground based installation can be approximated by using an average cost of $7,000/kW.

If the floating based installation option is chosen, its cost can be approximated by using an average cost of $8,000/kW given that additional structure or floating rafts would be needed for each panel.

Table 19: EDHWWTP – Capital Cost and Estimated power generation for potential projects

Type of System	Potential System Size	Average Cost ($/kW)	Total Estimated Capital Cost (1)	Potential Power Generation (2)
Ground Mounted	1-2 MW	$7,000	$7-14 Million	1,580,000 kW – 3,160,000 kW
Floating Arrays	1 MW	$8,000	$8 Million	1,580,000 kW

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.3.4 EID Headquarters

The EID Headquarters is located within the City of Placerville on the north side of Highway 50 off of Mosquito Road. Electrical load present:

Two (2) utility meters and services presently exist at the EID headquarters and at the adjacent maintenance yard. The meter for the Headquarters building is dedicated to the building and is 3 phase, 1600A, 480 vac service.

The maintenance yard service is 3 phase, 1200A, 480 vac.

6.3.4.1 Available Area

The building roof of the main office and the adjacent parking lot are two possible areas. The roof areas measure approximately 22,000 square feet. Some of the roof space is used for air handling equipment and will either reduce the total solar area or will force the solar panels to be built above them. The parking lot serving the main office has about 17,000 square feet of elevated space available.

Figure 20: View of EID Headquarters (potential for roof and parking lot solar)

Photo Credit: Domenichelli and Associates, 2009.

Figure 21: View of EID Headquarters parking lot evaluated for solar

Photo Credit: Domenichelli and Associates, 2009.

Additionally, EID currently has an open space available near the front of their parking lot area that has been reserved for display of historical artifacts related to EID or for potential demonstration displays. This area has been discussed for used as a solar demonstration. EID is consistently looking for opportunities to educate the public on solar and other types of green energy.

Another possible area is the upper parking area near the maintenance yard. This is a large parking lot that serves the main office. Approximately 40,000 square feet of elevated space could be made available above the parking lot.

See Appendix A for a plan of the site showing the potential solar locations.

6.3.4.2 Layout

Either roof mounted or elevated structure mounted panels would be required for this site.

6.3.4.3 Optimal Size of System

The optimal size of the system would offset the headquarters building power. Based on the utility meter readings, a system up to 250kW could be used to fully offset the meter.

6.3.4.4 Capital Cost and Generation Estimates

The roof of the headquarters building and annex are the most feasible as compared to the parking lot where new structures would be required. The structures over the parking lot would add significantly to the cost of the system.

Cost for roof based installation can be approximated by using an average cost of $9,000/kW. The roof area that would be utilized may require some improvements to the structure to support the panels.

Table 20: EID Headquarters – Capital Cost and Estimated power generation for potential projects

Type of System	Potential System Size	Average Cost ($/kW)	Total Estimated Capital Cost (1)	Potential Power Generation (2)
Roof Mounted/Parking Structure Units	250kW	$9,000	$2.25 Million	395,000 kW

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.4 Preliminary Environmental Constraints Analysis

6.4.1 Introduction

An initial environmental constraints analysis was performed for four (4) site locations under consideration for installation of solar panels. The four (4) site locations are owned and operated by EID and include Bass Lake, Deer Creek Wastewater Treatment Plant, El Dorado Hills Wastewater Treatment Plant, and the EID Headquarters Building. A brief summary of the conclusions of the analyses are provided below. Additional detail on the environmental constraints identified can be found in TM#7 provided in Appendix A.

6.4.2 Bass Lake

Based on the environmental review provided, more information is needed to determine the extent of environmental constraints associated with the installation of solar panels at the Bass Lake Reservoir. The panels would likely be proposed in a previously undeveloped area and/or on the reservoir. Based on this analysis, the environmental impacts could vary substantially based on the final location of the panels.

There are several biological resource concerns, including impacts to aquatic habitat and bald eagle foraging habitat associated with installing solar panels on the lake. In addition, mitigation for impacts to oak woodland habitat would be required if oaks are removed to install solar panels. An aesthetic impact associated with installing panels on the lake is also a major concern. Installing panels on the lake could require preparing an EIR. If the Project only involves land-mounted solar panels, it may quality for a mitigated negative declaration.

6.4.3 Deer Creek Wastewater Treatment Plant (DCWWTP)

Based on the environmental review provided, more information is needed to determine the extent of environmental constraints associated with the installation of solar panels at the Deer Creek Wastewater Treatment Plant. The panels may be proposed in a previously developed area and they may be installed in a previously undeveloped area. Based on this analysis, the environmental impacts associated with this location would depend on the final location of the panels.

There are several biological resource concerns, including special-status species and sensitive habitats associated with clearing native vegetation for the installation of solar panels. In addition, mitigation for exposure to naturally occurring asbestos would be required at this site. We recommend preparing a CEQA initial study. With appropriate mitigation, this project would likely meet CEQA requirements with a mitigated negative declaration.

6.4.4 El Dorado Hills Wastewater Treatment Plant (EDHWWTP)

Based on the environmental review checklist and based on a review of the IS/MND completed for EDHWWTP, Solar Photovoltaic System Project, there are no major environmental constraints associated with the installation of solar panels at the EDHWWTP. The panels would be located in a previously developed area and would essentially expand an area with existing panels. The installation of the panels would not result in a significant change to the character and setting of the area. We recommend further investigation into some of the checklist items checked as “maybe”. Based on this analysis, the environmental constraints associated with this

alternative location may meet the requirements for CEQA Categorical Exemption 15301(2)(b), Class 1 – Existing Facility (Minor Alteration).

6.4.5 EID Headquarters

Based on the environmental review checklist, there are no known environmental constraints associated with the installation of solar panels at the employee parking areas adjacent to the EID Headquarters Building. The panels would be located in a previously developed parking lot in an area that is behind the building and not readily visible from the nearby access road (Mosquito Road). The installation of the panels would not result in a significant change to the character and setting of the area. Based on this analysis and a discussion with EID Environmental Review Specialist, Chris Word, the environmental constraints associated with this alternative location may meet the requirements for an Addendum to the EID Headquarters Master Plan Final EIR (2000) or a CEQA categorical exemption Class 1 15301(2)(b) – Existing Facility (Minor Alteration). An addendum would not require public circulation.

6.5 Economic Feasibility Analysis

6.5.1 Introduction

In order to determine the feasibility of solar opportunities at each site the different economic programs were considered for each site opportunity along with environmental impacts and capital costs. An evaluation and recommendation for each site is presented below.

The following is based on EID owning and operating a solar project independently to either offset their existing electrical uses or to sell back to PG&E. Additionally, an agreement with private investors could be pursued by EID in the future to reduce initial costs, reduce risks and take advantage of tax incentive programs that EID is not eligible for. The details of such an agreement would need to be worked out between EID and the investor. This analysis does not speculate on the terms of such an agreement.

6.5.2 Operation and Maintenance costs

PV systems are extremely durable; having no moving parts and tend to degrade slowly over their 30-year lifespan. Maintenance consists of cleaning the modules at least once a year to prevent dirt, dust, and salt buildup. Inverters necessary to convert the direct current produced by the panels to alternating-current used by the plant require more maintenance that the panels themselves and need to be replaced every 10-15 years although larger inverters (> 50 kW) may be “rebuilt”. It is estimated that the annual maintenance costs for systems up to 1MW will be approximately $20,000 and systems 1-2MW will be $30,000 and over 2MW will be $50,000. This estimate includes cleaning, preventative maintenance, unscheduled maintenance, insurance, and rebuilding/replacing the inverter once in the 30-year life.

