Project 184

2008 Water Quality Monitoring Report

February 26, 2009

Prepared By:
El Dorado Irrigation District

1.0 Introduction

A monitoring water quality plan (EID 2007) was developed and approved on May 15, 2007, to satisfy the water quality monitoring requirements set forth in the Project 184 Settlement Agreement (EID 2003), U.S. Forest Service 4(e) License Condition No. 37 (USFS 2003), and the California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 15 (SWRCB 2006). The monitoring plan was designed to provide information regarding overall water quality within the vicinity of Project 184 (Project), identify potential water quality problems related to the Project operations and where the Project can control such factors, and develop resource measures for the protection, mitigation, and enhancement of water quality.

Water quality data will be collected eight times per year during the first three monitoring years. This report summarizes the results of the 2008 water quality monitoring requirements. The data collected under this monitoring plan was compiled and distributed electronically to the FS, SWRCB, and ERC by January 31, 2009 as required by the approved plan prior to the distribution of this report. A copy of the raw data spreadsheets is included at Appendix A.

2.0 Sampling Locations

The following sampling locations are identified in the Water Quality Monitoring Plan (EID, 2007):

Echo Creek below Echo Lake Dam (WQ1)
Pyramid Creek below Lake Aloha Dam (WQ2)
Caples Creek below Caples Lake Dam (WQ3)
Silver Fork American River below Silver Lake Dam (WQ4)
South Fork American River upstream of Kyburz Diversion Dam (WQ5)
South Fork American River downstream of Kyburz Diversion Dam (WQ6)
Carpenter Creek above Carpenter Creek Diversion Dam (WQ7)
Carpenter Creek below Carpenter Creek Diversion Dam (WQ8)
No Name Creek above No Name Creek Diversion Dam (WQ9)
No Name Creek below No Name Creek Diversion Dam (WQ10)
Alder Creek above of Alder Creek Diversion Dam (WQ11)
Alder Creek below of Alder Creek Diversion Dam (WQ12)

Mill Creek above Mill Creek Diversion Dam (WQ13)
Mill Creek below Mill Creek Diversion Dam (WQ14)
Bull Creek above Bull Creek Diversion Dam (WQ15)
Bull Creek below Bull Creek Diversion Dam (WQ16)
Ogilby Creek above Ogilby Creek Diversion Dam (WQ17)
Ogilby Creek below Ogilby Creek Diversion Dam (WQ18)
Esmeralda Creek above Esmeralda Creek Diversion Dam (WQ19)
Esmeralda Creek below Esmeralda Creek Diversion Dam(WQ20)

3.0 Collection

In-situ and analytical water quality monitoring were performed in 2008, as required by the plan. Date, time, site location, weather, and in-situ water quality data were recorded on a standard form and later transcribed to electronic format in a Microsoft Excel spreadsheet. GPS coordinates and photographs were taken at each sampling site to document conditions at the time of sampling. Sampling occurred over an eight-month period during the first week of each month: March, May, June, July, August, September, first storm of the season, and December. Total and Fecal Coliform samples were collect five times per month from May through September and captured days with high recreational periods (i.e. holiday weekends).

Temperature, dissolved oxygen, conductivity, and pH were measured in the field at each location using an YSI 556: Handheld Multi-Probe Meter. The YSI meter was calibrated in a laboratory per manufacturer's instruction prior to each field visit. During each sampling period, a back-up meter was also calibrated and ready for use. Turbidity was measured with a Hach handheld turbidity meter. The meter was calibrated prior to each sampling period per manufacturer's specifications.

Water samples were collected at each location. Two 100 ml bottles were used for the total and fecal coliform tests, and 1 four-liter container was used for testing copper, aluminum, TSS, Alkalinity, Hardness, and Nitrate levels at each sampling site. Two state certified laboratories were used to analyze the water samples: El Dorado Irrigation District laboratory in El Dorado Hills, California, and California Laboratory Services (CLS) in Rancho Cordova, California. All the samples were analyzed pursuant to the United States Environmental Protection Agency (USEPA), California Department of Public Health, or Environmental Laboratory Accreditation Program (ELAP) approved methodologies and results were certified to be in compliance both technically and for completeness. All samples met the appropriate hold times.

