MokeWISE Program Scope of Work:
Project 7f: Reliability and Replacement Assessment for Dams at Blue and Twin Lakes

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water purveyors in Amador County and northern Calaveras County are concerned with short and long-term water supply reliability in conditions of drought, curtailments by the State Water Resources Control Board, and climate change. These water purveyors want to firm up existing water supply reliability for their existing rights and contracts to better prepare for increasingly long droughts and adapt to climate change over the next 50-75 years. Of particular concern is the receding snowpack with drought and climate change, which is a natural reservoir that slowly melts during the summer refilling reservoirs.

The purpose of the study is to determine the engineering and environmental feasibility of maintaining or improving the function of Upper and Lower Blue Lakes and Twin Lakes dams. A considerable amount of Amador Water Agency's pre-1914 water right is backed up with water stored in these small reservoirs. A problem has been identified with the safety of these dams. PG&E has reported to the Federal Energy Regulatory Commission (FERC; Letter to Frank Blackett, Regional FERC Engineer, March 10, 2014) that a geotechnical consultant has reported the Upper Blue Lake Dam is likely to fail in an earthquake:

> "…*the saturated portion of the Upper Blue dam is likely to fully liquefy during postulated seismic shaking…*"

One potential earthquake source is Waterhouse Peak Fault (PG&E Letters to Frank Blackett, Regional Engineer, FERC, Jul. 31 & Sept. 30, 2014), which is very close to the Blue Lake dams. PG&E is continuing studies of this fault, and they are answering questions from FERC. The dams on Lower Blue and Twin Lakes appear to have the same soil characteristics and potential for liquefaction as Upper Blue Dam. The loss of water stored in these reservoirs would be a major problem for Amador County. This water would be lost if State or Federal dam safety regulators order these reservoirs drained for safety. The combined capacity of these three reservoirs is 13,176 ac-ft. Loss of water in these dams from an earthquake or from an order to drain them for safety by state or federal dam regulators could require AWA to severely restrict or ration water to customers during an extended drought or a State ordered drought curtailment of senior water right.

One of the questions raised by FERC (Nov. 25, 2014 FERC letter to PG&E) is why the recommended strengths from triaxial lab tests yield significantly higher values than the triaxial tests documented in the 1999 Woodruff report.

At present, PG&E nearly empties these reservoirs in the fall because of safety issues in the winter. Replacing these old dams could accomplish the goals of maintaining stability during an earthquake and improving local water supply reliability by storing "carry-over" water through the winter. There could also be a benefit if the reservoir storage capacity were increased slightly.

Environmental stakeholders in the MokeWISE process are concerned that unnecessary or poorly planned water development could have harmful environmental, social, economic and recreational impacts, particularly related to aquatic resources. They are concerned that premature water development may create a structural and financial imbalance between water infrastructure and other infrastructure (including transportation and land-use), incentivizing regional development to pay for water infrastructure. They are concerned that new surface storage development may create precedent for a new dam building era in California in place of more environmentally appropriate approaches to water supply and water use. Environmental stakeholders are also concerned that uncertainty over future water supply may cause water purveyors to oppose long-term river protection, including Wild & Scenic designation for portions of the upper Mokelumne River. Environmental stakeholders thus believe that this project may offer opportunities to avoid many undesirable consequences by firming up the reliability and possibly increasing the operational flexibility of these existing surface storage facilities.

Environmental stakeholders also have a general interest in assuring that existing hydropower infrastructure and its operation are safe and reliable.

Some non-governmental organizations are concerned that the ultimate use of the water for future development may have unnecessary significant impacts on the environment that should first be reduced through land use planning and pollution prevention. If the dam replacement projects ultimately involve substantial water utility investments, these organizations see the need for the upcountry water agencies to practice transparent decision-making processes, and to complete long-range financial planning, with appropriate ratepayer involvement, prior to engaging in such a project.

Water agencies have an interest in protecting the reliability of water available to them under existing contractual agreements for water allocated pursuant to senior water rights, in order to assure water supply reliability for their customers and to continue to meet downstream obligations. Water agencies are generally willing to participate as a part of a broad coalition of interested parties seeking water supply and/or environmental benefits from this project.

