FINAL TECHNICAL REPORTS

WEBER HYDROELECTRIC PROJECT RELICENSING
FERC PROJECT NO. 1744

Submitted to

Federal Energy Regulatory Commission
Division of Hydropower Licensing
888 First Street NE
Washington, DC 20426

Submitted by

PacifiCorp—Hydro Resources
1407 West North Temple
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June 30, 2017

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INTRODUCTION

PacifiCorp owns and operates 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, Utah. The current FERC license will expire May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. 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.

This submittal is comprised of the final technical reports prepared as part of the FERC ALP process, including:

- Water Resources
- Fisheries
- Recreation
- Terrestrial Threatened Endangered and Sensitive Species and Noxious Weeds
- Cultural Resources

The technical reports were prepared by PacifiCorp and its consultants in consultation with the Weber Hydroelectric Project Relicensing stakeholder group, made up of representatives of relevant federal, state and local agencies, as well as non-governmental agencies and interested parties identified during the Project's scoping process. In addition, working groups consisting of volunteers from the larger stakeholder group (see Appendix A for current members of the stakeholder and working groups) were formed to help guide studies for fisheries and water resources and recreation. The following table shows actions taken in developing the technical reports and the timeline for each.

Weber Hydroelectric Project Relicensing – Technical Report Actions and Timeline

Technical Report	Action	Date
Water Resources	• Preliminary draft technical report distributed to water resources work group for 30-day review • Stakeholder group invited to review	March 15, 2017
	• Comments on preliminary draft addressed, draft technical report filed with FERC for 30-day public comment	April 28, 2017
	• One comment received during public comment period. • Comment on draft technical report addressed in final report.	Closed May 29, 2017
Fisheries	• Preliminary draft technical report distributed to fisheries work group for 30-day review	December 22, 2016

Weber Hydroelectric Project Relicensing – Technical Report Actions and Timeline

Technical Report	Action	Date
	• Stakeholder group invited to review	
	• Comments on preliminary draft addressed, draft report filed with FERC for 30-day public comment	February 9, 2017
	• No comments received during public comment period.	Closed March 13, 2017
Recreation	• Preliminary draft technical report distributed to recreation work group for 30-day review. • Stakeholder group invited to review.	November 15, 2016
	• Comments on the preliminary draft addressed; draft technical report filed with FERC for 30-day public comment.	December 20, 2016
	• One comment letter received during public review period. • Comment on draft technical report addressed in comment matrix, no change to technical report.	Closed January 19, 2017
Terrestrial Threatened, Endangered and Sensitive Species and Noxious Weeds	• Preliminary draft technical report distributed to stakeholder group for 30-day review.	August 2, 2016
	• Comments on the preliminary draft addressed; draft technical report filed with FERC for 30-day public review.	September 13, 2016
	• No comments received during public review period.	Closed October 13, 2016
Cultural Resources	• Preliminary draft technical report distributed to stakeholder group for 30-day review.	August 2, 2016
	• Comments on the preliminary draft addressed; draft technical report filed with FERC for 30-day public review.	September 13, 2016
	• No comments received during public review period.	Closed October 13, 2016
All	• Final Technical Reports for all resources filed jointly with FERC	June 30, 2017

A matrix showing comments received during review periods for both the draft and preliminary draft technical reports and how each was addressed immediately follows each technical report in this submittal. In addition, redlines of each of the technical reports showing how comments on the preliminary draft reports were incorporated have been posted to PacifiCorp's web page for the Weber Project at http://www.pacificorp.com/es/hydro/hl/weber.html#.

Appendix A

Weber Hydroelectric Project Relicensing Stakeholders and Working Group Members

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Weber Hydroelectric Project Relicensing Stakeholder Group	
Federal	
Paul Abate Aquatics Branch Supervisor	U.S. Fish and Wildlife Service Utah Ecological Services Field Office Salt Lake City, UT
George Weekley Fisheries Biologist	U.S. Fish and Wildlife Service Utah Ecological Services Field Office Salt Lake City, UT
Sean Harwood District Ranger	USDA Forest Service Ogden Ranger District Uinta-Wasatch-Cache National Forest Ogden, UT
Jim Nutt Fisheries Biologist	USDA Forest Service Inter-Regional Hydropower and Ditch Bill Team Region 4 – Intermountain Region Boise, ID
Charlie Rosier Recreation, Lands and Special Uses	USDA Forest Service Supervisor's Office Uinta-Wasatch-Cache National Forest South Jordan, UT
Paul Chase Fisheries Biologist	USDA Forest Service Logan Ranger District Uinta-Wasatch-Cache National Forest Logan, UT
Wayne Pullan Area Manager	Bureau of Reclamation Provo Area Office Provo, UT
Justin Record Water Rights Coordinator	Bureau of Reclamation Provo Area Office Provo, UT
Rick Jones Wildlife Biologist	Bureau of Reclamation Provo Area Office Provo, UT
Evan Williams FERC Project Coordinator	Federal Energy Regulatory Commission Division of Hydropower Licensing Washington, DC
John Mudre Ecologist	Federal Energy Regulatory Commission Division of Hydropower Licensing Washington, DC
Kyle Olcott Outdoor Recreation Planner	Federal Energy Regulatory Commission Division of Hydropower Licensing Washington, DC
State	
Paul Thompson Aquatics Program Manager	Utah Division of Wildlife Resources Northern Region Office Ogden, UT
Bill James Energy Development/NEPA Coordinator	Utah Division of Wildlife Resources State Headquarters Salt Lake City, UT