4.0 Parameters and Results

Temperature

Water temperature is important for fish and other aquatic life to thrive. Temperature controls the rate of metabolic and reproductive activities in aquatic life. Since body temperatures are directly affected by water temperature, drastic changes can malfunction metabolic activities. Temperature can affect concentrations of dissolved oxygen (DO) in water with higher concentrations of DO occurring with colder temperatures and can inforluance the activity of bacteria in a water system. A thorough temperature evaluation at all sampling sites, as well as five additional sites, will begin in April 2009, per the approved Temperature Monitoring Plan (EID, 2007a).

Data shows an increase from spring to summer months and decreases again during the fall and winter seasons at a steady rate across the sampled streams. The difference in temperature downstream of each diversion structure did not exceed Basin Plan objectives, which states, "at no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5 degrees Fahrenheit above natural receiving water temperature" (RWQCB-5, 2005). On average, the temperature difference between upper and lower reaches was 0.67 degrees Celsius with a maximum difference of 2.36 degrees Celsius along Esmeralda Creek (WQ19 and WQ20) in June.

Dissolved Oxygen

Dissolved Oxygen is an indicator of a water body's ability to support aquatic life. DO is oxygen that diffuses from the surrounding air, aquatic plants and algae through photosynthesis, or is aerated by natural falls or rapids. The amount of DO affected by temperature and cold water generally contains higher levels of DO than warm water. Oxygen is removed from the water by respiration and decomposition of organic matter. The level of DO is water depends on several factors, including temperature (the colder the water, the more oxygen can be dissolved), the volume and velocity of water moving (i.e. velocity of flow or wave action) in the water body, and the amount of organisms using oxygen for respiration.

Basin Plan objectives states, "The DO concentrations shall not be reduced below the following minimum levels at any time…waters designated COLD 7.0 mg/L (RWQCB-5, 2005). DO ranged from the lowest concentration of 6.71 mg/L at Echo Creek (WQ01) to the highest concentration of 17.33 mg/L below the Kyburz diversion along the South Fork American River (WQ06). On average the DO levels for the project were 11.10 mg/L. DO levels remained consistent at each location throughout the sampling year.

Echo Creek (WQ01) fell below Basin Plan objectives twice during the summer months to a low of 6.71 mg/L and increased in September. All locations, except for WQ01, never fell below the COLD designated beneficial uses objective. Echo Creek's DO concentrations of less than 7.0 mg/L may be common during the summer months due to a high elevation, increase in air temperature, and a decrease of water flow, which limits the solubility of oxygen in the creek. However, Echo Creek descends in a water fall about 1,200 feet downstream of the dam, which would increase DO concentrations before it joins the Upper Truckee River and then Lake Tahoe.

Conductivity

Conductivity is a good measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for comparison with continued regular conductivity measurements. Significant variations in conductivity can be an indicator of water quality problems. Conductivity is a measure of how well water can pass an electrical current. It is an indirect measure of the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. These substances conduct electricity because they are positively or negatively charged when dissolved in water. The concentration of dissolved solids or the conductivity is affected by the geology in the watershed.

Currently there are no criteria or water quality objective for conductivity within the American River Watershed. Data illustrates consistent conductivity at all 20 stream sampling locations above and below each diversion dam with the largest variability of 33 uS/cm between upper and lower No Name Creek (WQ10). The overall average conductivity throughout the entire project area is 60.1 uS/cm.

pH

pH measures hydrogen concentration in water. Low pH of water has a high concentration of positive hydrogen ions (acidic) and with a high pH has a concentration of negative hydroxide ions (basic). A combination of low pH and certain chemicals or metals, can create a toxic environment of aquatic life. This is called synergy, which is a process when two, or more substances combine and produce effects greater than their sum. When pH falls to a more acidic level, the natural buffering materials found in the rocks in the water are absent. pH can change its value due to temperature changes and time of day with lower pH values observed at night and higher at midday. Photosynthesis and respiration of algae and rooted plants along the stream can also affect pH levels, as well as limestone deposits. Low pH has been known to coincide with days of high insolation (incident solar radiation) and snowmelt events.

