1.0 WATER QUALITY AND TEMPERATURE STUDY APPROACH

This preliminary draft study approach is provided to inform of the general methods DWR followed during the study phase under FERC's Traditional Licensing Process.

1.1 PROJECT NEXUS

Continued Project Operation and Maintenance (O&M) activities have the potential to affect water quality and water temperature in the Project reservoir.

1.1.1 Existing Information and Need for Additional Information

Existing, relevant, and reasonably available information regarding water quality and water temperature in Silverwood Lake and other Project features was presented in California Department of Water Resources (DWR) Pre-Application Document (PAD) in Section 4.4.7. Project water quality monitoring has been conducted by DWR since 1968. The water quality program monitors eutrophication, salinity and other parameters of concern for drinking water, recreation, and fish and wildlife purposes. Additional data are collected by the Metropolitan Water District (MWD). The monitoring program consists of collection, analysis, data archiving, and dissemination of data and information describing the quality of surface water resources. Extensive water quality sampling and analysis is ongoing by both DWR and MWD; the frequency of monitoring by parameter and the historical results are summarized in Section 4.4.7 of the PAD.

In addition, defined Beneficial Uses and Water Quality Objectives of Project waters are presented in Tables 4.4-6 and 4.4-7, respectively, in the PAD.

Additional water quality and temperature data from this study will be added to existing information.

1.1.2 Study Goals and Objectives

The goal of this *Water Quality and Temperature Study Approach* is to supplement existing information and ongoing data collection regarding water quality. The objective of the study is to gather sufficient data necessary to fill information gaps concerning water quality and temperature.

1.1.3 Study Methods

1.1.3.1 Study Area

The study area for the *Water Quality and Temperature Study Approach* consists of Silverwood Lake.

1.1.3.2 General Concepts and Procedures

- Personal safety is the most important consideration of each fieldwork team. Fieldwork will only occur in safely accessible areas and under conditions deemed

safe by the field crews. Locations within the study area that cannot be accessed in a safe manner (e.g., locations containing dense vegetation or unsafe slopes) and areas inundated when the surveys are performed, will not be surveyed; these areas will be identified in the data summary and an explanation for survey exclusion will be provided.

- The Water Quality and Temperature Study Approach does not include the development of requirements for the new license, which will be addressed outside the Water Quality and Temperature Study.

- The Water Quality and Temperature Study Approach focuses specifically on Silverwood Lake, and the study area for the Water Quality and Temperature Study Approach is specific to those resources.

- If required for the performance of the Water Quality and Temperature Study Approach, DWR will make a good faith effort to obtain permission to access private property well in advance of initiating the Water Quality and Temperature Study Approach. DWR will only enter private property if permission has been provided by the landowner.

- DWR will acquire all necessary agency permits and approvals prior to beginning fieldwork for the Water Quality and Temperature Study Approach.

- Field crews may make variances to the Water Quality and Temperature Study Approach in the field to accommodate actual field conditions and unforeseen problems. Any variances in the Water Quality and Temperature Study Approach will be noted in the data resulting from the Water Quality and Temperature Study Approach.

- DWR field crews will record incidental observations of aquatic and wildlife species observed during the performance of this study. The purpose of this effort is to opportunistically gather data for specific target species during the performance of the study

- To prevent the introduction and transmittal of amphibian chytrid fungus and invasive aquatic species (e.g., quagga mussels, zebra mussel, and Asian clams), field crews will be trained on, provided with, and use materials (e.g., Quat) for decontaminating their boots, waders, and other equipment when leaving or traveling between water-based study sites. Field crews will follow DWR's Quagga and Zebra Mussel Rapid Response Plan and CDFW's Aquatic Invasive Species Decontamination Protocol which can be found at the following link: (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=43333). All boats used during the study will follow cleaning protocols, including inspections before and after use. All decontamination requirements in place at Project reservoirs including those of DWR's Quag*ga and Zebra Mussel Rapid Response Plan* for the State Water Project will be strictly followed (DWR 2010).