6.5.3 Criteria for Evaluation

In order to evaluate the feasibility of each potential project the criteria for evaluation must be established. Based on criteria used previously by EID projects are evaluated and ranked on the following criteria:

- Net Present Value (NPV) of the project
- Payback period for the project (must be less than 20-years)

Potential projects at each site were evaluated using the criteria and then ranked. In order to provide equal comparison each project was evaluated using a 30-year loan period with a 6% interest rate. The following sections describe the programs used to determine the potential annual return for each project which will be used to determine the NPV and payback periods in a separate section.

The projects will be ranked by this criterion and then the most feasible projects will be identified.

The following programs were utilized to determine the economic feasibility of the projects. These program descriptions are based on the latest information when the analysis was completed in 2009. For updates to the programs see Chapter 4 of this report. Additional descriptions of each of these programs can be found in the Final TM#7 provided in Appendix A.

- California Solar Initiative
- PG&E's Net Energy Metering
- PG&E's Feed-In Tariff (ReMAT) Program
- PG&E's Solar PV Program
- Federal Tax Incentives for Private Investors
- Renewable Energy Credits

6.5.4 Site Evaluation Data

6.5.4.1 Bass Lake

The programs that could be applied at the Bass Lake Facilities include:

- California Solar Initiative (CSI)
- PG&E's Net Metering Program (NMP)
- PG&E's Feed-In Tariff (FIT)

If the 750kW system is selected to offset the usage of the Recycled Water Pump Station EID could utilize the CSI and NMP Programs. The capital cost of the system would be significantly reduced by the CSI Program. As mentioned previously the CSI program will pay $0.26/kWh for the first five years. For the 750kW system that equals approximately $308,100/year and $1,540,500 over five years.

To determine the annual return of offset costs for the system it is assumed that EID would utilize the A6 rate schedule. Using assumptions on the usage yields an annual potential cost savings of approximately $302,663.

To determine the feasibility the annual payment for a 30-year loan at 6% interest was determined. For the 750kW project the annual payment would be $359,476/year.

The other ground mounting and floating arrays would utilize the FIT program to feed electricity back into the system. The FIT program rates are $0.09674/kWh for off-peak times and $0.19735/kWh for peak times (other TOD factors were neglected for this analysis). For a 1MW system this yields an annual return of $216,435 (assuming 40% production during peak times and 60% during off-peak). This yields a payback period of well over 30 years for these projects (see table below).

Unfortunately, these systems do not meet the requirements of the CSI program and the large capital costs cannot be offset which makes these projects less feasible.

Table 21: Bass Lake Economic Feasibility Summary

Type of System	Total Estimated Capital Cost (1)	Potential Power Generation (2)	App. Programs	Potential Annual Return	Annual Debt Service (6% interest)	O&M Costs
Ground Mounted (near Recycled Water PS) (750kW)	$4.875 Million	1,031,250 kW	CSI NMP	$263,400 with an additional $268,125/yr for the first 5 years	$359,476	$20,000
Ground Mounted on north side of Lake (>2MW)	$12 Million	2,750,000 kW	FIT	$432,869	$884,864	$50,000
Floating Arrays (1-2MW)	$8-16 Million	1,375,000 kW - 2,750,000 kW	FIT	$216,435 - $432,869	$589,909 - $1,179,818	$50,000

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project, (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.5.4.2 Deer Creek Wastewater Treatment Plant (DCWWTP)

The program that could be applied at the DCWWTP Facilities is PG&E's Feed-In Tariff (FIT)

The ground mounting systems would utilize the FIT program to feed electricity back into the system. The FIT program rates are $0.09674/kWh for off-peak times and $0.19735/kWh for peak times (other TOD factors were neglected for this analysis). For a 1MW system this yields an annual return of $216,435 (assuming 40% production during peak times and 60% during off-peak). This yields a payback period of well over 30 years for these projects.

Unfortunately, these systems do not meet the requirements of the CSI program and the large capital costs cannot be offset which makes these projects less feasible.

Table 22: DCWWTP Economic Feasibility Summary

Type of System	Total Estimated Capital Cost (1)	Potential Power Generation (2)	App. Programs	Potential Annual Return	Annual Debt Service (6% interest)	O&M Costs
Ground Mounted (on sloped area up to 1 MW)	$8 Million	1,185,000 kW	FIT	$216,435	$589,909	$50,000
Ground Mounted (on sloped area up to 6 MW)	$36 Million	9,480,000 kW	FIT	$1,298,610	$2,654,591	$50,000

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project, (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.5.4.3 El Dorado Hills Wastewater Treatment Plant (EDHWWTP)

The programs that could be applied at the EDHWWTP include:

- California Solar Initiative (CSI)
- PG&E's Net Metering Program (NMP)

It is recommended to utilize the energy created on site for the added load anticipated for the treatment plant expansion and utilize the CSI and NMP Programs. The capital cost of the system would be significantly reduced by the CSI Program. As mentioned previously the CSI program will pay $0.26/kWh for the first five years. For the 1MW system that equals approximately $410,800/year and $2,054,000 over five years.

To determine the annual return of offset costs for the system it is assumed that EID would utilize the A6 rate schedule. Using assumptions on the usage yields an annual potential cost savings of approximately $403,550.

To determine the feasibility the annual payment for a 30-year loan at 6% interest was determined. For the 1MW ($7 million) project the annual payment would be $516,171/year.

Table 23: EDHWWTP Economic Feasibility Summary

Type of System	Total Estimated Capital Cost (1)	Potential Power Generation (2)	Applicable Programs	Potential Annual Return	Annual Debt Service (6% interest)	O&M Costs
Ground Mounted (1-2MW)	$7-14 Million	1,580,000 kW – 3,160,000 kW	CSI NMP	$403,550 with an additional $357,500/yr for the first 5 years for a 1MW system. If the new load is determined to be greater a larger system could be utilized	$516,171 - $1,032,342	$30,000
Floating Arrays (1MW)	$8 Million	1,580,000 kW	CSI NMP	Same as above	$589,909	$30,000

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project, (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.5.4.4 EID Headquarters

The programs that could be applied at the Bass Lake Facilities include:

- California Solar Initiative (CSI)
- PG&E's Net Metering Program (NMP)

It is recommended to utilize the energy created on site to offset the usage at the EID Headquarters and utilize the CSI and NMP Programs. The capital cost of the system would be significantly reduced by the CSI Program. As mentioned previously the CSI program will pay $0.26/kWh for the first five years. For the 0.25MW system that equals approximately $102,700/year and $513,500 over five years.

To determine the annual return of offset costs for the system it is assumed that EID would utilize the A6 rate schedule. Using assumptions on the usage yields an annual potential cost savings of approximately $100,888.

To determine the feasibility the annual payment for a 30-year loan at 6% interest was determined. For the 0.25MW project the annual payment would be $165,912/year.

Table 24: EID Headquarters Economic Feasibility Summary

Type of System	Total Estimated Capital Cost (1)	Potential Power Generation (2)	Applicable Programs	Potential Annual Return	Annual Debt Service (6% interest)	O&M Costs
Roof Mounted/Parking Structure Units (250kW)	$2.25 Million	395,000 kW	CSI NMP	$100,888 with an additional $102,700/yr for the first 5 years	$165,912	$5,000

Note: (1) Capital Costs assume that the site work will be completed by an outside contractor as part of the overall project, (2) Potential power generation is based on a 1MW system producing approximately 1.580 MWh annually

6.6 Project Ranking and Recommendations

In order to rank the projects the NPV was determined using the data summarized in the sections above. All NPVs were determined to be negative based on the annual debt service exceeding the potential annual return from the projects. Additionally, it was determined that the payback period for each project exceeds the project feasibility criteria of 20-years (all are well over 30-years) and therefore this criterion was not used in the project rankings.