The Basin Plan states that "pH shall not be depressed below 6.5 nor raised above 8.5 and that changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD beneficial uses" (RWQCB-5, 2005). Upper watershed locations (WQ-01, WQ-02, WQ-03, and WQ-04) revealed several sampling days with pH below the 6.5 objective in the Basin Plan. pH was below 8.5 at all locations during all sampling events throughout the year. Upper Kyburz (WQ05) fell below 6.5 units by .03 and .12 units in the winter months, but recovered to the Basin Plan objectives by lower Kyburz (WQ06), most likely due to the increase of flow from runoff and contributing tributaries.

Turbidity

Turbidity is a measure of the cloudiness in the water. Turbidity is water caused by suspended matter such as clay, silt, and organic matter and by plankton and other microscopic organisms that interfere with the passage of light through the water. Turbidity is closely related to total suspended solids (TSS), but also includes plankton and other organisms. Turbid waters become warmer as suspended particles absorb heat from sunlight, causing DO levels to fall. Turbidity may indicate the presence of microbes or by soil erosion, runoff, and high flow rates.

The Basin Plan states, "where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent" (RWQCB-5, 2005). Turbidity measurements were generally low throughout the study area. Turbidity ranged from 0.0 NTUs to 4.46 NTUs. The 4.46 was measured at No Name Creek (WQ10) where a cabin owner had placed a decorative water wheel in the middle of the creek above the designated sampling location. This caused an increase in sediment and organic matter to move downstream. The average turbidity levels throughout the study area were 0.88 NTUs.

Caples Creek (WQ03) had a turbidity level of 11 NTUs during the November 3, 2008 sampling session. Caples Lake storage at this time was approximately 1000 acre-feet to facilitate the emergency repairs of the outlet works at Caples Lake Main Dam. Water quality monitoring data collected in Caples Lake during the emergency repairs revealed that turbidity was highly variable depending on the amount of wind and wave action. The 11 NTUs is within the range observed in Caples Lake during the water quality monitoring effort for the emergency repairs. Turbidity during the December sampling event at Caples Creek was 4.8 NTUs, which is consistent with Basin Plan objectives.

Total Suspended Sediments

TSS refers to matter suspended in water and is related to both specific conductance and turbidity. TSS is solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

The Basin Plan has a narrative objective that states, "Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses" (RWQCB-5, 2005). TSS measurements were extremely low throughout the project area. Most sample locations yielded a non-detect throughout the year. The average TSS was 4.64 mg/L with the highest being 33 mg/L at Bridal Veil Falls (WQ20) at the end of summer. Photo documentation shows there was a significant amount of trash, decomposing leaves and other organic matter within the water at this location.

Alkalinity

Alkalinity is a measurement of alkalinity compounds in the water and its capacity to resist changes in pH that would make water more acidic. Alkalinity of natural water is determined by the soil and bedrock through which it passes. Areas rich in granite and some conglomerate and sandstone may have low alkalinity and therefore have a poor buffering system. Conversely, areas that contain carbonate, bicarbonate, and hydroxide compounds, such as limestone are natural sources of alkalinity. High alkaline compounds are natural buffers that can remove excess hydrogen ions that have been added from sources such as acid rain or mine drainage. Alkalinity mitigates or relieves metals toxicity. Alkalinity is often related to hardness because hardness compounds contribute carbonate ions to a buffering system. Many streams are naturally low in alkalinity concentrations.

There are currently no Basin Plan objectives for alkalinity. The U.S. Environmental Protection Agency recommends ambient water quality criteria for alkalinity to protect freshwater aquatic life to be measured as a continuous concentration 4-day average expressed as a total recoverable. The aquatic life 4-day average concentration for alkalinity is 20 mg/L. The recommendation also states that "20 mg/L is a minimum concentration except where natural concentrations are less (Water Quality Goals, 2008).