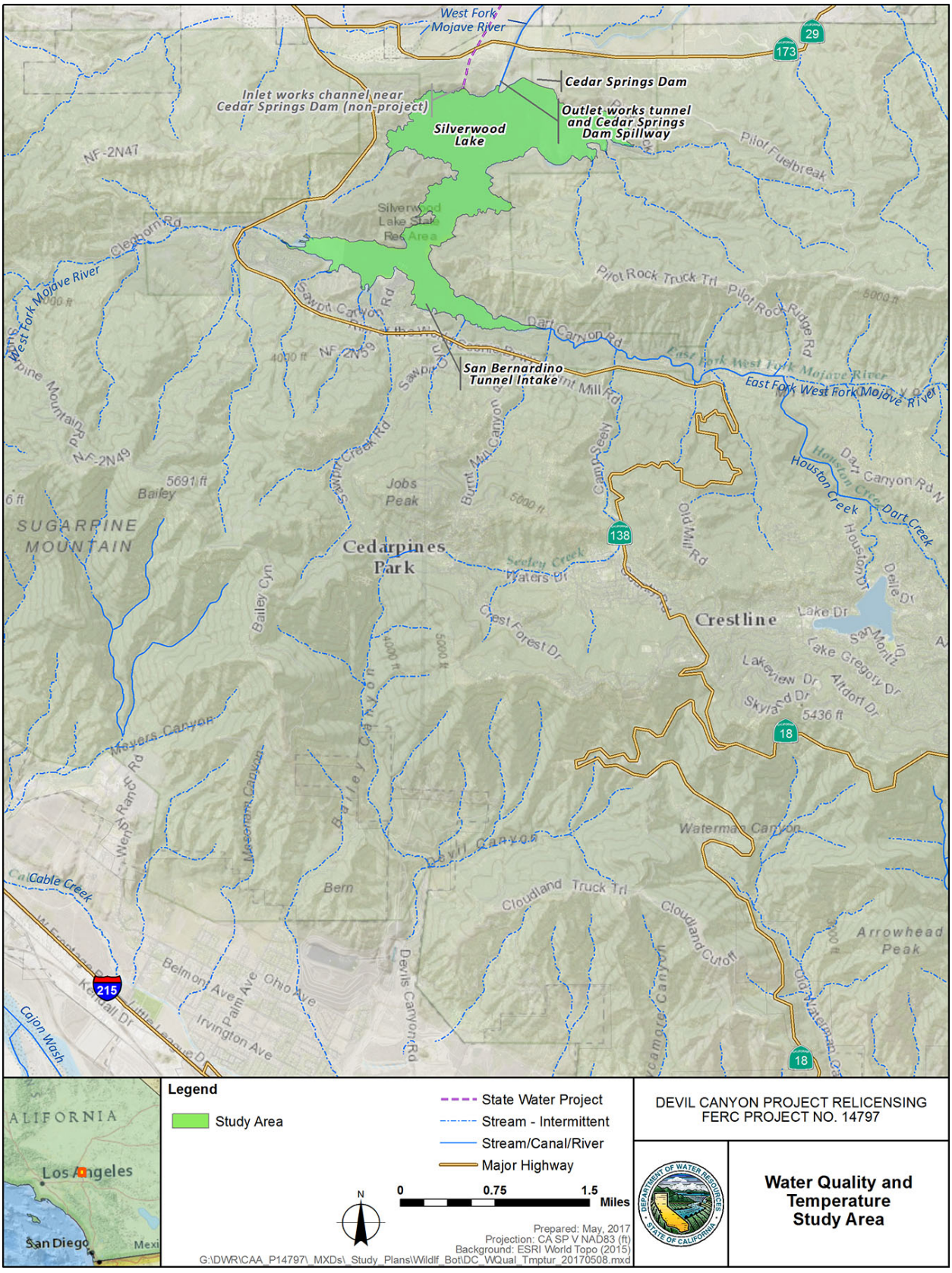

Figure 1.1-1. Map of Study Area for Water Quality and Temperature Study.

1.1.3.3 Methods

This *Water Quality and Temperature Study Approach* will consist of four steps: (1) select water quality parameters; (2) select sampling locations; (3) collect water quality samples; and 4) collect water temperature profiles. These steps are described below.

Step 1 – Select Water Quality Parameters. For the purpose of this *Water Quality and Temperature Study Approach*, the water quality parameters and constituents to be measured are divided into two categories: (1) basic water quality – in situ; and (2) basic water quality – laboratory, which includes inorganic ions, nutrients and metals. The parameters included in each category and associated information are listed in Table 1.1-1. Water temperature will also be monitored as described in Steps 2 and 3 below.

