Weber Hydroelectric Project
FERC Project No. 1744

Preliminary Study Plan
Water Quality

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For Public Review

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1.0 INTRODUCTION

PacifiCorp, a subsidiary of Berkshire Hathaway Energy, plans to file a new application for relicense of a major project, the Weber Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or Commission) Project No. 1744, on the Weber River in Weber, Morgan, and Davis counties in Utah. The current license will expire on May 31, 2020. The Project has a generation capacity of 3.85 megawatts (MW) and is located partially on federal lands managed by the Wasatch-Cache National Forest, and partially on lands owned by the Union Pacific Railroad Company. PacifiCorp filed a Notice of Intent to File Application for New License (NOI) and a Pre-Application Document (PAD) to initiate the Federal Energy Regulatory Commission's (FERC) Alternative Licensing Process (ALP) for the Project on May 29, 2015.

During preparation of the PAD, PacifiCorp conducted a desktop-level assessment to evaluate existing water quality data for the Weber River and to inform analysis of potential Project impacts on water quality. One of the more significant findings from the assessment is that recent comprehensive water quality data (within the last 10 years) for the portion of the Weber River in question are lacking. This lack of data prohibits a rigorous assessment of potential project impacts to this resource from Project operations without obtaining additional water quality sampling data.

The importance of such data is evident given that the Weber River is a highly valued and heavily used resource in Utah, with several stakeholder groups deeply vested for a variety of reasons that include agriculture, municipal water supply, recreation, and fishing. Generally speaking, water quality in the Weber River watershed is moderately degraded with approximately 56% of assessed water bodies meeting beneficial uses as defined and classified in Utah Administrative Code R317-2-6 and R317-2-13 (Weber River Partnership 2014). Common causes for impairments include low dissolved oxygen (DO), high temperatures, high nutrient levels, sedimentation, and habitat degradation.

This water quality study plan aims to achieve two goals: 1) to gain a better understanding of current water quality in the Project area and 2) to determine the effect of Project operations on water quality. Achievement of the study plan goals will identify whether there is a need to develop project-specific mitigation measures for water quality in the Project area. The guiding principles behind the water quality study plan and monitoring strategy will be the beneficial uses and associated Utah water quality standards assigned by the Utah Division of Water Quality to the portion of the Weber River within the Project Area.

2.0 PROJECT AREA

For the purposes of this document, the FERC Project Boundary (or Project Boundary) is defined as all lands and waters within the existing FERC Project Boundary for the Weber Hydroelectric Project No. 1744, as denoted on the project's Exhibit G. The Project Area is the area that contains all project features (encompassing the FERC Project Boundary defined above) and that extends out for the purposes of characterization and analysis from the farthest edge of the Project Boundary across the river to the far riverbank (including the river regardless of which side of the river the project features are found), as shown in Figure 1.

The existing Project consists of:

(1) a 27-foot-high, 79-foot-long concrete diversion dam, having two radial gates approximately 29 feet wide, and a 35-foot-wide intake structure, for a total width of 114 feet, on the Weber River;

(2) a 9,107-foot-long, 5-foot to 6.3-foot diameter steel pipeline partially encased in concrete beginning at the intake and terminating at the powerhouse on the Weber River;

(3) a 3-foot by 18-foot non-operative fish passage structure (used however to pass the minimum flow through the calibrated slide gate opening);

(4) a powerhouse containing a generating unit with a rated capacity of 3,850 kilowatt (kW) operating under a head of 185 feet producing a 30-year average annual energy output of 16,932 megawatt-hours (MWh);

(5) a discharging pipe returning turbine flows into the Weber River at the powerhouse; and,

(6) a 77-foot-long, 46-kilovolt (kV) transmission line which connects to the Weber substation.