Table 25 below shows the proposed rankings of the projects based on their NPVs.

Table 25: Proposed Ranking of Projects based on NPV

Ranking	Project	NPV
1	EDHWWTP Ground 1MW	($352,227)
2	Bass lake Ground 750 kW	($395,200)
3	EID Headquarters 250 kW	($497,508)
4	EDHWWTP Float 1MW	($1,352,227)
5	EDHWWTP Ground 2MW	($3,303,350)
6	Bass lake Float 1MW	($5,709,050)
7	DCWWTP 1MW	($5,709,101)
8	Bass lake Ground 2MW	($6,729,873)
9	Bass lake Float 2MW	($10,729,873)
10	DCWWTP 6MW	($18,813,094)

6.6.1 Bass Lake Recommendations

For the Bass Lake site it is recommended to pursue the 750kW solar system to offset the usage at the Recycled Water Pump Station. The other systems are less feasible and would require additional environmental analysis. The 750kW system could qualify for a Mitigated Negative Declaration (MND). The larger projects are cost prohibitive and would require EID to find a

grant program or perform some of the work in house to reduce the capital costs of the project. While the cost of a floating array system has been reduced significantly due to new technologies the rate of return and the environmental issues make this a less feasible alternative. As previously mentioned the District would need to pursue a low interest loan program or offset the capital costs with a grant in order to make the project feasible.

6.6.2 DCWWTP Recommendations

It is not recommended to pursue any potential projects at the DCWWTP due to the poor economics of the project and the additional environmental studies that would need to be performed.

6.6.3 EDWWTP Recommendations

It is recommended that EID pursue additional solar power generation at the EDHWWTP site to offset future demands anticipated due to the expansion of the system. Having an existing system on site will make it easier to expand under the environmental process. Because both the ground mounted and floating array systems have similar payback periods either one could be pursued. As previously mentioned the District would need to pursue a low interest loan program or offset the capital costs with a grant in order to make the project feasible.

6.6.4 EID Headquarters Recommendations

It is recommended that EID pursue solar power generation at the EID Headquarters to offset existing demands. The environmental impact of the roof mounted and parking structure arrays is minimal. This would also be an opportunity for an educational information display on-site to help promote renewable energies in El Dorado County. As previously mentioned the District would need to pursue a low interest loan program or offset the capital costs with a grant in order to make the project feasible.

6.6.5 Other Benefits

It is also important to note that there are benefits to construction of a solar project other than economical. These include:

- Solar energy is renewable
- Solar energy is environmental friendly
- Increase in power self-sufficiency

While the projects may not be economically feasible these additional benefits and EID's commitment to renewable energies make them worth pursuing.

6.7 Solar Opportunities Conclusions

From the analysis performed above it can be seen that none of the projects identified and evaluated for this project are economically feasible based on typical financing available to water agencies. Two major factors were identified that make solar projects, developed and financed through water agencies, similar to these not feasible. These factors are; 1) high initial capital

costs and 2) high financing costs. While the capital costs of solar technologies have been reduced in recent years the capital costs are still high (especially when the costs must be financed) and exceed the potential return on the investment causing the NPVs of the projects to be negative.

In order to identify potential programs and assistance that could help make the solar projects more feasible the following cost reduction factors were quantified for the three top ranked projects:

1. The capital cost reduction necessary (through grants or other incentives) for a payback period of 20-years at a 6% interest rate.
2. The interest rate necessary for a payback period of 20-years if the capital costs were not reduced.

Table 26 below summarizes the results.

Table 26: Cost reduction or interest rate requirements for a 20-year payback period

Ranking	Project	Capital Cost	Reduced Cost Required (6% interest)	% Cost Reduction Required	Interest Rate Required (with no cost reduction)
1	EDHWWTP Ground 1MW	$7,000,000	$5,790,509	17%	3%
2	Bass lake Ground 750kW	$4,875,000	$3,921,219	20%	3%
3	EID Headquarters 250kW	$2,250,000	$1,532,438	32%	1%

6.7.1 Solar Generation Opportunities Conclusions

Based on the above it can be seen that in order to make these project feasible either a large reduction in capital costs (20-50%) or a reduction in financing interest rate to 1-3% are necessary. This would require additional grant funding programs or low interest rate financing programs.

As previously stated in this report the existing solar array facility located and operated by EID at their EDHWWTP was financed using a grant program from PG&E that offset the initial capital costs by 50%.

It is the conclusion and recommendation of the project team that the CEC and other government agencies interested in promoting solar energy consider the following:

1. Implement additional grant programs to offset capital costs
2. Implement a low interest loan program to offset financing costs

The California Solar Initiative Program (CSI) was discontinued due to lack of funding sources. Reinstatement of the program which provides a cost offset based on actual generation in the

first five years of a project would be a step in the right direction. Other grant programs could be modeled after programs currently run by PG&E.

A low interest loan program could be modeled after the State Revolving Fund (SRF) program used by the California Department of Public Health (CDPH) to fund water and wastewater projects. This program has successfully been run through the State of California.

CHAPTER 7:
Short and Long Term Efficiency Alternatives

7.1 Renewable Energy Options

The purpose of this study was to identify opportunities throughout El Dorado County and adjacent areas for near, mid-term and long-term energy efficiency and generation opportunities. Each of the following El Dorado County water purveyors was contacted to determine the opportunities within their District:

- El Dorado Irrigation District (EID)
- Grizzly Flats Community Services District (GFCSD)
- South Tahoe Public Utility District (STPUD)
- Georgetown Divide Public Utility District (GDPUD)
- Tahoe City Public Utility District (TCPUD)
- City of Placerville (provides water and sewer distribution service)

A survey form was sent to each of the agencies. The form provided a format for describing potential energy generation and efficiency projects. Each District was asked to provide as much information as available on potential projects. Additionally, survey forms were distributed to other water purveyors outside of El Dorado County that have systems and challenges similar to El Dorado County. These included:

- Heavenly Ski Resort
- City of Folsom
- Amador Water Agency
- Tuolumne Utilities District

Although responses were not received from the majority of agencies contacted, phone and email contact did yield limited results. The following describes the energy generation opportunities that were identified from this effort. Facilities were visited when possible. Additionally, other reports, studies and quotes provided to the agencies were utilized to identify potential opportunities.

7.1.1 El Dorado County Overview

El Dorado County is located in east-central California and encompasses approximately 1,805 square miles of rolling hills and mountainous terrain. The County's western boundary contains part of Folsom Lake, and the eastern boundary is also the California-Nevada State line. The County is topographically divided into two zones. The northeast corner of the County is in the

Lake Tahoe basin, while the remainder of the County is in the "western slope," the area west of Echo Summit.

El Dorado County has twelve water purveyors which include a number of smaller water systems in the Tahoe basin and the City of the Placerville which distributes water provided by EID. The smaller systems in the Tahoe basin were not contacted for renewable opportunities. The focus of this TM is on the five largest water purveyors in El Dorado County which include:

1. El Dorado Irrigation District (EID)
2. Grizzly Flats Community Services District (GFCSD)
3. South Tahoe Public Utility District (STPUD)
4. Georgetown Divide Public Utility District (GDPUD)
5. Tahoe City Public Utility District (TCPUD)

A Figure showing the service areas of each of these Districts is provided in the Final TM#8 provided in Appendix A. The water supply for the western slope areas mainly consists of surface water from the watersheds of the Sierra Nevada mountain range. The Tahoe Basin purveyors obtain most of their supplies from groundwater. The Sierra Nevada snowpack serves as natural storage for much of the region's annual precipitation. The surface water is stored in a system of reservoirs that are utilized for both water storage and recreational use. The water distribution system consists of water storage tanks (treated water), pipelines, and pump stations. A majority of the area is served by gravity with the use of multiple pressure reducing stations in order to mitigate for the large variation in elevation throughout the region.