The frequency of monitoring in the approved plan does not provide for a direct relationship to the recommended average concentration. Alkalinity monitoring revealed concentrations at sampling locations along Carpenter, No Name, Mill, and Bull Creeks (WQ-07, WQ08, WQ-09, WQ10, WQ12, WQ-13, WQ14, and WQ-15) were above 20 mg/L, which is attributed to calcium carbonate ($CaCO_3$) rich soil that runs 100%

under these waters (USDA/NRCS, 2008). The sampling areas that have the lowest alkalinity are Echo Creek and Silver Fork American River (WQ01 and WQ04). The average alkalinity throughout the Project boundary is 29 mg/L.

Hardness (Calcium Carbonate)

Hardness in water can contain minerals such as magnesium and calcium that can cause the water to increase hardness. Hardness generally refers to the amount of calcium and magnesium in water. Calcium and magnesium help keep fish from absorbing metals such as lead, arsenic, and cadmium, into their bloodstream through their gills. Therefore, the harder the water, the less easy it is for toxic metals to absorb through the gills.

There is currently no Basin Plan objective for hardness. Total hardness measurements were below 30 mg/L in eighty percent of the sample streams. The lowest measured hardness value was 0.7 mg/L at location Echo Creek (WQ-01). Hardness levels were similar to alkalinity with concentrations increasing at sampling locations along Carpenter, No Name, Mill, and Bull Creek's (WQ-07, WQ08, WQ-09, WQ10, WQ12, WQ-13, WQ14, and WQ-15) with No Name Creek (WQ09 and WQ10) reading a level of 82 mg/L. Again, the geology at these locations contains large quantities of calcium carbonate that naturally leech into the streams (USDA/NRCS, 2008) producing a higher hardness concentration at these locations. The average hardness for the entire project area is 23.81 mg/L.

Nitrate (Nitrate plus Nitrite)

Excessive nitrate concentrations can be harmful to humans and wildlife. High levels can over-stimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption. This process is called eutrophication. Nitrates can enter waterways from animal waste, septic tanks, and car exhausts discharges.

There are currently no Basin Plan objectives for nitrate. The U.S. Environmental Protection Agency recommends ambient water quality criteria for non-cancer health effects and the California and Federal primary contaminated levels in drinking water to be 10 mg/L (Water Quality Goals, 2008). The highest nitrate value of 0.75 mg/L was from location Echo Creek (WQ-01) with most measurements resulting in a non-detect. The nitrate levels are extremely low throughout the project area.

Copper

Copper is released from natural sources, like volcanoes, windblown dusts, decaying vegetation, and forest fires. Copper is also released into the environment by mining, farming, and manufacturing operations and through wastewater releases into rivers and lakes. Natural organic matter, such as humic and fulvic acids, are strong complexing agents that may affect the bioavailable copper concentration. Copper released into the environment usually attaches to particles made of organic matter, clay, soil, or sand. Copper does not break down in the environment; however, compounds can break down and release free copper into the air, water, and foods.

There is no specific Basin Plan objective for copper; however, the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed bays, and Estuaries of California (SIP, 2005), and the California Toxics Rule (CTR, 2000), provides a formula for deciphering a one-hour total recoverable and/or dissolved copper limit based on its hardness value. This standard has been incorporated by adoption into the Basin Plan. Therefore, the lower the hardness value, the lower the available copper is in the water (greater copper concentration can be allowed due to limited availability of copper in the water table), and the greater the hardness value, the lower the copper concentration must be (more available dissolved copper can affect aquatic life). Ninety-eight percent of the copper results meet the CTR criteria. Pyramid Creek (WQ02) exceeded the copper criteria in July 2008, and Caples Creek (WQ03) exceeded in both August and September of 2008. All other copper levels were below the SIP/CTR 1-hour average total recoverable and dissolved maximum criteria concentrations (Table 1).