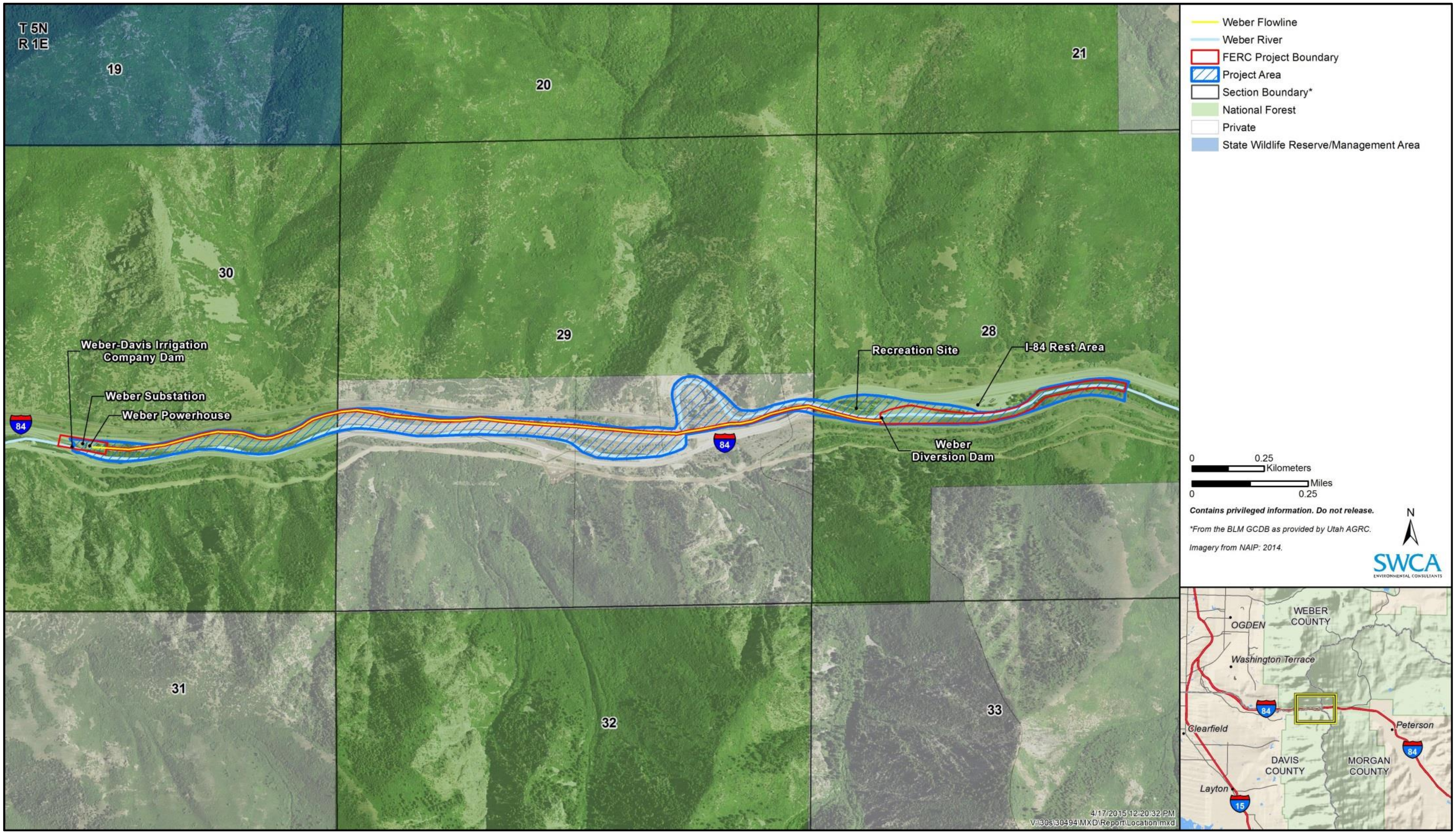

Figure 1: Weber Hydro Relicensing Project Location.

3.0 BACKGROUND

3.1 Existing Data

A water quality analysis as it relates to the Weber Dam and its operation was conducted using existing water quality data from the Weber River-3 Assessment Unit (AU) (UT16020102-002). According to the *2014 Integrated Report* (Utah Department of Environmental Quality [UDEQ] 2014), AUs are delineated by the Utah Division of Water Quality based on similarity in physical, chemical, and biological conditions of a waterbody. The Weber River-3 AU extends from the confluence with the Ogden River upstream to the confluence with Cottonwood Creek. It is approximately 19.5 miles long and encompasses the entirety of the Weber Project Area. Beneficial uses for this portion of the river are identified as Class 2B, 3A, and 4. The description for each Class is provided in Table 1. The *2014 Integrated Report* lists the Weber River-3 AU as "not supporting" because it does not meet beneficial use 3A due to a biological impairment (UDEQ 2014). While this AU is listed as impaired and will require a total maximum daily load (TMDL) study, the current TMDL priority is low (UDEQ 2014), and has not been scheduled.

Table 1. Summary of Use Designations for the Weber River-3 Assessment Unit

Class	Designated Beneficial Use
2B	Protected for infrequent primary contact recreation where there is a high likelihood of ingestation of water or a high degree of bodily contact with water.
3A	Protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain
4	Protected for agricultural uses including irrigation of crops and stock watering
Source: Utah Administrative Code R317-2	

Water quality data for the Weber River-3 AU were obtained from the U.S. Environmental Protection Agency STORET Data Warehouse. Database queries covered two STORET stations, one of which is located approximately 1 river mile upstream of the Project Area (Station ID 4921000) and one that is located approximately 12.6 miles downstream of the Project Area (Station ID 4922990) (Figure 2). Data from 1995 to 2006 were used, and the specific parameters analyzed included pH, specific conductance, turbidity, DO, temperature, alkalinity, phosphate, hardness, and total suspended solids (TSS). Monthly and annual water quality parameters are summarized in Tables 2, 3, and 4.