Background Information

Pacific Gas & Electric (PG&E) owns and operates Upper and Lower Blue and Twin Lakes Reservoirs. Their consultant, AMEC, has been conducting seismic stability studies on Upper Blue Lake dam. In December 2013, PG&E submitted a field investigation report to FERC by AMEC with data on field borings in Upper Blue Lake dam and its soil properties. Since that time, AMEC through PG&E has performed additional dam stability analyses based on the recommended properties. PG&E submitted a report to Federal Energy Regulatory Commission (FERC) on March 3, 2014. These reports are classified by PG&E as "Critical Energy Infrastructure Information (CEII), Do Not Release." In the report, AMEC assesses

seismic stability using ground motions from two separate potential seismic sources. In a PG&E letter to FERC, they disclosed that AMEC has found Upper Blue Lake dam is likely to liquefy in an earthquake. FERC acknowledges the risk of dam failure in their letter to PG&E on November 25, 2014, where they refer to a

"Category III Potential Failure Mode (PFM) associated with the dam's (Upper Blue Lake) performance under extreme seismic loading, and recommendations of the Ninth Independent Consultant."

PG&E also has consultants studying the Waterhouse Peak Fault, which may be located on the east side of the lake. PG&E reported to FERC in July 2014, that the Waterhouse Peak Fault is considered Active by California's definitions. They have researched other sources of earthquakes and concluded that the Carson Fault, a part of the Sierra Nevada Frontal fault system, continues to have the highest slip rate of nearby faults and could generate a Magnitude 7.1 earthquake with a minimum possible acceleration at the dam of 0.38g. The California Geologic Survey has mapped a potential earthquake fault approximately 6 miles to the east toward Markleeville.

All three of the dams on these lakes are classified as an ERRK (earth and rock) type by the California Division of Dam Safety. They appear to be constructed of a similar silty, sandy soil. The following information is from the State Division of Dam Safety:

Upper Blue Lake Dam is in Alpine County, is owned by PG&E, was constructed in 1901, has a capacity of 7,576 acre-feet (AF), an area of 354 acres, a drainage area of 2 square miles, a crest elevation of 8,131 feet, is 31 feet high and 790 feet long, and is a homogenous earth embankment.

Lower Blue Lake Dam is also in Alpine County, is owned by PG&E was constructed in 1903, has a capacity of 4,300 AF, an area of 157 acres, a drainage area of 4.8 square miles, a crest elevation of 8,055 feet, and is 48 feet high and 1,050 feet long.

Twin Lakes Dam is in Alpine County, is owned by PG&E, was constructed in 1902, has a capacity of 1,300 AF, an area of 114 acres, a drainage area of 0.8 square miles, a crest elevation of 8,171 feet, is 22 feet high and 1,260 feet long, and is classified as an ERRK.

Total storage capacity of these three reservoirs is 13,176 AF.

There are at least 2 listed threatened or endangered species in the area. PG&E monitoring shows that Yosemite Toad-Western Toads were present at Upper Blue Lake Reservoir and Twin Lakes in 2014 (January 2015). Sierra Nevada Yellow-Legged frogs were also found at Upper Blue Lake. Populations or modifications of the habitats of these species would need to be addressed and provided for in the feasibility and environmental analysis.

Project Information

Project Description

The Blue and Twin Lakes Dams Reliability and Replacement Assessment will:

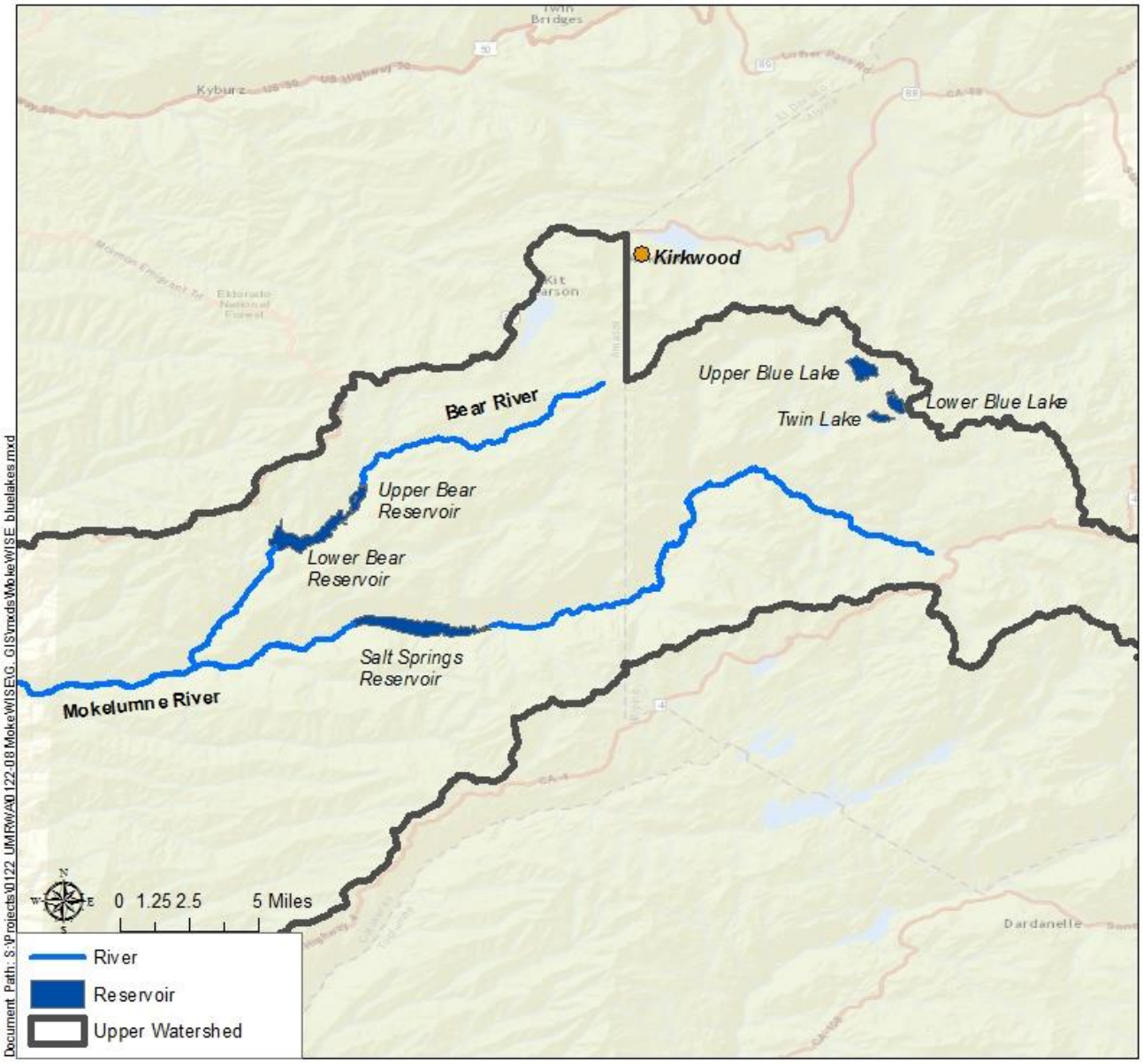
- Review existing engineering, geology, and environmental information on the area and dams;
- Conduct geotechnical field and laboratory investigation and testing to independently determine the safety of these dams during earthquakes and without lowering the water levels during the winter;
- Review the long-term reliability and risk of losing storage in these reservoirs;
- Identify and evaluate feasible replacement options and costs;
- Identify legal alternatives related to these dams and the water stored within them;
- Evaluate the feasibility and changes required to allow water to be stored safely during winter;
- Evaluate the hydrology of the area, including under conditions of drought and climate change. The study will identify the amount, or possible amounts, of unappropriated water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types;
- Evaluate potential impacts on threatened and endangered aquatic and other species;
- Evaluate the feasibility and cost-benefit of increases in water storage for domestic use by agreement or increased capacity;
- Produce an Engineering Feasibility Analysis of alternatives and cost-benefits to increase seismic stability and increase storage;
- Assess and document the existing environmental conditions and potential impacts of replacing the 3 dams. Include consideration of water, environmental, social and recreational opportunities and impacts;
- Evaluate dam replacement options that will protect cultural, recreational, and historic resources;
- Evaluate dam replacement options that will continue the flow regime in PG&E's current FERC license and incorporated settlement agreement;
- Identify the sources of the water supply, the nature and amount of the proposed water uses, and the locations and the descriptions of the diversions and the storage facilities. The study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural purposes;
- Explain how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water;

- Include consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study;
- Involve interested public and stakeholders, including the Project 137 Ecological Resources Committee, in all phases of the project, from design through final project approval with the public and stakeholders to review the draft and work. Attempt to resolve any identified concerns;
- Develop a process through which interested stakeholders and members of the public could review material related to the project when that material is classified "Critical Energy Infrastructure Information" by PG&E and the Federal Energy Regulatory Commission;
- Identify ongoing means of providing timely information and meaningful opportunities to participate for ratepayers and other interested parties. After the study, but before the utilities make further legal and financial commitments, funding applications, or permit applications associated with reservoir reoperation, the utilities will indicate their willingness to provide such a process;
- Recommend next steps.