The large variations in elevation provide significant opportunities for hydroelectric generation throughout the County. The western slope area is mainly served by Pacific Gas and Electric (PG&E), which also operates several of the existing hydroelectric projects in the area along with the Sacramento Municipal Utility District (SMUD). The Tahoe Basin electric service provider is Liberty Utilities.

7.1.2 Types of Renewable Energy Generation Considered

There are multiple types of energy generation which may be applicable in the El Dorado County Region. They include:

- Hydroelectric
- Solar
- Wind
- Biomass
- Biogas

A description of each of these types of renewable energies and there applicability in El Dorado County is described in more detail the Final TM#8 provided in Appendix A.

7.2 Renewable Opportunities by Water Purveyor

The following provides an overview of each water purveyor contacted as part of the survey process and renewable energy opportunities identified. The opportunities identified are for near-term, mid-term and long-term. If a response was not received by an agency an overview is provided along with recommendations for future study. It should be noted that the following provides estimates based on limited data available. These estimates are expected to change based on final site locations, permitting requirements and equipment selection.

7.2.1 El Dorado Irrigation District

7.2.1.1 Overview

El Dorado Irrigation District (EID) is the largest water purveyor in El Dorado County. EID serves more than 100,000 customers, and its service area encompasses approximately 220 square miles on the western slope of the Sierra Nevada mountains. Elevations in the service area range from 500 to more than 4,000 feet. EID's delivery infrastructure for water include approximately 1,200 miles of pipeline, 27 miles of ditches, 5 treatment plants, 36 storage reservoirs and 37 pumping stations.

EID's main potential for renewable energy systems include hydroelectric and solar. Other energy savings opportunities explored for EID include demand management and reoperation of pump stations for improved efficiency. These opportunities have been analyzed in more detail in TMs 6 and 7. EID is currently in the process of final design and permitting for the Pleasant oak Main PRS 5 (Tank 7) project. The project is expected to go to construction in late 2014.

Table 27: Summary of Renewable Energy Projects Identified for EID

Project Name	Type of Renewable	Term (Near, Mid or Long)	Capacity	Potential Generation
Sly Park Dam	RPS-Qualified Hydro	Near-term	400kW	1,833 MWh/year
Sly Park Dam Fish Release	RPS-Qualified Hydro	Near-term	44kW	343 MWh/year
Sly Park Narrows Dam	RPS-Qualified Hydro	Long-term	576kW	4,037 MWh/year
Weber Dam Re-Op	RPS-Qualified Hydro	Long-term	204kW	581 MWh/year
Weber Dam Re-Op w/ Flashboards	RPS-Qualified Hydro	Long-term	216kW	615 MWh/year
Caples Lake - Kirkwood Meadows PUD	RPS-Qualified Hydro	Long-term	280kW	1,000 MWh/year
Silver Lake Dam	RPS-Qualified Hydro	Long-term	29kW	76 MWh/year
Echo Lake Dam	RPS-Qualified Hydro	Long-term	144kW	505 MWh/year
El Dorado Main 1-PRS 12 (at airport)	RPS-Qualified Hydro	Mid-term	25kW	220 MWh/year
El Dorado Main 1-PRS 13 at Reservoir 6 (Tank 6 inlet)	RPS-Qualified Hydro	Mid-term	110kW	590 MWh/year
El Dorado Main 2 PRS 1 (Tank 3)	RPS-Qualified Hydro	Near-term	360kW	1,739 MWh/year
El Dorado Main 2 - PRS 4 (Whispering Pines)	RPS-Qualified Hydro	Near-term	90kW	472 MWh/year
El Dorado Main PRS 3	RPS-Qualified Hydro	Mid-term	195kW	892 MWh/year
Diamond Springs Main PRS I (Res 8)	RPS-Qualified Hydro	Mid-term	140kW	690 MWh/year
Pleasant Oak Main at Res B	RPS-Qualified	Mid-term	450kW	2,657

Project Name	Type of Renewable	Term (Near, Mid or Long)	Capacity	Potential Generation
(2 stations)	Hydro			MWh/year
Pleasant Oak Main PRS 2 at Res C	RPS-Qualified Hydro	Near-term	174kW	914 MWh/year
Pleasant Oak Main PRS 3	RPS-Qualified Hydro	Mid-term	140kW	620 MWh/year
Pleasant Oak Main PRS 4	RPS-Qualified Hydro	Long-term	91kW	477 MWh/year
Pleasant Oak Main PRS 5 (Tank 7)	RPS-Qualified Hydro	Mid-term	420kW	1,765 MWh/year
Deer Creek WWTP Outflow	RPS-Qualified Hydro	Long-term	3kW	26 MWh/year
Oak Ridge Tanks to Bass Lake Tanks Pumped Storage	RPS-Qualified Hydro	Mid-term	280kW	874 MWh/year
PRS into Bass Lake Tanks Sta. 6.5 (1477')	RPS-Qualified Hydro	Mid-term	72kW	567 MWh/year
EDHWWTP Ground	Solar	Mid-term	1MW	1,580 MWh/year
Bass Lake Ground	Solar	Mid-term	750kW	1,185 MWh/year
EID Headquarters	Solar	Mid-term	250kW	395 MWh/year
EDHWWTP Float	Solar	Mid-term	1MW	1,580 MWh/year
EDHWWTP Ground	Solar	Mid-term	2MW	3,160 MWh/year
Bass Lake Float	Solar	Long-term	1MW	1,580 MWh/year
DCWWTP (Smaller project)	Solar	Long-term	1MW	1,580 MWh/year
Bass Lake Ground	Solar	Long-term	2MW	3,160 MWh/year

Project Name	Type of Renewable	Term (Near, Mid or Long)	Capacity	Potential Generation
Bass Lake Floating Arrays	Solar	Long-term	2MW	3,160 MWh/year
DCWWTP (Larger project)	Solar	Long-term	6MW	9,480 MWh/year

7.2.1.2 Increased Efficiency Potential

As previously discussed in TM#5 multiple pump stations have been identified in EID's system that have the potential to increase efficiency through pump replacement, changes to the system configuration and providing a closer match between the pump and the system curve. The following pump stations were recommended for upgrades or changes:

- Moosehall
- Reservoir 8
- Dolomite
- Outingdale RW
- Strawberry RW
- Oro Loma
- Log Cabin
- Sportsman
- Ridgeview
- Reservoir A

One of the key recommendations following TM#5 is the need to more accurately identify system curve information through the use of flow meters and pressure gages. Additional analysis was performed on the Oro Loma Pump Station where data was available from EID's Hydraulic model to allow for development of a system curve. The additional analysis is provided in TM #9.

7.3 Georgetown Divide Public Utility District

7.3.1 Overview

The Georgetown Divide Public Utility District (GDPUD) serves the communities located in northwestern El Dorado County among the foothills of the Sierra Nevada Mountain Range, situated in the heart of the Mother Lode. Its service area encompasses approximately 72,000

acres and includes irrigation and domestic water supplies along with on-site wastewater disposal. GDPUD serves approximately 15,000 people, and its system is mainly served by gravity flow with the use of multiple storage facilities.

7.3.2 Renewable Energy Projects Identified

The renewable projects identified for GDPUD include both hydroelectric and solar.