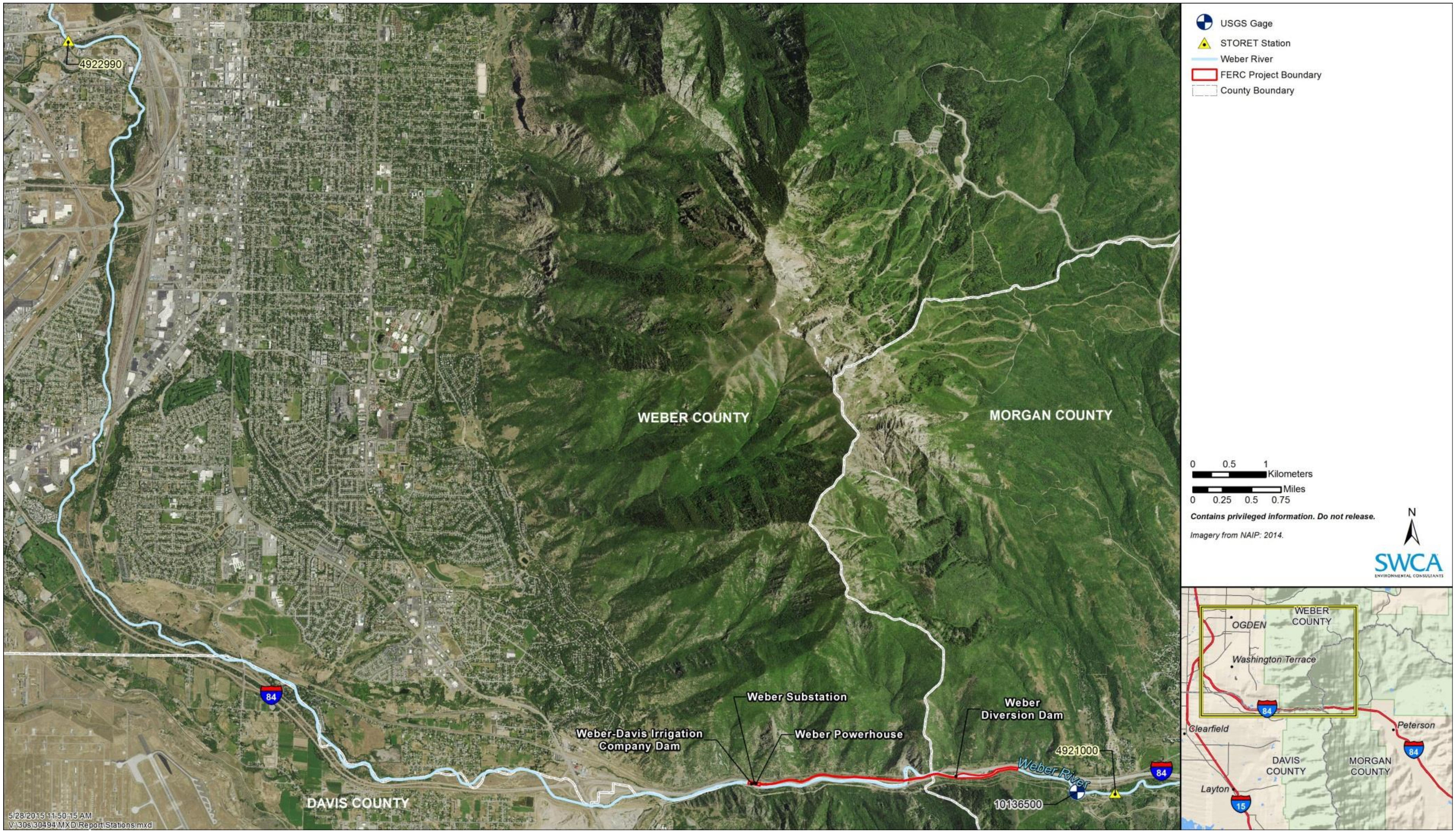

Figure 2. Map of Existing Water Quality Data Locations.

Table 2. Monthly Summary of Water Quality Data for Field Parameters* for the Weber River-3 Assessment Unit, 1995–2006

	January	February	March	April	May	June	July	August	September	October	November	December	Mean
pH													
Average	8.2	8.2	8.1	8.0	8.2	8.2	8.4	8.3	8.4	8.2	8.3	8.3	8.2
Maximum	8.5	8.6	8.9	8.4	9.2	9.3	8.7	9.0	8.7	8.8	8.7	8.5	8.8
Minimum	8.0	7.4	7.0	7.2	7.1	6.7	8.1	8.0	8.1	7.5	8.0	8.0	7.6
Specific conductance (umho/cm)													
Average	571	609	470	365	359	419	529	579	553	551	649	585	520
Maximum	909	766	679	472	611	569	843	669	623	634	846	732	696
Minimum	235	538	291	238	140	263	293	482	294	348	537	512	348
Turbidity (NTU)													
Average	12.7	4.5	29.3	26.6	15.6	6.4	2.3	3.2	5.8	3.0	2.8	2.7	9.6
Maximum	62.3	13.1	99.3	110.0	44.4	18.4	6.5	7.9	14.1	6.8	5.9	3.6	32.7
Minimum	1.5	1.3	2.9	3.5	1.8	1.7	1.0	0.8	1.2	0.8	0.9	1.4	1.6
DO (mg/L)													
Average	10.8	10.9	9.4	9.8	9.9	9.4	10.2	10.4	10.3	9.9	11.8	12.1	10.4
Maximum	13.5	12.9	11.5	10.6	13.0	12.2	13.4	13.2	14.1	12.7	13.4	13.7	12.9
Minimum	8.3	9.7	8.0	8.8	8.2	8.4	7.6	7.5	7.4	6.3	9.9	11.1	8.4
Temperature, water (ºC)													
Average	2.8	4.2	6.2	8.6	12.4	14.7	19.7	17.2	14.6	8.7	7.6	2.3	9.9
Maximum	3.7	7.2	9.2	12.5	17.2	17.7	22.2	20.1	18.0	10.4	10.6	4.2	12.7
Minimum	0.1	1.8	3.4	5.1	6.1	10.5	15.9	14.4	12.4	6.9	5.4	0.7	6.9

Notes: umho/cm = micromhos per centimeter; NTU = nephelometric turbidity units; mg/L = milligrams per liter; ºC = degrees Celsius

*Utah State water quality standard limits listed in Table 6 of Section 4.2, this document (pg. 15)

Table 3. Summary of Monthly Water Quality Data for Nutrient, Sediment, and Hardness Parameters for the Weber River-3 Assessment Unit, 1995–2006

	January	February	March	April	May	June	July	August	September	October	November	December	Mean
Alkalinity, carbonate as CaCO3 (mg/L)													
Average	213	213	167	124	125	157	187	213	211	219	217	215	188
Maximum	256	235	241	159	192	202	202	231	233	241	226	239	221
Minimum	163	184	93	97	81	100	162	190	193	203	194	197	155
Hardness, Ca + Mg (mg/L)													
Average	267	267	197	152	153	198	224	247	250	249	260	246	226
Maximum	382	306	277	183	239	252	265	272	267	283	285	281	274
Minimum	200	235	111	125	93	110	186	223	236	223	229	174	179
Phosphate-phosphorus as P (mg/L)													
Average	0.061	0.044	0.062	0.067	0.065	0.032	0.030	0.052	0.044	0.036	0.024	0.055	0.048
Maximum	0.140	0.074	0.176	0.213	0.224	0.064	0.050	0.094	0.094	0.055	0.034	0.231	0.121
Minimum	0.022	0.020	0.021	0.021	0.021	0.021	0.020	0.021	0.010	0.026	0.020	0.020	0.020
Solids, total suspended (mg/L)													
Average	26.0	12.1	80.8	52.6	52.1	13.3	23.4	13.3	14.8	4.4	6.4	5.9	25.4
Maximum	86.7	21.2	273.0	166.0	135.5	37.6	97.0	35.2	44.0	12.8	17.6	12.0	78.2
Minimum	0.0	0.0	5.6	4.0	4.4	4.0	4.0	0.0	0.0	0.0	0.0	0.0	1.8

Table 4. Summary of Average Annual Water Quality for the Weber River-3 Assessment Unit, 1995–2006.