Table 1.1-1. Water Quality Parameters and Analytes, Methods, Reporting Limits, and Laboratory Holding Times

Parameter		Method	Target ReportingLimit[1] µg/L (or other)	Hold Time
BASIC WATER QUALITY – *IN SITU*				
Temperature		SM 2550 B	0.1 °C	Field (in situ)
Dissolved oxygen	DO	SM 4500-O	0.1 mg/L	Field (*in situ*)
Specific conductance	--	SM 2510A	0.001 ms/cm	Field (*in situ*)
pH	--	SM 4500-H	0.1 su	Field (*in situ*)
Turbidity	--	SM 2130 B	0.1 NTU	Field (*in situ*)
Secchi disc (for open water)	--	--	--	Field (*in situ*)
BASIC WATER QUALITY – LABORATORY				
Total organic carbon	TOC	SM 5310	0.5	28 d
Dissolved organic carbon	DOC	EPA 415.1 D	0.5	28 d
Total dissolved solids	TDS	EPA 2540 C SM 2340 C	1.0 mg/L	7d
Total suspended solids	TSS	EPA 2520 D SM 2340 D	1.0 mg/L	7d
INORGANIC IONS				
Total alkalinity	--	SM 2340 B	2000	14 d
Calcium	Ca	EPA 200.7	1.0 mg/L	180 d
Chloride	Cl	EPA 300.0	1.0 mg/L	28 d
Hardness (measured value)	--	EPA 2340 B SM 2340 C	1.0 mg/L as $CaCO_3$	14 d
Magnesium	Mg	EPA 200.7	1.0 mg/L	180 d
Potassium	K	EPA 200.7	500	180 d
Sodium	Na	EPA 200.7	1.0 mg/L	180 d
Sulfate	SO_4^{2-}	EPA 300.0	1.0 mg/L	28 d
Sulfide	S^{2-}	SM 4500 S2 – D	0.05 mg/L	28 d

Table 1.1-1. Water Quality Parameters and Analytes, Methods, Reporting Limits, and Laboratory Holding Times (continued)

Parameter		Method	Target ReportingLimit[1] µg/L (or other)	Hold Time
NUTRIENTS				
Nitrate-nitrite	--	EPA 4500-NO3	2	28 d at 4 °C
Total ammonia as N	--	EPA 4500-NH3 SM 4500-NH3	10	28 d at 4 °C
Total Kjeldahl nitrogen as N	TKN	SM 4500 N	100	28 d at 4 °C
Total phosphorus	TP	SM 4500 P	100	28 d at 4 °C
Dissolved orthophosphate	PO_4	EPA 365.1 EPA 300.0	10	48 h at 4 °C
METALS				
Aluminum (total and dissolved)	Al	EPA 1638	0.1	180 d
Arsenic (total and dissolved)	As	EPA 1638	0.1	180 d
Cadmium (total and dissolved)	Cd	EPA 1638	0.1	180 d
Chromium, total (total and dissolved)	Cr	EPA 1638	0.1	180 d
Copper (total and dissolved)	Cu	EPA 1638	.05	180 d
Iron (total and dissolved)	Fe	EPA 1638	0.2	180 d
Lead (total and dissolved)	Pb	EPA 1638	.04	180 d
Mercury (total)	Hg	EPA 1631	.0002	28 d
Methylmercury (total and dissolved)	CH_3Hg	EPA 1630	.005	90 d
Nickel (total and dissolved)	Ni	EPA 1638	0.1	180 d
Selenium (total)	Se	EPA 1638	0.2	180 d
Silver (total and dissolved)	Ag	EPA 1638	.04	180 d
Zinc (total and dissolved)	Zn	EPA 1638	0.1	180 d
PESTICIDES				
Chlorpyrifos	--	EPA 8081A	0.005mg/L	7 d
Diazinon	--	EPA 8141A	0.005mg/L	7 d

[1]The Target Reporting Limit is the minimum accuracy at which the parameter will be reported in DWR's DLA and FLA based on the limit of detection identified in the laboratory.

Key:
EPA = United States Environmental Protection Agency
$CaCO_3$ = calcium carbonate
d = days
h = hours
µmhos = micro-mhos
µg/L = micrograms per liter (equals parts per billion)
mg/L = milligrams per liter (equals parts per million)
NTU = Nephelometric Turbidity Units
SM = Standard Method
su = standard unit
TDS = total dissolved solids
TOC = total organic carbon
TSS = total suspended solids

Step 2 – Select Sampling Locations. Water quality and temperature data will be collected in Silverwood Lake at three locations: (1) near the dam, (2) a location at a distance one-third of the length of the reservoir measured from the dam, and (3) a location at a distance two-thirds of the length of the reservoir measured from the dam.