Table 28: Summary of Renewable Energy Projects Identified for GDPUD

Project Name	Type of Renewable	Term (Near, Mid or long)	Capacity	Potential Generation
GDPUD Sandtrap Siphon	RPS-Qualified Hydro	Near-term	180 kW	1,130 MWh/year
GDPUD Kaiser Siphon	RPS-Qualified Hydro	Long-term	580 kW	3,638 MWh/year
GDPUD Buffalo Siphon	RPS-Qualified Hydro	Mid-term	180 kW	860 MWh/year
GDPUD Stumpy Meadows Dam	RPS-Qualified Hydro	Long-term	485 kW	2,000 MWh/year
GDPUD Office site solar	Solar	Long-term	500 kW	800 MWh
Walton WTP Solar	Solar	Long-Term	1MW	1,600 MWh
Auburn Lake Trails WTP Solar	Solar	Mid-term	1MW	1,600 MWh

7.4 South Tahoe Public Utility District

7.4.1 Overview

The South Tahoe Public Utility District (STPUD), a public agency established in 1950, supplies drinking water and provides sewage collection, treatment, and export to protect Tahoe's delicate ecosystem.

STPUD serves portions of El Dorado County within the Tahoe Basin, and its service area extends from Hwy. 89 north to Cascade Lake; Hwy 89 south to Luther Pass; Hwy. 50 East to Nevada state line; and, Hwy. 50 West to Echo Lake. STPUD has over 14,000 residential water connections, 660 commercial and government sites, and 16 active wells. Additionally STPUD has a recycled water export system which transports an average of 4.5 MGD of recycled water 27 miles to the Harvey Place Reservoir in eastern Alpine County where it is stored for agricultural use.

The projects identified below will be analyzed in more detail under a future Energy Commission grant-funded project currently underway titled, "Renewable Energy Regional Exploration Study: PIR-12-502". It is expected that many of the numbers provided below will change as part of that study.

7.4.2 Renewable Energy Projects Identified

Table 29: Summary of Renewable Energy Projects Identified for STPUD

Project Name	Type of Renewable	Term (Near, mid or long)	Capacity	Potential Generation
STPUD C-Line Upper Project	RPS-Qualified Hydro	Mid-term	1.0 MW	8,000 MWh/year
STPUD C-Line Upper Project with Energy Storage Sub-Option	RPS-Qualified Hydro	Mid-term	1.5 MW	8,000 MWh/year
STPUD C-Line Lower Project	RPS-Qualified Hydro	Long-term	1.5 MW	13,000 MWh/year
STPUD C-Line Lower Project with Energy Storage Sub-Option	RPS-Qualified Hydro	Long-term	2.0 MW	13,000 MWh/year
STPUD B-Line Load Shifting Project	Energy Efficiency	Long-term	N/A (Load Shifting)	
STPUD Micro-Hydro Units on Existing PRVs	RPS-Qualified Hydro	Mid-term	5 to 25 kW	20 to 100 MWh/year*
STPUD Small Hydro Project at Diamond Valley Ranch	RPS-Qualified Hydro	Mid-term	55 kW	450 MWh/year
STPUD Solar Project at Diamond Valley Ranch (up to hundreds of acres)	Solar	Near-term	10 MW+	16,000+ MWh/year
STPUD Wind Generation Project at Diamond Valley Ranch (up to hundreds of acres)	Wind	Long-term	TBD	TBD
Angora Ridge Pumped Storage Project	Pumped Storage	Mid-term	N/A (Grid Balancing)	

7.5 Grizzly Flats Community Services District

7.5.1 Overview

The Grizzly Flats Community Services District (GFCSD) water system serves approximately 1,228 parcels. GFCSD has about 600 residential customers. Elevations of the service area vary from 3,600 feet at the southwesterly end of the area to 4,200 feet at the northeasterly end.

District Facilities:

- Primary water production from diversions of North Canyon Creek & Big Canyon Creek
- 31ac-ft HDPE lined raw water reservoir
- 2 Water Treatment Plants
- 2 Filter Units
- 4 Storage Tanks
- Distribution system is mainly by gravity, pumping is required in limited areas
- 150 Fire Hydrants

7.5.2 Renewable Energy Projects Identified

The survey response from GFCSD indicated that the greatest potential for renewable energy in their system includes the use of solar power at their water treatment plant facility.

Hydroelectric options for GFCSD were previously explored as part of the El Dorado County Hydro Development Options Study. The projects identified were dependent on portions of the facility being constructed as part of another project in order to reduce the capital costs. To date these projects have not been scheduled. The projects are considered long term and should be reconsidered as other improvements move forward. GFCSD is mainly fed by gravity and does not require the use of pressure reducing stations. Due to the size of GFCSD and the relatively low elevation drop from tanks to the system in-conduit hydro projects are not feasible.

Table 30: Summary of Renewable Energy Projects Identified for GFCSD

Project Name	Type of Renewable	Term (Near, Mid or Long)	Capacity	Potential Generation
Water Treatment Plant Solar	Solar	Near-term	22kW	34,760kWh
Spring Flat Reservoir (400 ac-ft)	RPS-Qualified Hydro	Long-term	N/A	<3MWh
Grizzly Flat Pipeline/Intertie	RPS-Qualified Hydro	Long-term	N/A	<1MWh

7.5.3 Increased Efficiency Potential

GFCSD recently completed a Water System Improvement Project in 2012 funded through the USDA Rural Community Grant Program that included improvements at their treatment plant, lining the storage reservoir and pipeline distribution improvements. Additionally, GFCSD has four pump stations; Tyler Tank Pump Station, South View Pump Station, Winding Way Pump Station and Forest View Pump Station. All pump stations are associated with a storage tank. GFCSD has indicated that the pumps do not require upgrades at this time. GFCSD had identified the need to reconfigure the piping at the Tyler Tank; however, the project was not expected to yield any improvements to the pump efficiency.

7.6 Tahoe City Public Utility District

7.6.1 Overview

The Tahoe City Public Utility District (TCPUD) maintains sewer and water infrastructure on the west side of Lake Tahoe in both Placer and El Dorado Counties. The boundaries of TCPUD extend from Emerald Bay to Dollar Hill, and along the Truckee River to the Nevada County line. The service area encompasses over 31 square miles. TCPUD facilities include:

- Approximately 3,926 service connections
- 5 separate service areas
- 11 tanks (1 @ 0.28mg, 1 @ 0.50mg, 3 @ 0.56mg, 6 @ 3.7mg)
- groundwater wells
- 1 active lake intake/treatment plant
- 6 booster pump stations
- 67 miles of water lines

7.6.2 Renewable Energy Projects Identified

A response was not received from TCPUD in regards to renewable energy opportunities identified in their district. A review of their facilities indicates that the greatest potential for renewables may be in solar projects at their treatment plant. There may be opportunities also for load shifting and grid balancing through operations changes and small scale pumped storage hydroelectric. The area has less elevation change than some of the larger districts and therefore has lower potential for hydroelectric facilities. Additionally, there is potential to add storage facilities for fire suppression and utilize the storage facilities for demand management to deliver water by gravity during the day and pump to storage at day during off-peak hours. This type of project has been proposed by outside consultants and would be a long term project for TCPUD to consider. It is recommended that TCPUD consider opportunities for solar to offset usage at some of their larger facilities such as their treatment plant.

7.7 City of Placerville

7.7.1 Overview

The City of Placerville is located along Highway 50 in central El Dorado County. Its city boundaries extend beyond its water service area (EID is solely responsible for the periphery area). The City serves a population of about 10,900, with 3,025 active service connections. All service connections are metered, and water uses include residential, commercial, and unbilled municipal water use. The City includes 8 separate service zones.

The City receives 100% of its water from EID and connects to EID's water supply through multiple water meters. The City's water distribution system consists of 37 miles of pipe of 4-inch or greater diameter, and 2 miles of pipe of less than 4-inch diameter. The City has three pump stations; one pump station is a hydro-pneumatic system, and the other two are small privately-operated facilities installed in new developments to provide adequate water pressure.