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
pH	8.3	8.5	8.2	8.3	8.2	8.3	8.2	8.4	8.4	8.0	8.0	8.0
Specific conductance (umho/cm)	479	494	510	528	434	511	499	544	644	488	512	554
Turbidity (NTU)	9.9	5.7	21.0	5.9	24.1	3.7	2.7	1.7	3.1	8.8	–	–
DO (mg/L)	9.8	10.6	9.3	9.8	9.7	10.8	11.2	11.5	12.0	10.2	10.4	10.8
Temperature, water (ºC)	9.9	9.5	9.7	10.9	8.3	10.5	10.3	10.5	12.3	10.4	11.0	–
Alkalinity, carbonate as CaCO3 (mg/L)	187	189	189	203	157	193	197	198	215	157	–	–
Hardness, Ca + Mg (mg/L)	219	214	210	238	195	240	229	235	259	209	–	–
Phosphate-phosphorus as P (mg/L)	0.061	0.073	0.084	0.040	0.061	0.049	0.027	0.036	0.029	0.041	–	–
Solids, total suspended (mg/L)	36.1	15.8	46.5	13.8	42.6	5.4	2.7	0.0	10.0	16.3	–	–

Dash = Data not available.

Seasonal water temperatures from 1995 to 2006 ranged from lows of 0–2°C during the winter (December through February) to highs of 14–19°C during the summer months (June through August). Variation in average annual temperature is relatively small with the greatest difference occurring from 1998 to 1999 (see Table 4). From 1995 to 2005, maximum temperatures occurred during the summer months with the highest temperature recorded during the summer of 2003 at 22.2°C (Figure 3). The UDEQ cold-water fishery temperature standard states that greater than 10% of samples must exceed 20°C in order for the waterbody to be listed as impaired. It should be noted that while this data set does include temperatures that surpass 20°C, fewer than 10% of the samples exceeded 20°C. In addition to denoting the 20°C standard, Figure 3 also shows the average maximum temperature from 1995 to 2005, further identifying temperature conditions in the Weber River-3 AU and illustrating that as it relates to fisheries, temperature is not a water quality issue for the time period covered by this data set.

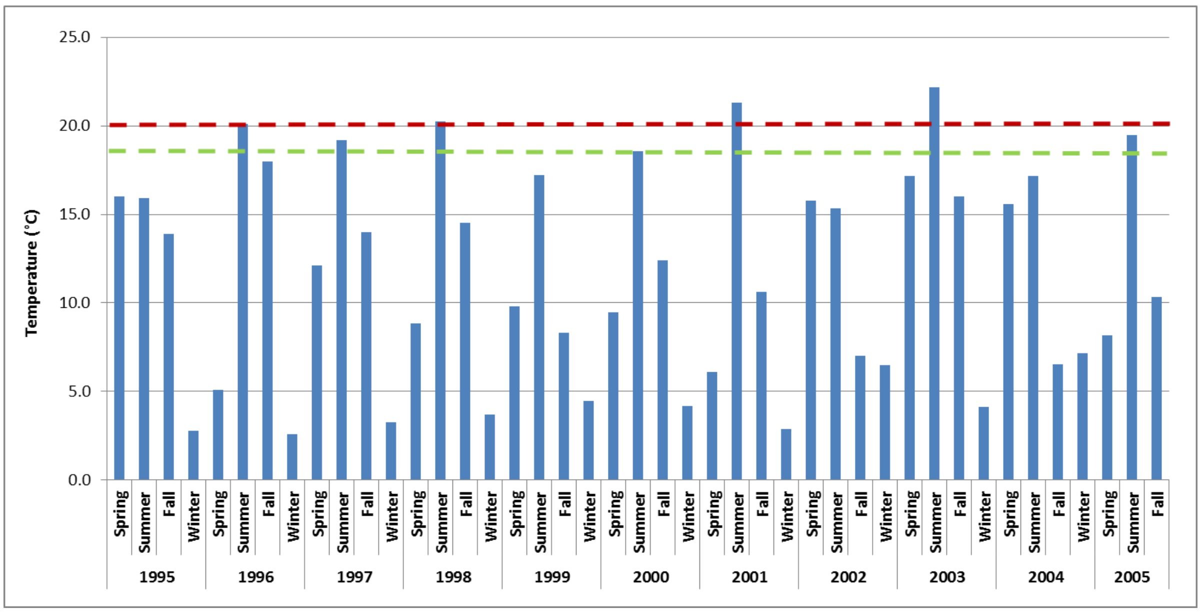

Figure 3. Maximum temperature values by season from 1995 to 2005 compared to the UDEQ temperature standard of 20°C (red dashed line) for Class 3A waters. The average maximum value from 1995 to 2005 is also shown (green dashed line) for reference.

Average alkalinity (ability of the water to neutralize a strong acid) ranged from 124 mg/L to 219 mg/L over the analyzed period with lower values occurring in late spring and higher values occurring in winter. Similarly, total hardness (Ca++ and Mg++) ranged from 152 mg/L to 267 mg/L with lower values occurring in late spring and higher values occurring in winter. Data indicate that water hardness and alkalinity in the Weber River-3 AU is on the high end; however, for this area of Utah, these values are reasonable. On a seasonal basis, the highest concentrations are found during low-flow periods driven by groundwater recharge, with low concentrations occurring during snowmelt and spring runoff. The pH along this portion of the Weber River remains relatively stable, with average monthly values ranging from 8.0 in April to 8.4 in July.