Aluminum

It is shown that aluminum concentration in natural waters varies widely and substantially depends on the solubility of minerals containing aluminum and the influence of chemical composition and pH values of aquatic environment on the solubility. The hydrolysis and complexation processes play the major role in fate of aluminum in natural waters.

Aluminium forms during mineral weathering of feldspars, such as orthoclase, anorthite, albite, micas and bauxite, and subsequently ends up in clay minerals. A number of gemstones contain aluminium, such as rubies and sapphires. At pH values below 4.5 solubility rapidly increases, causing aluminium concentrations to rise above 5 ppm. This may also occur at very high pH values. Dissolved Al^{3+}-ions are toxic to plants; these affect roots and decrease phosphate intake. As mentioned above, when pH values increase aluminium dissolves. This explains the correlation between acid rains and soil aluminium concentrations. At increasing nitrate deposition, the aluminium amount increases, whereas it decreases under large heather and agricultural surfaces. In forest soils, it increases.

There are currently no Basin Plan objectives for aluminum. The U.S. Environmental

Protection Agency recommends ambient water quality criteria for freshwater aquatic life expressed at a maximum concentration 1-hour average to be 750 ug/L (Water Quality Goals, 2008). All waters were below the criteria except for No Name Creek (WQ-10) above the diversion, which was analyzed with 800 ug/L aluminium in July 2008. The average aluminium found within the project area is 51.7 ug/L.

Total Coliform

Two measurement methods were used to detect coliform bacteria in waters. Total coliform measurements targeted all coliform bacteria, regardless of origin. Bacteria are generally found in all natural water whether from surface or shallow ground sources. Most of these bacteria are essential to the breakdown of natural organic materials found in water, and are harmless to humans. However, presence of coliform bacteria (from human or animal waste) in the water supply shows possible pollution that cause human illness and disease. Since disease-causing bacteria are difficult, expensive, and time consuming to isolate and identify, microbiologists have developed the "total coliform test" to simplify sampling. Coliform bacteria can survive longer in water than most disease causing organisms, and are easier to identify. Safe water contains no total coliform bacteria. Microbiologists use one of several methods to determine the presence of coliform bacteria.

There are no total coliform criteria at this time. Ninety-five percent of the analyzed samples provided extremely low results. Fecal coliform testing was used to further identify coliform issues (see fecal coliform results).

Fecal Coliform

Fecal coliform bacteria are found in the feces and intestinal tract of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. If a large number of fecal coliform bacteria are found in water, it is possible that an illness-causing organism could also be present in the water. Pathogens are typically present in such small amounts it is impractical to monitor them directly. Fecal concentrations of the bacteria in water may be caused by septic tank failure, pet or wild animal waste, upland runoff, and recreational visitors.

Basin Plan objectives for coliform state that, "waters designated for contact recreation, the fecal coliform concentration based on a minimum of not less than five samples in any 30-day period shall not exceed a geometric mean of 200 MPN/100 mL, nor shall more than ten percent of the total number of the samples taken during any 30-day period exceed 400 MPN/100 mL", (RWQCB-5, 2008). The largest geometric mean was 72 MPN/100 mL taken at Pyramid Creek (WQ02) and the lowest geometric mean was

1.8 MPN/100 mL. The average geometric mean within the Project boundary is 7.8 MPN/100 mL.

5.0 Conclusions

Water quality in the project area met most applicable Basin Plan objectives and other criteria during the 2008 monitoring program. Measurements for *in-situ* parameters did not vary above and below the diversion dams along each stream reach and provide normal distributions across the sampling locations based on stream flow elevation and time of year. Therefore, project operations do not seem to affect water quality in the stream reaches.