7.7.2 Renewable Energy Projects Identified

A response from the City indicated that they had previously considered solar power at their main parking structure and WWTP near Weber Creek; however it was determined to not be economically feasible at the time. Information was not provided on the potential generation of the facilities. The City also indicated that they were considering efficiency improvements at their pump stations however the potential for improvements were low. It is recommended that the City continue to pursue potential solar energy as a renewable source and consider grant or low interest loan opportunities to increase the economic feasibility of the projects.

7.8 Agencies outside of El Dorado County

7.8.1 Heavenly Ski Resort

7.8.1.1 Overview

Heavenly Ski Resort spans the California-Nevada border in South Lake Tahoe and owns the largest snow-making system on the West Coast. Heavenly Ski Resort is owned by Vail Resorts, the premier mountain resort company in the world and a leader in luxury, destination-based travel at iconic locations.

7.8.1.2 Renewable Energy Projects Identified

Table 31: Summary of Renewable Energy Projects Identified for Heavenly Ski Resort

Project Name	Type of Renewable	Term (Near, Mid or Long)	Capacity	Potential Generation
Heavenly Ski Resort CA Base Pump Station	RPS-Qualified Hydro	Near-term	60 kW	175 MWh/year

7.8.2 Amador Water Agency

7.8.2.1 Overview

Amador County is located approximately 45 miles southeast of Sacramento in the foothills of the Sierra Nevada Mountains. The county is bordered on the north by the Cosumnes River and on the south by the Mokelumne River. The main water purveyor in the western portion of Amador County is Amador Water Agency (AWA). AWA was formed in 1959, and currently provides both water and wastewater services. It is comprised of four service areas: Amador Water System (AWS), Central Amador Water Project System (CAWP), La Mel Heights, and Lake Camanche Village (LCV). AWA serves a total population of 25,640, with about 7,465 retail service connections and about 5,535 wholesale service connections.

AWA utilizes a combination of both surface water and groundwater. Both AWS and CAWP receive surface water from the Mokelumne River. AWA has two water treatment plants located within the AWS service area. Because AWS supplies both potable and raw water, AWS includes 120 miles of potable water mains and 23 miles of conveyance canals for raw water. CAWP includes 90 miles of potable water piping for both wholesale and retail services. LCV has 4 groundwater wells treated with on-site chlorine injection, 6 storage tanks, and 2 pump stations. La Mel Heights has 2 groundwater wells, and the groundwater is treated at a water treatment plant.

7.8.2.2 Renewable Energy Projects Identified

Table 32: Summary of Renewable Energy Projects Identified for AWA

Project Name	Type of Renewable	Term (Near, mid or long)	Capacity	Potential Generation
Tanner Powerhouse at WTP	RPS-Qualified Hydro	Near-term	110 kW	560 MWh/year
Ione Powerhouse	RPS-Qualified Hydro	Near-term	250 kW	1,566 MWh/year
Tanner WTP and AWA Office Solar	Solar	Long-term	1.0 MW	1,600 MWh/year

7.8.3 City of Folsom

7.8.3.1 Overview

The City of Folsom (City) covers about 15,170 acres. It is bordered by the El Dorado County line to the east, Folsom Reservoir and Folsom State Prison to the north, Lake Natoma and the American River to the west, and Highway 50 to the south. The area north of the American River and Folsom State Prison receives water from San Juan Water District (SJWD). The City has four distinct service areas: Folsom Service Area (West), Folsom Service Area (East), Ashland Area,

and Nimbus Area. To supply all of the Ashland Area's water, the City purchases wholesale water from SJWD.

All of the water supplied to the area south of the American River passes through the City of Folsom Water Treatment Plant, which has a capacity of 50MGD. Service elevations throughout the entire distribution system range from below 170 feet to 790 feet. Static pressure in the system ranges from about 32 to 114 psi, depending on the pressure zone. The distribution system south of the American River includes 250 miles of pipelines, ranging from 4 inches to 30 inches in diameter. The City operates a total of 18 PRV stations and one flow control valve station in its service area. There are ten treated water storage tanks/reservoirs located throughout the distribution system, with an additional two that are located at the City's WTP. In total, the 12 storage tanks have a capacity of 34.5 MG. The City also operates six booster pump stations, three of which are located at the WTP. These pump stations are equipped with multiple pumps to meet the varying demands in the pressure zones.

7.8.3.2 Renewable Projects Identified

A response was not received from the City of Folsom in regard to current renewable opportunities. The City of Folsom currently owns and operates a solar project at their sports complex which offsets energy usage at the site. The City should consider the use of solar at their treatment facilities. There is significant opportunity for solar usage at the new development south of Hwy 50 that was recently annexed into the City. The City also has some opportunity for small in-conduit hydroelectric facilities along their supply pipeline from Folsom Lake, which also could be modified for small scale pumped storage for grid balancing. It is recommended that the City consider these opportunities in the future.

7.8.4 Tuolumne Utilities District

7.8.4.1 Overview

Tuolumne Utilities District (TUD) was formed in 1992 as part of a state-mandated consolidation of local water systems. Today, TUD serves a population of 28,997 through a total of 11,428 service connections. TUD's service area encompasses a number of towns and communities, including Jamestown, Sonora, Columbia, Big Hill, Standard, Soulsbyville, Tuolumne City, Twain Harte, and Sugar Pine, all of which are located in Tuolumne County. The treated water system consists of 17 separate distribution systems with irregular boundaries.

TUD is heavily reliant on the ditch system, which was originally designed in the 1850s. The ditch system consists of 57 miles of open channels flowing from the Lyons Reservoir, which is operated by PG&E. Some water from the ditch system supplies raw water to customers for agricultural needs, while some of the water is treated by TUD to provide potable water. TUD also draws surface water from small reservoirs in the area and groundwater from its 26 wells. TUD owns and operates 14 surface WTPs and 7 well WTPs. TUD also has 71 treated water storage tanks, though 61% of these are in fair or poor condition. TUD's water distribution system includes 9 reservoirs, 31 pumps, and 20 hydroelectric systems.

7.8.4.2 Renewable Projects Identified

A response from TUD indicated that they have previously considered additional hydroelectric facilities including use of an existing Pelton Wheel at a facility that does not have an agreement with PG&E for power generation. Additional information on opportunities within TUD was not provided at this time. A brief review of their system indicates that there is potential for additional solar energy systems at their treatment plants. It is recommended that the District continue to consider opportunities for both solar and hydroelectric energy projects.

7.9 Projects Identified for Further Analysis

Based on the responses received from the agencies and information available at this time the following projects have been identified for further analysis. Additional information and detail is provided in *TM#9 – Preliminary Engineering, Economic and Environmental Analyses of Recommended Near and Mid-term System Alternatives*.

- EID – Pleasant Oak Main PRS 5 – Tank 7 Hydroelectric (Update to previous analysis)
- EID – Pleasant Oak Main – Reservoir B
- EID – El Dorado Main 2 PRS 1 (Tank 3)
- EID – Oro Loma Pump Station Efficiency Improvements
- GDPUD – Sandtrap Siphon
- GFCSD – WTP Reservoir Solar
- AWA – Tanner Powerhouse Hydroelectric

A number of the projects listed above are currently in various stages of the design and permitting process including EID – Tank 7 Hydroelectric, GDPUD – Sandtrap Siphon (in permitting), STPUD – Small Hydroelectric at Diamond Valley Ranch and AWA – Tanner Powerhouse Hydroelectric. TM#9 (Appendix A) provides an overview of the projects along with the current status.