High concentrations of DO (6.0–8.0 mg/L or greater) are important for the health and viability of fish and other aquatic life in the Weber River. Low DO concentrations (less than 4.0 mg/L) can cause an increase in stress to fish species and lower resistance to environmental stress and disease, and can ultimately result in mortality (at levels less than 2.0 mg/L). Low DO in water bodies can be related to a number of factors that include decomposition of algae and other organic matter and subsequent depletion of DO. From 1995 to 2006, DO ranged from 6.3 mg/L to 14.1 mg/L in the Weber River-3 AU with an overall average of 10.4 mg/L. The minimum DO water quality standard of 4.0 mg/L as a 1-day minimum was not exceeded during this time period (Figure 4). It should be noted that several other DO state water quality criteria apply to the designated uses assigned to Weber River-3 AU; however, the existing data set used for this analysis precluded the application of these standards.

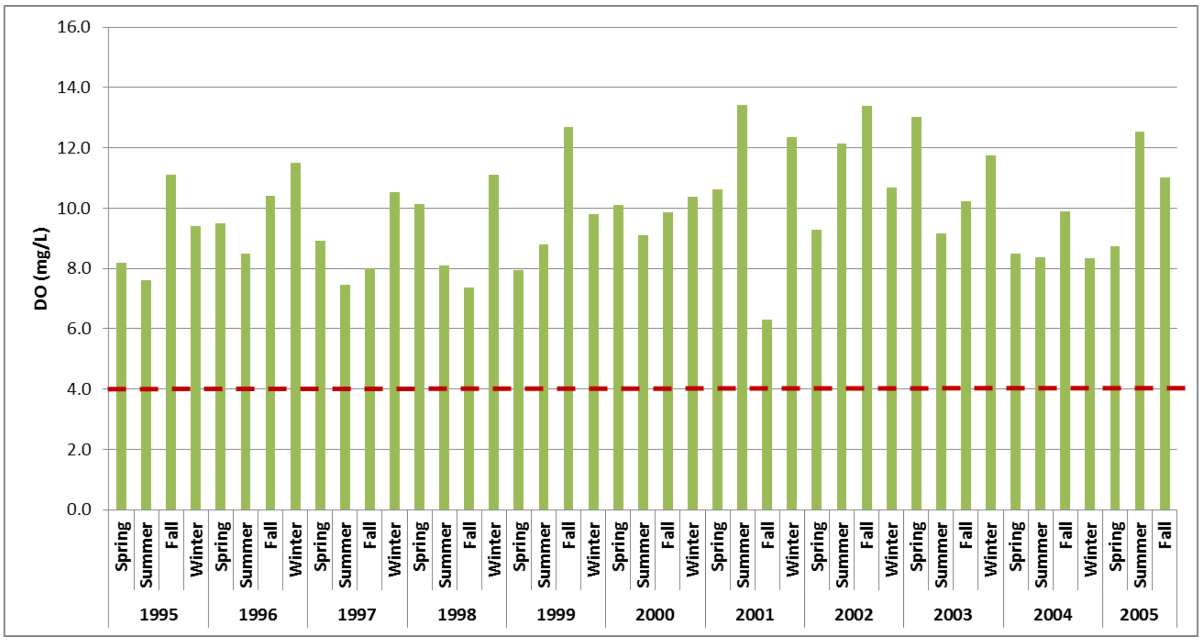

Figure 4. Minimum DO values by season from 1995 to 2005 compared to the UDEQ DO standard of 4°C as a 1-day minimum (red dashed line) for Class 3A waters.

Seasonal average specific conductivity ranged from 168 mg/L to 733 mg/L with an average value of 517 mg/L from 1995 to 2005. Seasonally, higher values were observed during the low flows of the winter months (Figure 5), possibly due to groundwater sourcing of flow or surface runoff containing dissolved solids associated with deicing roads.

Turbidity ranged from 1 NTU to 110 NTU with an average value of 10 NTU, and TSS ranged from 0 mg/L to 273 mg/L with an average value of 22 mg/L. These two parameters (turbidity and TSS) are particularly important for understanding macroinvertebrate habitat because an increase in these parameters can indicate that pores of the streambed are becoming clogged with sediments, causing a reduction of habitat diversity and surface area

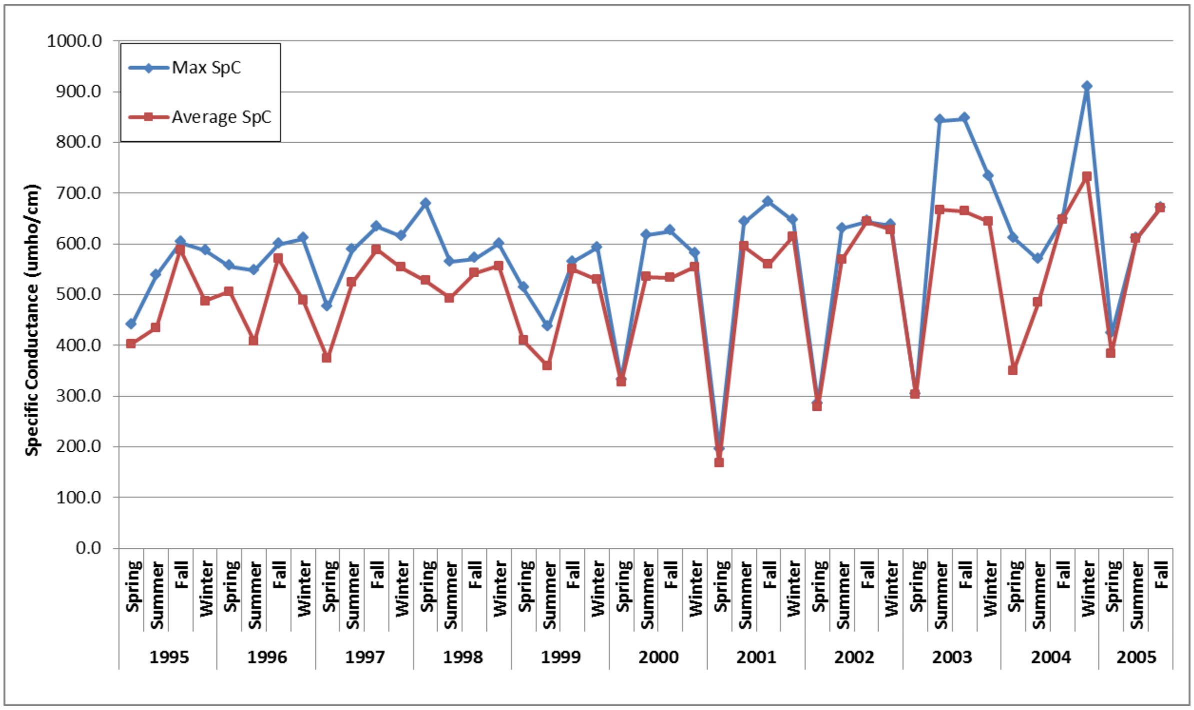

Figure 5. Maximum and average specific conductance by season from 1995 to 2005.