Project Location

This study includes areas located within Alpine county as shown in **Figure 1**.

Figure 1: Blue and Twin Lakes, Alpine County



Project Sponsor

Amador Water Agency is the lead project sponsor.

Scope of Work

Task 1. Gather and Review Information

Subtask 1.1 Review Existing Information

Review existing information on engineering, geology, seismology, hydrology, and environmental information on the area and dams, including the impact of climate change on hydrology and water storage in the area, the MokeWISE Plan and water analysis, and the California Water Plan 2013 Update. This includes all existing reports from the Ninth Independent Consultant referred to in the FERC November 25, 2014, letter, mapping and dating of the Waterhouse Peak Fault, all possible earthquake generation sources, soil drilling and sampling methods and results, laboratory testing data, hydrology of the watersheds, environmental surveys, including threatened, endangered, and sensitive plant and animal species. "Critical Energy Infrastructure Information" will be requested and Non-Disclosure agreements will be used if agreeable with PG&E and FERC.

Subtask 1.2 Conduct Geotechnical Testing

Conduct geotechnical drilling, sampling, and lab testing on the three dams for an independent assessment of information relating to the seismic stability of the dams.

Subtask 1.3 Conduct Seismic Analysis

Identify potential earthquake locations, sources, and characteristics. Analyze the stability of these dams during earthquakes individually based on the existing and new information available.

Task 2. Evaluate Dam Safety and Operations

Subtask 2.1 Analyze Storage

Analyze the long-term reliability and risk of losing storage in these reservoirs. Create computer models of the dams and earthquake simulations to determine the risk of failures.

Subtask 2.2 Evaluate Engineering Feasibility

Evaluate the engineering feasibility and changes required to allow water to be stored safely during winter.

Subtask 2.3 Develop Feasibility Analysis Report

Develop an Engineering Feasibility Analysis to identify a range of alternatives and cost-benefits to increase seismic stability including increased storage.

Subtask 2.4 Evaluate Area Hydrology

Evaluate the hydrology of the area, including under conditions of drought and climate change. The study will identify the amount, or possible amounts, of water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types.

Task 3. Establish a Level of Service[1]

Subtask 3.1 Develop Level of Service Objectives

Develop level of service (LOS) objectives for future reliability. Working with local water agencies and utilities in Amador County and interested stakeholders, LOS objectives will be developed to define the acceptable frequency, duration, and extent of water supply outages resulting from inadequate storage capacity. These LOS objectives will establish a quantitative benchmark for assessing potential climate change impacts on reliability and articulating a potential need for improved reliability in the future.

Subtask 3.2 Develop Climate Change Scenarios

Develop a minimum of three climate change scenarios to reflect a range of climate change impacts. Each scenario will include specific assumptions related to future changes in mean temperatures and precipitation patterns in the Upper Mokelumne River watershed.

Subtask 3.3 Assess Water Supply Reliability

This task will include assessing projected future water supply reliability for Amador County. The reliability assessment will compare projected future supplies and a range of demands in the region to quantify projected future supply shortfalls under a range of hydrologic and population change conditions and establish a range of future supply needs. Supply availability will be overlaid with projected demand patterns to identify any projected changes in the timing, extent, and / or severity of projected outages. These projections will be compared to the LOS objectives developed in Task 1.1 to determine whether or not additional reliability is needed in future years to meet stated LOS objectives. If additional reliability is needed, the analysis will indicate the magnitude and conditions under which reliability improvement is needed.

Subtask 3.4 Unreasonable Use Avoidance Documentation

Document how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water.

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[1] This task may have already been completed in other studies and the resulting information could be used here.

Task 4. Develop Alternatives

Develop alternatives to rehabilitate or replace the dams located at Blue and Twin Lakes. Consistent with MokeWISE Program objectives, alternatives will be designed to be socially, environmentally, and economically acceptable. Potential alternatives may include a no project alternative, rehabilitation of all three dams, and/or storing the water in Salt Springs to back up the water rights associated with the upper reservoirs. Include consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study.