Water Quality sampling in Silverwood Lake will occur at two depths at each sampling location: within the hypolimnion and just below the surface of the epilimnion. Water temperature sampling in Silverwood Lake will occur from the surface to near the bottom of the reservoir. To the extent possible, the sampling locations will correspond with the sampling locations of recent or ongoing water quality monitoring by DWR.

Step 3 – Collect Water Quality Samples. General water chemistry samples listed in Table 1.1-1 will be collected once in Silverwood Lake at the locations described in Step 2 when Silverwood Lake elevation is expected to be its lowest for the year and a boat can still be safely launched. The *in situ* parameters listed in Table 1.1-1 will be recorded each time reservoir profiles are collected.

The description below provides a broad overview of the sample collection procedures that will be followed. Specific quality assurance and quality control (QA/QC) protocols will be followed to prevent sample contamination and ensure the sample accuracy. These protocols will be included in the Quality Assurance Project Plan (QAPP) to be developed in collaboration with the laboratory. The QAPP will include instrument calibration, equipment decontamination, sample cross contamination prevention, labels and documentation, laboratory certification, chain of custody procedures, and sample collection, preservation, storage, transport, and analyses protocols.

In situ water quality measurements will be made with a Hydrolab DataSonde 5 (Hydrolab), or other instrument with similar precision and accuracy. Water temperature (±0.1°C), dissolved oxygen (±0.2 milligrams per liter [mg/L]), pH (±0.2 standard unit, or su), specific conductance (±0.001 micro-mhos per centimeter [µmhos/cm]), and turbidity (± 1 Nephelometric Turbidity Unit [NTU]) will be measured at each location. Prior to and after each use, the instrument will be calibrated using the manufacturer's recommended calibration methods. Any calibration variances will be noted on the field data sheet, and recalibration or repair done as necessary. Field crews will note relevant conditions during each sampling event on the field data sheet (e.g., air temperature, reservoir elevation, and description of the sampling location, floating material, evidence of oil and grease, and activities in the vicinity of the sampling site that could cause short- or long-term alterations to water quality).

DWR will follow United States Geological Survey sampling protocol for water quality (Wilde, 2011). In summary, each sample will be collected in laboratory-supplied clean containers. Containers used during stream sampling and reservoir surface sampling will be filled directly from the water, submerged approximately six inches below the surface and facing downstream in order to prevent material from flowing into the container. Sampling from near the bottom of the reservoir will be done using a Kemmerer sampler (or equivalent) designed for trace metals sampling. Containers for the deep water samples will be filled directly from the sampler. The sampler will be thoroughly cleaned

with Alconox and distilled water in between sample locations. While in the field, samples requiring refrigeration will be stored on ice, in an ice chest, until transferred to an appropriate laboratory refrigerator. Water samples to be analyzed for metals will be collected using "clean hands" methods consistent with the Environmental Protection Agency's (EPA) Method 1669 sampling protocol, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria (EPA, 1995). Samples requiring filtration before metals analysis will be filtered in accordance with standard protocols in the field. Certification of filter cleanliness will be obtained from the vendor and kept in the Project files.

All sample containers will be labeled with the date and time that the sample is collected, and a sampling site or unique sample identification number. A field sample log sheet will be maintained that includes a table of sample label information. The sampling site location will be recorded using a GPS unit. All containers will be handled in a manner consistent with appropriate chain-of-custody protocols. The sample containers will be preserved as appropriate, stored and delivered to a State of California-certified water quality laboratory for analyses of the parameters listed in Step 1, and in accordance with maximum holding periods for each parameter. A chain-of-custody record will be maintained with the samples at all times.

As part of the field quality assurance (QA) program, one field blank and one equipment rinsate will be collected and submitted to the laboratory, with a target of one for every 10 samples. A field blank is a sample of analyte-free water poured into the container in the field, preserved and shipped to the laboratory with samples. A field blank for filtered samples will be similarly created, but filtered using field techniques before pouring into the sample container. A field blank assesses the contamination from field conditions during sampling. A rinsate is a sample of analyte-free water poured over or through decontaminated field sampling equipment prior to the collection of samples and assesses the adequacy of the decontamination processes. Two duplicate samples will also be collected to confirm the laboratory's QA process.

Step 4 – Collect Reservoir Profiles. Reservoir profiles will be taken once quarterly at the three locations in Silverwood Lake described in Step 2. Sampling will occur in the second, third and fourth quarters of 2017 and first quarter of 2018. Sampling will occur no sooner than two months after the previous event to capture maximum variation between events.

A GPS receiver will be used during each successive sampling occasion to locate the geographical coordinates of each sample site. Care will be taken to identify the same site for successive profiles where water conditions and GPS accuracy allow.