available for microbial and macroinvertebrate growth and, subsequently, for habitat availability and surface protection for eggs and juvenile fish to become limited.

3.2 Water Quality Upstream and Downstream of the Dam

Paired data points from 2003 and 2004 were identified from the two water quality monitoring stations and compared to gain insight into differences in water quality upstream and downstream of the Project Area. Table 5 summarizes the number of data pairs available and the average difference and percentage change from upstream to downstream in water quality for all paired water quality samples for these stations. Trends were graphically explored for specific conductance and turbidity due to the magnitude of difference in matched pairs. Both specific conductance and turbidity are higher at the downstream sampling station versus the upstream sampling station (Figures 6 and 7). These differences are likely due to the fact that the upstream and downstream sampling stations are far enough apart (13.6 miles total) that other factors may be influencing these parameters, including that the downstream site is likely being affected by the urban corridor it traverses. Additional data will be acquired so that the degree to which the Project is affecting water quality can be identified. While historical data are useful for characterizing the evolution of water quality in the watershed, the addition of more recently collected data in closer proximity to the Project Area will be helpful for determining current trends and informing additional resource studies and courses of action during the relicensing process.

Table 5. Paired Water Quality Parameters and Average Percentage of Difference for Upstream and Downstream Sampling Locations

Parameter	Number of Data Pairs	Average Upstream	Average Downstream	Average Difference	Percentage Change
pH	25	8.1	8.2	+0.1	+1.2%
Specific conductance (umho/cm)	24	500.0	601.0	+101.2	+20.2%
Turbidity (NTU)	13	5.0	8.2	+3.2	+64%
DO (mg/L)	13	10.9	10.7	-0.3	-1.8%
Temperature, water (ºC)	13	11.6	11.1	-0.5	-4.3%
Alkalinity, carbonate as CaCO3 (mg/L)	13	173.0	186.0	+12.7	+7.5%
Hardness, Ca + Mg (mg/L)	13	220.7	235.8	+15.0	+6.8%

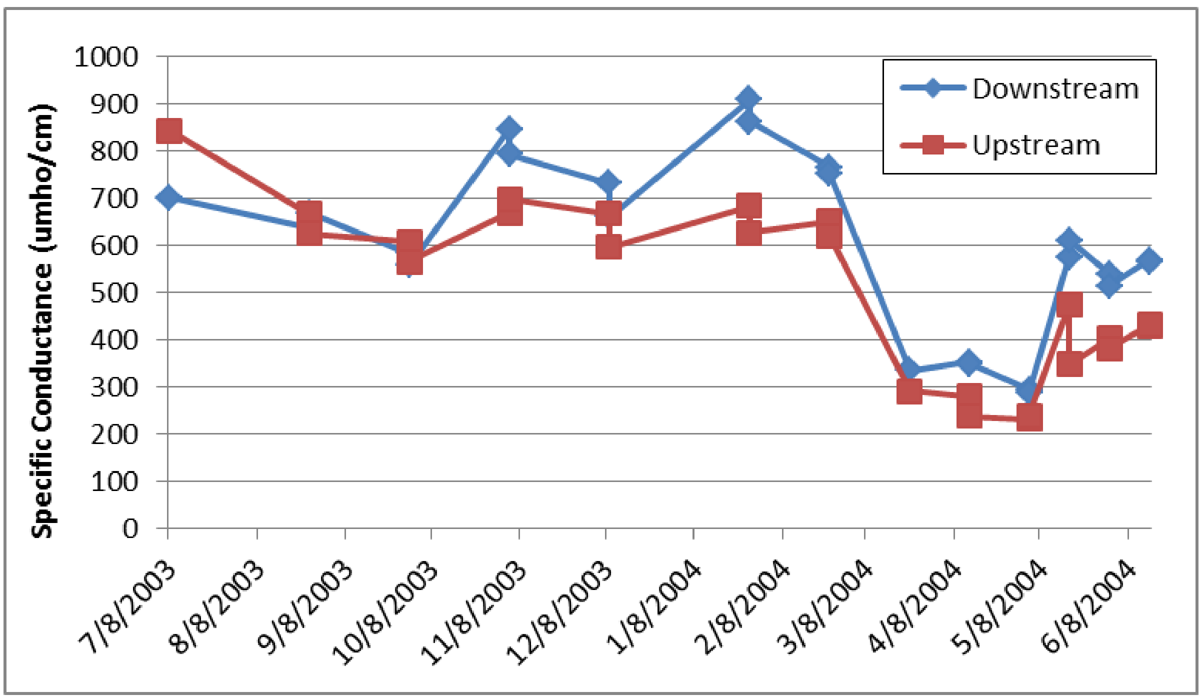

Figure 6. Matched pair values for specific conductance upstream and downstream of the dam from 2003 to 2004.