Task 5. Analyze Alternatives

Subtask 5.1 Economic Analysis

This task will evaluate the feasibility and cost-benefit of each alternative developed in Task 4. These costs will include any staffing costs associated with coordination between AWA and PG&E and/or legal counsel, as well as any infrastructure costs associated with rehabilitation or replacement of existing structures. The analysis will also consider potential costs associated with a reduction in hydropower generation. The economic analysis will also consider the potential cost of impacts associated with seismic failure of any or all of the three dams.

The study shall identify one or more ways in which the capital, operations, and maintenance costs of the project could or may be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir replacements or enhancements, the utilities will identify cost sharing options acceptable to the utilities.

Subtask 5.2 Legal Analysis

The legal analysis will evaluate consistency of alternatives with existing permits and licenses and demonstrate how conflicts (if any) between current and required legal constructs could be resolved. Existing permits and licenses that could be affected include PG&E's hydropower operations and licenses, water supply contracts between PG&E and Amador Water Agency (AWA), Lodi Decrees, and EBMUDs water supply operations to meet contractual obligations to downstream users. The legal analysis will also define the legal issues that might be related to single or joint execution of any project, including legal responsibility for project execution and project governance. The legal analysis will also define regulatory requirements for the project, including those required by FERC, USDA Forest Service, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Department of Safety of Dams, and Army Corps of Engineers, State Water Resources Control Board, and Alpine County.

Subtask 5.3 Environmental Analysis

This task includes an assessment of the potential environmental effects and any needed mitigation of each alternative. Include consideration of water, environmental, social and recreational opportunities and impacts. The assessment will identify how each alternative could impact threatened, endangered species, sensitive and other aquatic and terrestrial species and resources in the surrounding area and their habitat, behavior, or populations. The assessment will propose project design that avoids potential impacts to these resources. The assessment will also identify construction impacts, including direct impacts (air, road use, staging, materials disposal, etc.) and indirect impacts such as water operations during construction.

Subtask 5.4 Review of Alternatives Analysis Findings

Interested stakeholders and public will review the results of the assessment to clearly define the potential benefits and impacts of each alternative to fish, wildlife, recreation, and consumptive use.

An extensive alternatives analysis process will be documented. The alternatives analysis will consider, at a minimum:

- Seismic Safety
- Engineering feasibility
- Legal feasibility
- Estimated cost
- Benefits or impacts to fish and wildlife and other environmental issues
- Benefits or impacts to consumptive use
- Institutional feasibility
- Consistency with existing licenses and agreements (see Task 5.2)

Based on the findings, the Collaborative Group will identify recommended next steps.

Task 6. Agency Coordination and Stakeholder Engagement

The project will include a strategy to involve interested public and a stakeholder group including former members of the Mokelumne Collaborative Group (MCG) and other interested stakeholders, notably the Project 137 Ecological Resources Committee. Stakeholder concerns and interests will be identified at the outset of the study, such that the assessment may answer questions and issues. Coordination meetings will be held with the public, water agencies, PG&E, environmental interests, recreation interests, and state and federal agencies.

Task 7. Environmental Review Strategy

This task will produce all environmental information and analysis necessary for NEPA and CEQA documentation that will be necessary for the project(s). This will include, but may not be limited to, identifying and discussing impacts to biological resources, public services, recreation, water supply, utilities, and land use and population. In coordination with the stakeholder group, a qualified consultant will prepare a written analysis of the level of review needed under both federal and state statutes.

Budget

This investigation, analysis, and environmental assessment is estimated to cost $2,500,000.

References

2014, March 10; PG&E Letter to Frank Blackett, Regional FERC Engineer.

2014, July 31; PG&E Letter to Frank Blackett, Regional Engineer, FERC.

2014, September 30; PG&E Letter to Frank Blackett, Regional Engineer, FERC.

2014, November; FERC Letter to PG&E from Frank Blackett, Regional Engineer, FERC.

2015, January; "2014 Amphibian Surveys for Foothill Yellow-legged Frog (Rana boylii), Sierra Nevada Yellow-legged Frog (Rana sierra) and Yosemite Toad-Western Toad (Anaxyrus canorus – Anaxsyrus boreas); PG&E and Garcia and Associates."