CHAPTER 8:
Conclusions and Recommendations

8.1 Renewable Energy Opportunities and Projections in El Dorado County

8.1.1 Overview of all renewable energy opportunities identified

As shown in the previous chapters of this report and the attached TMs there are significant opportunities throughout El Dorado County for its water purveyors to implement renewable energy projects of varying sizes. Due to extensive elevation changes that exist in the County this and past studies have found that the main opportunity for renewable energy is hydroelectric power. The topography of the County necessitates the use of energy dissipating devices. The opportunity exists to capture this lost energy through small hydroelectric projects.

Additionally, the other main source of renewable energy generation potential is solar power. Solar generation is a renewable source that can be relatively easy to integrate into an existing water or wastewater facility. The nature of the facilities does not require changes to the operation of the system. However, solar does require significant area. While many water and wastewater facilities have extra land that can be utilized for this purpose there are often other long term plans for that area.

However, there are significant challenges and impediments that often make these projects difficult to implement. The following section summarizes the impediments and challenges identified during this study.

8.1.2 Impediments and challenges to implementation identified

8.1.3 Current Impediments to Hydroelectric Projects

The following are examples of impediments that continue to hinder small hydroelectric development within existing water and wastewater systems:

- **Interconnection with the electric utility causes many projects to be economically infeasible –** Many hydroelectric sites only have single phase (two-wire) power lines in the immediate project vicinity for interconnection to the electric utility grid, but hydropower requires 3-phase (three-wire) power line interconnections; upgrading the electric utility power lines from single phase to 3-phase is expensive (roughly $80/foot), quickly causing the project to become economically infeasible unless 3-phase power is in close proximity. Lack of nearby interconnection to 3-phase power is even more of an impediment for several existing dams in rural portions of the Sierra Nevada (e.g., Caples Lake along Highway 88 and Stumpy Meadows Dam along Wentworth Springs Road) where projects otherwise would be economically feasible to develop. In the latter two cases, there is no nearby single phase power either, and constructing a completely new power line, even along existing roads for distances of only a few miles, makes the projects economically infeasible.

- **Variability of flow and pressure for in-conduit projects make design and operations more complex –** Many existing raw and treated water and wastewater systems operate using simplistic pressure regulating valves and water level sensors that do not require active or remote monitoring or controls. Adding an in-conduit hydroelectric system requires electrical, mechanical, and communications equipment that must interface with the existing water system, have remote monitoring, and be managed by water system operators that may or may not have the training, education, or experience. This increases risks to system reliability, worker safety, and maintenance costs that often are not considered acceptable by water managers.
- **Power generation is secondary to providing a safe and reliable water supply –** As a water purveyor, small hydroelectric energy generation is secondary to providing a reliable source of safe drinking water to customers. Any changes to the current delivery system, operations, or schedule that could adversely affect the water supply will be considered detrimental to the primary objective. The proposed generation facility design must demonstrate that no adverse impacts to the delivery system will occur and that incorporation of the facility does not create complex operational requirements.
- **Small hydro additions to existing water systems are dependable and carbon-free, have negligible environmental effects, and are also dispatchable with storage, but these values are not reflected in current energy pricing policy or rates –** There are limited incentives for in-conduit and other small hydro relative to other renewable resources, including those that are intermittent and cannot be dispatched. The economic life of small hydro is double (40-plus years) that of most other renewable energy resources including solar and wind. In-conduit hydro has relatively negligible environmental impacts compared to other renewables because construction and operation are within/along existing water and wastewater systems. Despite these relative benefits of in-conduit hydro, public energy policies and pricing do not reflect these significant public policy advantages of small hydroelectric systems.
- **Power generation requires understanding of the electric utility and grid operations –** Many of the water purveyors without hydroelectric operations do not have a full understanding of the opportunities and benefits of integrating energy generation into their systems. Historically, but to a lesser extent today, water systems have operated to deliver clean water to customers 'on-demand', without consideration of the electric grid energy supply and demands. A greater understanding of the benefits to the utility grid and in turn to the purveyor will reduce resistance to pursuing many small hydro projects within existing water and wastewater systems.
- **Aging water infrastructure adds costs for development of discretionary small hydro projects –** Often, developing hydro generation facilities requires upgrades to water systems that are nearing the end of their economic life (e.g., the new hydroelectric equipment requires upgrades to the water systems for structural integrity, communications and controls, and system reliability). Many water purveyors do not have the financial resources to add discretionary investments (i.e., small hydro projects)

in addition to rebuilding the water systems, therefore, the added costs to invest in small hydro are not supported in water purveyor decision making.

8.1.4 Current Impediments to Solar Projects

The following are examples of impediments that continue to hinder solar development within existing water and wastewater systems:

- **High capital costs make many projects economically infeasible –** While advances in solar technologies have reduced the capital costs over time the initial costs continue to remain significant. Most solar projects that are implemented within water and wastewater facilities have required grant funding for up to 50% of the capital cost. Without such subsidies most of these projects are not economically feasible.
- **Significant Area Requirements –** Solar facilities require a large area of land for set up of equipment. This area is then dedicated to that facility in the future. Many water and wastewater facilities use their additional area for equipment storage or are saving the area for future expansions. Available land for solar fields is a problem for purveyors in the foothills and mountainous regions.

8.2 Operational and Equipment Efficiency Opportunities in El Dorado County

8.2.1 Overview of all efficiency improvements identified

The significant elevation changes in El Dorado County warrant the use of pumping facilities to move water between facilities. A survey of the water purveyors did not yield a significant response for the need of energy efficiency improvements. However, it is known that like many areas the infrastructure in El Dorado County is aging. As shown in the EID case study, aging of equipment can reduce efficiencies by up to 20%. Considering the El Dorado County and surrounding area water purveyors utilize over 100 pumping stations (many with multiple pumps) the energy inefficiencies due to aging pump stations is significant. While it is unknown how many of these system could also benefit from a pump change to better match system requirements, based on EID's case study that number is likely also significant.

Other energy efficiency opportunities considered would rely on demand management strategies. Demand management strategies can be difficult to identify within systems without significant study of operations. The case studies of EID and GDPUD show that the demand management opportunities are limited without the addition of significant storage facilities. The incremental cost of added storage was found to be quite high relative to the benefits.

8.2.2 Impediments and challenges to implementation identified

The following are examples of impediments that make implementation of operational and equipment efficiency projects within existing water and wastewater systems difficult:

- **Lack of accurate information –** Most utilities do not have enough flow meters and pressure gages within their systems to accurately determine system demand and supply

requirements long term. Often the location where information is needed (where a system splits flow or in the middle of a pipeline) accurate information cannot be obtained in the current system.

- **Challenges to implement operational changes –** Operations staff at most water and wastewater facilities are dedicated to providing customer service and have developed a working operations system over time. Most are reluctant to try new operational scenarios that have not been previously tested. It can be difficult to implement a new operational plan based on the need to reduce energy costs. Operational staff will often challenge the need for the changes.

8.3 Recommendations

8.3.1 Water Purveyor Challenges and Solutions

Based on the challenges and impediments identified above the following solutions are recommended:

1. Interconnection regulations and costs must be reduced. A partnership with the utility provider needs to emphasize the need to bring these costs and requirements for interconnection to a more reasonable level.
2. Additional incentive and grant programs are needed for both hydroelectric and solar projects. These programs could include low interest loans as well.
3. Energy pricing and regulations need to reflect the benefits of hydroelectric and solar projects.
4. Flow meters and pressure gages need to be added in water systems to more accurately estimate potential for energy generation and efficiency improvements.

8.3.2 Recommendations for future programs and studies

While many challenges and impediments towards renewable energy development were identified, the environment for renewable energies continues to remain positive in California and regulations continue to change. Programs such as the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) program that allows a project to feed directly into the power grid and offset that credit on up to 50 "benefiting accounts" are providing more financial incentives to make projects economically feasible. At the same time expedited permitting for FERC and CEQA permit exemptions for existing facilities allow some projects to clear permitting hurtles that previously made them infeasible. These are examples of progress that has been made toward achieving renewable energy goals.