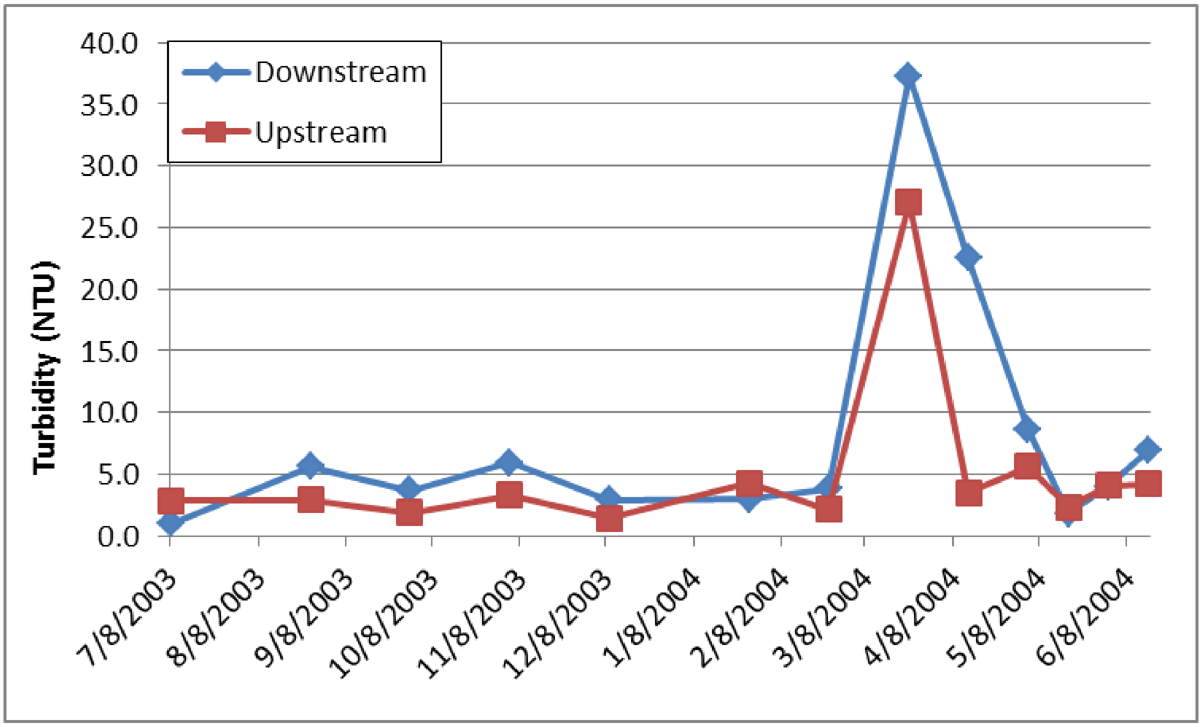

Figure 7. Matched pair values for turbidity upstream and downstream of the dam from 2003 to 2004.

3.3 Nexus to the Project

Water quality may be affected by all types of diversion dams, however the Weber Hydroelectrric Project is a run-of-the-river facility with a very small forebay and associated short retention time. PacifiCorp does not flush the Project forebay to reduce sediment build-up, although limited dredging may occur periodically on an as-needed basis. Historically, when dredging does occur, any dredged materials are removed and disposed of at an off-site location. There are no other Project operations that are known to affect water quality parameters such as temperature, pH, and DO.

4.0 PROPOSED WATER QUALITY STUDY

4.1 Monitoring Locations

PacifiCorp will evaluate the current water quality conditions in the Project Area to determine if beneficial uses and associated Utah state water quality standards are being met and to determine the effects of the project on water quality parameters.

PacifiCorp has selected three locations to monitor water quality: 1) upstream of the Weber Diversion Dam in the eastern portion of the Project Area, 2) downstream of the Project dam in the bypass reach, and 3) the lower end of the bypass reach just downstream of the point where bypass water mixes with powerhouse discharge, and upstreamof the point it enters the Weber-Davis Canal (Figure 8). All sondes will be placed in the river at locations most likely to be representative of the entire stream channel. Where possible, bridges or other