Field crews will use a Hydrolab® DataSonde 5® multi-parameter water quality monitoring system (or equivalent) to measure water temperature (±0.2°C) at each of the reservoir sampling sites. Generally, measurements will be taken at 10-foot vertical increments where the change in temperature with respect to depth is low. Where the temperature gradient is higher or where measuring water temperatures near the intake elevations, 5-foot or smaller vertical increments will be used. At each sample depth, the

parameter readings will be allowed to stabilize before water temperature will be recorded. Data will be collected throughout the entire water column.

Field crews will collect a Secchi disc depth reading as an indicator of water clarity and photic zone during each reservoir water temperature profile collection. Secchi depth readings will be taken by lowering a Secchi disc over the shaded side of the boat until the disc is no longer visible from the boat. The disc will then be raised until visible, at which location the depth of the disc will be recorded in tenths of a foot, and the average of the two readings will be used as the water clarity reading for that location.

1.1.3.4 Quality Assurance and Quality Control

A Quality Assurance Project Plan (QAPP), developed in collaboration with the laboratory, will be followed during all field sampling. Field data will be collected in a manner that promotes high quality results, and will be subject to appropriate QA/QC procedures as described in the QAPP. QA/QC of laboratory data will follow that laboratory's QA/QC procedures. All water quality data will be verified and/or validated as appropriate. DWR will subject all data to additional QA/QC procedures including, but not limited to: (1) spot-checks of transcription; (2) review of electronic data submissions for completeness; (3) graphical review of data to check for errors; (4) comparison of results to field blank and equipment rinsate results; and (5) identification of any data that seem inconsistent.

If any datum seems inconsistent during the QA/QC procedure, DWR will consult with the laboratory to identify any potential sources of error before concluding that the data is correct. Values that are determined to be anomalous will be removed from the analysis if the reason for the reading cannot be identified. Should the laboratory need to re-extract samples and re-run the sample under different calibration conditions, the data identified by the laboratory as the most certain will be used. If field-sampling conditions, as measured by the field blank and the rinsate sample results, indicate that samples have been contaminated, DWR will identify the data accordingly.

1.1.3.5 Analysis

DWR will analyze the raw data relative to the Lahontan Basin Plan water quality objectives, as appropriate (California Regional Water Quality Control Board [RWQCB] Lahontan Region 1995). Reservoir profiles will be plotted as water temperature versus water surface elevation.

1.1.3.6 Reporting

DWR will compile and summarize results of this study for incorporation into the Draft License Application and Final License Application. A table showing the results, reporting limits and regional water quality objectives (if applicable) will be included in the summary. Reservoir water temperature profiles will be included.

1.1.4 Consistency of Methodology with Generally Accepted Scientific Practices

The *Water Quality and Temperature Study Approach* methods are generally consistent with the methods used for collecting water quality and temperature data in recent relicensing efforts in California, including for the Don Pedro Project (FERC No. 2299), Yuba River Hydroelectric Project (FERC No. 2246) and Merced River Hydroelectric Project (FERC No. 2179).

1.1.5 Schedule

The study may begin as early as May 2017, but fieldwork is anticipated to begin in June 2017. DWR anticipates the schedule below will be followed to complete the Study.

Fieldwork Preparations	May 2017 – August 2017
Water Quality Sampling	May 2017 – February 2018
Reservoir Profiles (Quarterly)	June 2017 – March 2018
Data QA/QC	October 2017– March 2018
Data Analysis and Reporting	November 2017– March 2018

1.1.6 Level of Effort and Cost

Based on the work effort described above, DWR estimates the current cost to complete this study will range between $40,000 and $60,000.

1.1.7 References

California RWQCB Lahontan Region. 1995. Water quality control plan for the Lahontan Region, North and South Basins. Plan effective March 31, 1995, amended through August 16, 2011. Available: http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml

DWR. 2010. The Quagga and Zebra Mussel Rapid Response Plan for the State Water Project. 93 pp. CONFIDENTIAL/PRIVILEGED – Not for Public Distribution.

EPA. 1995. Method 1669: Sampling ambient water for trace metals at United States Environmental Protection Agency water quality criteria levels. EPA 821-R-95-034, United States Environmental Protection Agency, Washington, D.C.

Wilde, F.D., 2011, Water-quality sampling by the U.S. Geological Survey—Standard protocols and procedures: U.S. Geological Survey Fact Sheet 2010-3121, 2 p. Available at https://pubs.usgs.gov/fs/2010/3121.