Background levels of the upper elevation waters show a naturally low pH. Research suggests that low pH levels at higher elevations, may reflect the influence of acidic snowmelt events due to increase in air temperature, as well as intense solar radiation causing snow melt (Howell and Springer, 1989). With the increase of air temperature, the snowpack chemistry (melt water) can change the stream's water chemistry. The melt and pre-melt conditions may be conducive to producing an acidic pulse thereby shown as a decrease in pH (Jenkins, et., al. 1993). The upper lakes held pH levels as low as 3.01 at WQ03 during an April snow-melting event. WQ02 maintained a pH value between 4.03 and 4.65 throughout the summer. Snowmelt at this location continued throughout the summer and was still visible in fall. pH levels do not seem to be influenced by project operations, but more from snowmelt events throughout the spring and summer.

Laboratory-measured analytical parameters also did not vary in the stream reaches above and below the diversion dams. Project operations did not increase or decrease water quality parameters in almost all cases. The high alkalinity levels in WQ07, WQ08, WQ09, WQ10, WQ12, WQ-13, WQ14, and WQ-15 come from the natural background chemistry of the geologic soils. The NRDS web soil survey shows a solid layer of calcium carbonate under these streams. Alkalinity is the natural buffering capacity of the water and is directly proportional to the amount of free carbonate ($CO3^-$) and bicarbonate ($HCO3^-$) leeched from the rocks. Project operations do not influence alkalinity levels.

The water quality constituent copper was exceeded three times during 2008 monitoring. The first occurrence was located at Pyramid Creek and may be attributed to the yearly release that is necessary to ensure that Lake Aloha does not spill. Two occasions were located at Caples Creek (WQ03), which may be attributed to releases necessary for the reservoir drawdown to facilitate the emergency repairs at Caples Lake Main Dam.

6.0 Recommendations

Constituents to be removed

The 2008 monitoring demonstrates that throughout the year these parameters were well within the acceptable range for all applicable federal, state, and Basin Plan requirements: Total Suspended Sediments, Nitrates, Aluminum, total coliform, and fecal coliform.

Sample Sites to be removed

Both Mill Creek (WQ13 and WQ14), and Carpenter Creek (WQ07 and WQ08), no longer divert water into the canal system. The water moves unimpaired and is not influenced by project operations.

7.0 Literature Cited

Central Valley Regional Water Quality Control Board. 1998. Water Quality Control Plan (Basin Plan) for the Central Valley Region. Sacramento River and San Joaquin River Basins (Basin Plan). Published by the California Regional Water Quality Control Board, Central Valley Region and the State Water Resources Control Board, Sacramento.

Central Valley Regional Water Quality Control Board. 2003. A Compilation of Water Quality Goals. Published by the California Regional Water Quality Control Board. Updated August 2007.

EID. 2003. El Dorado Relicensing Settlement Agreement. El Dorado Project FERC Project 184.

EID. 2007. Project 184 Water Quality Monitoring Plan. Version 3.0. 3/8/2007.

EID. 2007a. Project 184 Water Temperature Monitoring Plan. Version 5.0. 10/2007

Howell, G.D. & Springer T.A. 1989. Automatic monitoring of short duration snowmelt events in a Nova Scotia headwater stream. Water, Air, and Soil Pollution 46: 145-153.

Jenkins, A., Ferrier, R. and Waters, D. 1993. Melt water chemistry and its impacts on stream water quality. Hydrological Processes 7: 193-203.

State Water Resources Control Board of California. 2006. Clean Water Act Section 401 Technically-Conditioned Water Quality Certification for Federal Energy Regulatory Commission El Dorado Hydroelectric Project (FERC No. 184).

State Water Resources Control Board of California. 2005. Policy for Implementation of Toxics Standards for Inland Surface Waters Enclosed Bays, and Estuaries of California (SIP). 2/24/2005.

United States Department of Agriculture – Natural Resources Conservation Service (USDA/NRCS). 2008. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/app/ . Last Updated 11/13/2008

United States Environmental Protection Agency. 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule (CTR). Federal Register. 5/18/2000

United States Forest Service. 2003. Forest Service Final Terms and Conditions Provided Under 18 CFR 4.34(b)(1) In Connection With the Application for Relicensing of The El Dorado Hydroelectric Project (FERC No. 184). October 31, 2003.