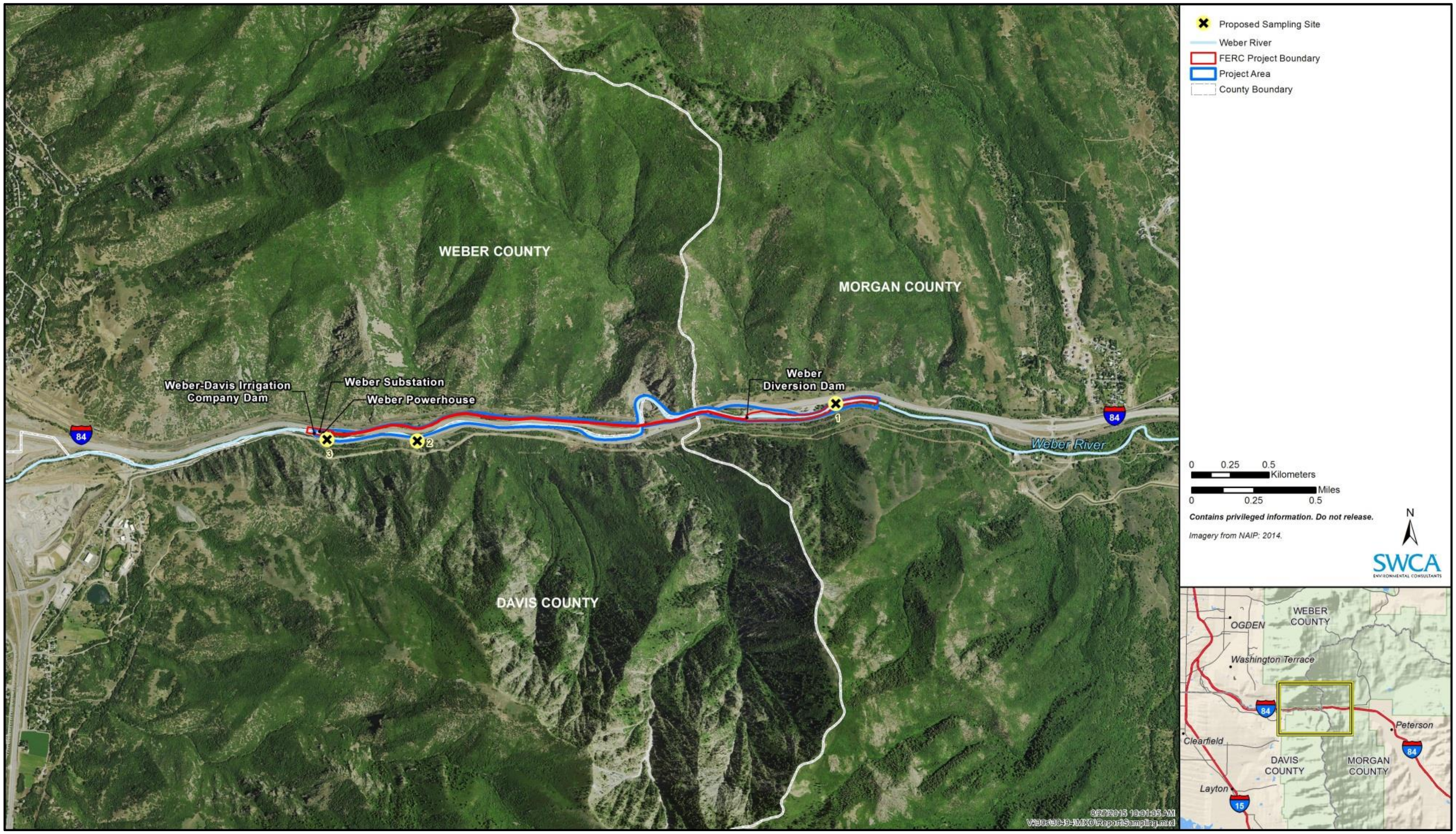

Figure 8. Water Quality Sampling Locations

infrastructure will be used to secure sondes in the middle of the river. At the third downstream-most site, the sonde will be placed as close to the middle of the river as possible and anchored by chaining it to boulders

4.2 Water Quality Parameters

As stated previously, this portion of the Weber River is a part of the Weber River-3 AU, which extends from the confluence with the Ogden River upstream to the confluence with Cottonwood Creek. It is approximately 19.5 miles long, and beneficial uses for this portion of the river are identified as 2B, 3A, and 4. Utah state water quality standards associated with these beneficial uses, as well as the potential for impacts from Project operations, drove the selection of parameters to be monitored for this study plan. Water quality parameters to be monitored include temperature, pH, DO, and turbidity. In addition to monitoring the four parameters with state water quality standards, PacifiCorp also proposes to monitor TSS and specific conductance because these two parameters can lend additional insight into water quality issues. The water quality parameters and associated Utah state water quality standards are listed in Table 6.

Table 6. Monitored Parameters and Associated Utah Water Quality Standards

Parameter	Utah Water Quality Standard
Temperature (max/change)	20°C /2°C
pH	6.5–9.0
DO[1] (30-day average) (7-day average) (1-day minimum)	 6.5 mg/L 9.5/5.0 mg/L 8.0/4.0 mg/l
Turbidity (increase)	10 NTU
TSS	No water quality standard
Specific conductance	No water quality standard

[1] First number in column details when early life stages are present; second number details when all other life stages are present.

To capture current water quality conditions and evaluate potential impacts to water quality from Project operations, a YSI 6920 V2-2 Multiparameter Water Quality Sonde will be deployed at each of the three sampling locations by February 2016. The sondes will be used to record temperature, pH, DO, turbidity, and specific conductance data on an hourly basis. The sondes will remain at the three locations for approximately 1 year to capture all hydrologic periods, including baseflow, spring runoff, and storm flows. Grab samples for laboratory analysis of TSS will be taken once a month and during any planned Project operations that may affect TSS.

4.3 Quality Assurance, Quality Control

QA/QC is an integral part of any water quality study plan and is best described as a set of activities and procedures designed to assure the reliability and accuracy of data and the attainment of quality standards. QA/QC is addressed by establishing both field and laboratory checks that result in qualitative and quantitative measurements of data quality. QA/QC procedures carried out for this study plan include calibrating and servicing water quality sondes on a monthly basis. After sonde deployment, monthly service trips will be conducted (at the same time as TSS sampling) to ensure that sondes are recording data properly. All sondes will be calibrated according to manufacturer's instructions, and batteries will be replaced during monthly checks. Prior to sampling for TSS, all sampling containers will be acquired from the contract laboratory. Once collected, samples will be kept on ice and delivered to the laboratory within the appropriate holding time and under the standard chain of custody protocols.

4.4 Reporting

Results of the water quality study will be presented in a technical report that will include the following components:

- Detailed descriptions of the procedures and methods used to collect and analyze water quality data
- Presentation of the water quality results in both tabular and graphical format
- Statistical analysis of the water quality results by hydrologic period
- Discussion and summary of findings
- Identification of project impacts on water quality (if any)
- Recommendations for mitigation of project impacts on water quality (if any)

4.5 Schedule and Cost

Water quality monitoring equipment is expected to be installed at the three sampling locations identified in section 4.1 by early February 2016. Data will be gathered for approximately 1 year to capture all hydrologic periods and any Project operations that may impact water quality. Following the field effort, all water quality data will be analyzed and presented in a draft report (section 4.4). Stakeholder and agency comments will be addressed within a 2-week period following the 30-day review period, and the report then will be finalized and submitted to FERC. The estimated cost for each component of this study is presented in Table 7.

Table 7. Proposed Tasks and Associated Potential Costs

Task	Cost
Water quality sondes deployment and use	$7,391
Water quality sampling	$11,251
Laboratory analysis	$776
Reporting	$5,533
Total	**$24,951**

5.0 REFERENCES

Utah Department of Environmental Quality (UDEQ). 2014. *2014 Integrated Report*. Available at: http://www.deq.utah.gov/ProgramsServices/programs/water/wqmanagement/assessment/currentIRoct.htm. Accessed July 22, 2015.

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