Additionally, as our infrastructure continues to age, the need for replacement of facilities is on-going. As these systems require replacement the opportunity is provided to do so with the addition of renewable energies in mind. Often a project that was not feasible on its own can become more feasible if some of the infrastructure costs are shared between projects. Water

purveyors are encouraged to reevaluate renewable energy projects on a continual basis to account for changes in programs and existing infrastructure.

The following future programs and studies are recommended for implementation.

1. Grant programs related to hydroelectric and solar – additional grant programs are necessary to make more projects feasible in the future.
2. Additional study of water systems for potential efficiency improvements – as mentioned it is not clear how many pump stations are in need of replacement due to age or inefficiency.
3. Additional studies that also take into account potential operational changes – an example is EID's recent IWRMP which emphasizes the use of gravity flow systems over pumping facilities in an effort to reduce future energy consumption.
4. Re-examine the "top 10" hydroelectric projects previously identified in the El Dorado County 2009 Hydroelectric Development Options Study based on the new regulatory and financial programs.
5. Continue to re-examine solar generation opportunities as financial programs (including grants) become available.
6. As aging infrastructure is replaced incorporate additional monitoring facilities (flow meters and pressure gauges) in order to allow for additional assessment in the future.
7. As aging infrastructure is replaced continue to reevaluate projects that were not cost effective due to the high costs to replace older facilities. New facilities should also be evaluated for future energy generation opportunities and designed to take advantage of these future opportunities if financially feasible.

GLOSSARY

Term	Definition
A	Amperes
A6 Rate Schedule	According to PG&E, this time-of-use schedule applies to single-phase and polyphase alternating current service, that is not applicable to those eligible for a residential or agricultural schedule.
AB	Assembly Bill
AB 32	CARB Scoping Plan Measures for Water, Electricity, and Other Sectors
AMT	Alternative Minimum Tax. A tax calculation that adds certain tax preference items back into adjusted gross income.
AWA	Amador Water Agency
Bladder Tank	A flexible and mobile container made from reinforced PVC tarpaulin to hold water.
BV	Black & Vetch
CARB	California Air Resources Board
CAWP	Central Amador Water Project
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CPH Systems	Combined Heat and Power Systems. Systems that generate electricity and useful thermal energy in a single, integrated system, by recovering heat that is normally wasted in conventional power generation.
CPUC	California Public Utility District
CSI	California Solar Initiative
DCWTP	Deer Creek Water Treatment Plant
EDCWA	El Dorado County Water Agency
EDH	El Dorado Hills
EDHWTP	El Dorado Hills Water Treatment Plant
EDU	Equivalent Dwelling Units

EID	El Dorado Irrigation District
EIR	Environmental Impact Report
Electrical Grid	A network of synchronized power providers and consumers that are connected by transmission and distribution lines and operated by one or more control centers.
E-ReMAT	Electric-Renewable Market Adjusting Tariff
FERC	Federal Energy Regulatory Commission
FIT	Feed-In Tariff
FLIPS	Folsom Lake Intake Pump Station
Fuel Cells	A device that produces a continuous electric current directly from the oxidation of a fuel, as that of hydrogen by oxygen.
GDPUD	Georgetown Divide Public Utility District
Geothermal Heat Pumps	Using heat found in outside air, geothermal heat punps rely on the relatively constant heat of the earth (thermal energy) to provide heating, air conditioning and, most commonly, hot water.
GFCSD	Grizzly Flats Community Services District
GHG	Greenhouse Gas
GHI	Gold Hill Intertie
GPM	Gallons Per Minute
Head	The linear vertical measurement of the maximum height a specific pump can deliver a liquid to the pump outlet.
HP	Horsepower
HR 1424	Energy Improvement and Extension Act (2008)
HR 678	Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act (2008)
IEPR	Integrated Energy Policy Report
In-Conduit Hydroelectric Facility	A method of using mechanical energy of water as part of the water delivery system through man-made conduits to generate electricity.
IOU	Investor-Owned Utility
IS/MND	Initial Study/Mitigated Negative Declaration

ITC	Investment Tax Credit
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
LCV	Lake Camanche Village
MG	Million gallons
MGD	Million gallons per day
Microturbine	Small electricity generators that burn gaseous and liquid fuels to create high-speed rotation that turns an electrical generator.
MND	Mitigated Negative Declaration. A Negative Declaration that incorporates mitigation measures into the design of the project or establishes measures as conditions of project approval to avoid significant effects.
MPOs	Metropolitan Planning Organizations. Federally mandated and federally funded transportation policy-making organization in the United States that is made up of representatives from local government and governmental transportation authorities.
MW	Megawatt
NMP	Net Metering Program
NPSH	Net Positive Suction Head. The NPSH available to a centrifugal pump combines the effects of atmospheric pressure, water temperature, supply elevation and the dynamics of the suction piping.
NPV	Net Present Value. In a time series of cash flows, net present value is the sum of the present values, which are future amount of money that have been discounted to reflect the current value, of individual cash flows.
O&M	Operation and Maintenance
OPR	Office of Planning and Research
ORPS	Oak Ridge Pump Station
Passive Solar System	An approach in which the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun, to use of the sun's energy for the heating and cooling of living spaces.
PAT	Pumps as Turbines. A micro hydro plant in which the water flows back through a pump, the impeller runs in reverse, and the pump functions as a

	turbine
Payback Period	The length of time required for an investment to recover its initial outlay in terms of profits or savings.
PDP	Peak Day Pricing
PG&E	Pacific Gas and Electric Company
PIER	Public Interest Energy Research
POM	Pleasant Oak Main
PPR	Program Participation Request
PRS	Pressure Reduction Station
PRV	Pressure Reducing Valve
PS	Pump Station
Regenerative Power Converter	A unit that transforms DC regenerative electrical energy into fixed frequency utility electric power.
RES-BCT	Renewable Energy Self-Generation Bill Credit Transfer
RPS	Renewables Portfolio Standard
RW	Recycled Water
SACOG	Sacramento Area Council of Government
SB	Senate Bill
SB 375	California's Sustainable Communities and Climate Protection Act (2008)
SCE	Southern California Edison
SCS	Sustainable Communities Strategy
SDGE	San Diego Gas and Electric
SJWD	San Juan Water District
SMUD	Sacramento Municipal Utility District
Solar PV System	Solar Photovoltaic System. A system that uses photovoltaic cells, which are specialized semiconductor diodes, to directly convert sunlight into electricity.
Solar Thermal	A system that uses solar thermal collectors to absorb the sun's thermal energy, which can be used to heat water and other fluids, or can power a

System	solar cooling system.
Special-Status Species	A general term that refers to all of the species that the California National Diversity Database (CNDDB), a computerized inventory of location information on the most rare animals, plants, and natural communities in California, is interested in tracking, regardless of their legal or protection status.
SRF	State Revolving Fund
STPUD	South Tahoe Public Utility District
TCPUD	Tahoe City Public Utility District
Three-phase Power	Power systems have at least three conductors carrying AC voltages that are offset in time by one-third of the period.
TM	Technical Memorandum
TOD Factors	Time-of-Day factors. Adjustments which recognize the higher value of power supplied during the on-peak hours, and the lower value of power supplied during the off-peak hours.
TUD	Tuolumne Utilities District
UV	Ultraviolet
VAC	Volts Alternating Current
VFD	Variable Frequency Drive
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant

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APPENDIX

Appendix A: El Dorado County Water Systems Energy Generation Storage, Efficiency, Demand Management & Grid Support

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