Weber Hydroelectric Project Relicensing Stakeholder Group	
Sarah Seegert Native Aquatics Coordinator	Utah Division of Wildlife Resources State Headquarters Salt Lake City, UT
Chris Hansen SHPO Compliance and Preservation	Utah Division of State History State Historic Preservation Office Salt Lake City, UT
Kari Lundeen Weber River Watershed TMDL Coordinator	Utah Department of Environmental Quality Division of Water Quality Salt Lake City, UT
William Damery Water Quality Management	Utah Department of Environmental Quality Division of Water Quality Salt Lake City, UT
Brent DeYoung South District Engineer	Utah Department of Transportation Ogden, UT
Local	
Cole Panter Weber and Ogden Water Commissioner	Ogden, UT
Rick Smith General Manager	Weber River Water Users & Davis and Weber Counties Canal Company Sunset, UT
Jeff Budge Operations and Engineering Manager	Provo River Water Users Pleasant Grove, UT
Mark Anderson Assistant General Manager	Weber Basin Water Conservancy District Layton, UT
Non-governmental Organizations	
Charlie Vincent Regional Coordinator	American Whitewater Salt Lake City, UT
Kevin Colburn National Stewardship Director	American Whitewater Cullowhee, NC
Paul Burnett Weber River Program Coordinator	Trout Unlimited Ogden, UT
Fred Reimherr	Stonefly Society Salt Lake City, UT
PacifiCorp	
Eve Davies Relicensing Project Manager	PacifiCorp Salt Lake City, UT
Todd Olsen Director of Compliance	PacifiCorp Portland, OR
Frank Shrier Fisheries Biologist	PacifiCorp Portland, OR
Russ Howison Recreation Specialist	PacifiCorp Portland, OR
Jack Kolkman Plant Director	PacifiCorp Salt Lake City, UT

Weber Hydroelectric Project Relicensing Fisheries and Water Resources Working Groups	
Federal	
Paul Abate Aquatics Branch Supervisor	U.S. Fish and Wildlife Service Utah Ecological Services Field Office Salt Lake City, UT
George Weekley Fisheries Biologist	U.S. Fish and Wildlife Service Utah Ecological Services Field Office Salt Lake City, UT
Jim Nutt Fisheries Biologist	USDA Forest Service Inter-Regional Hydropower and Ditch Bill Team Region 4 – Intermountain Region Boise, ID
Paul Chase Fisheries Biologist	USDA Forest Service Logan Ranger District Uinta-Wasatch-Cache National Forest Logan, UT
John Mudre Ecologist	Federal Energy Regulatory Commission Division of Hydropower Licensing Washington, DC
State	
Paul Thompson Aquatics Program Manager	Utah Division of Wildlife Resources Northern Region Office Ogden, UT
Sarah Seegert Native Aquatics Coordinator	Utah Division of Wildlife Resources State Headquarters Salt Lake City, UT
Kari Lundeen Weber River Watershed TMDL Coordinator	Utah Department of Environmental Quality Division of Water Quality Salt Lake City, UT
William Damery Water Quality Management	Utah Department of Environmental Quality Division of Water Quality Salt Lake City, UT
Non-governmental Organizations	
Paul Burnett Weber River Program Coordinator	Trout Unlimited Ogden, UT
Fred Reimherr	Stonefly Society Salt Lake City, UT
PacifiCorp	
Eve Davies Relicensing Project Manager	PacifiCorp Salt Lake City, UT
Frank Shrier Fisheries Biologist	PacifiCorp Portland, OR

Weber Hydroelectric Project Relicensing Recreation Working Group	
Federal	
Jim Nutt Fisheries Biologist	USDA Forest Service Inter-Regional Hydropower and Ditch Bill Team Region 4 – Intermountain Region Boise, ID
David Ashby District Recreation Staff	USDA Forest Service Intermountain Region Wasatch-Cache National Forest Logan, UT
Rick Jones Wildlife Biologist	Bureau of Reclamation Provo Area Office Provo, UT
Kyle Olcott Outdoor Recreation Planner	Federal Energy Regulatory Commission Division of Hydropower Licensing Washington, DC
State	
Paul Thompson Aquatics Program Manager	Utah Division of Wildlife Resources Northern Region Office Ogden, UT
Non-governmental Organizations	
Charlie Vincent Regional Coordinator	American Whitewater Salt Lake City, UT
PacifiCorp	
Eve Davies Relicensing Project Manager	PacifiCorp Salt Lake City, UT
Russ Howison Recreation Specialist	PacifiCorp Portland, OR

FINAL
WATER RESOURCES TECHNICAL REPORT

WEBER HYDROELECTRIC PROJECT RELICENSING
FERC PROJECT NO. 1744

Prepared for

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June 30, 2017

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1.0 INTRODUCTION

PacifiCorp owns and operates 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, Utah. The current FERC license will expire on May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. The Project has a generation capacity of 3.85 megawatts 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 and a Pre-Application Document (PAD) (PacifiCorp 2015) to initiate the FERC Alternative Licensing Process for the Project on May 29, 2015.

During preparation of the PAD, PacifiCorp conducted a desktop-level assessment to evaluate existing water resources data for the Weber River and to inform analysis of potential Project effects on water resources. One finding from the desktop-level assessment is that recent, comprehensive water quality data (within the last 10 years) for the portion of the Weber River in question (i.e., the Weber River-3 Assessment Unit [AU]) 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 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.

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 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.

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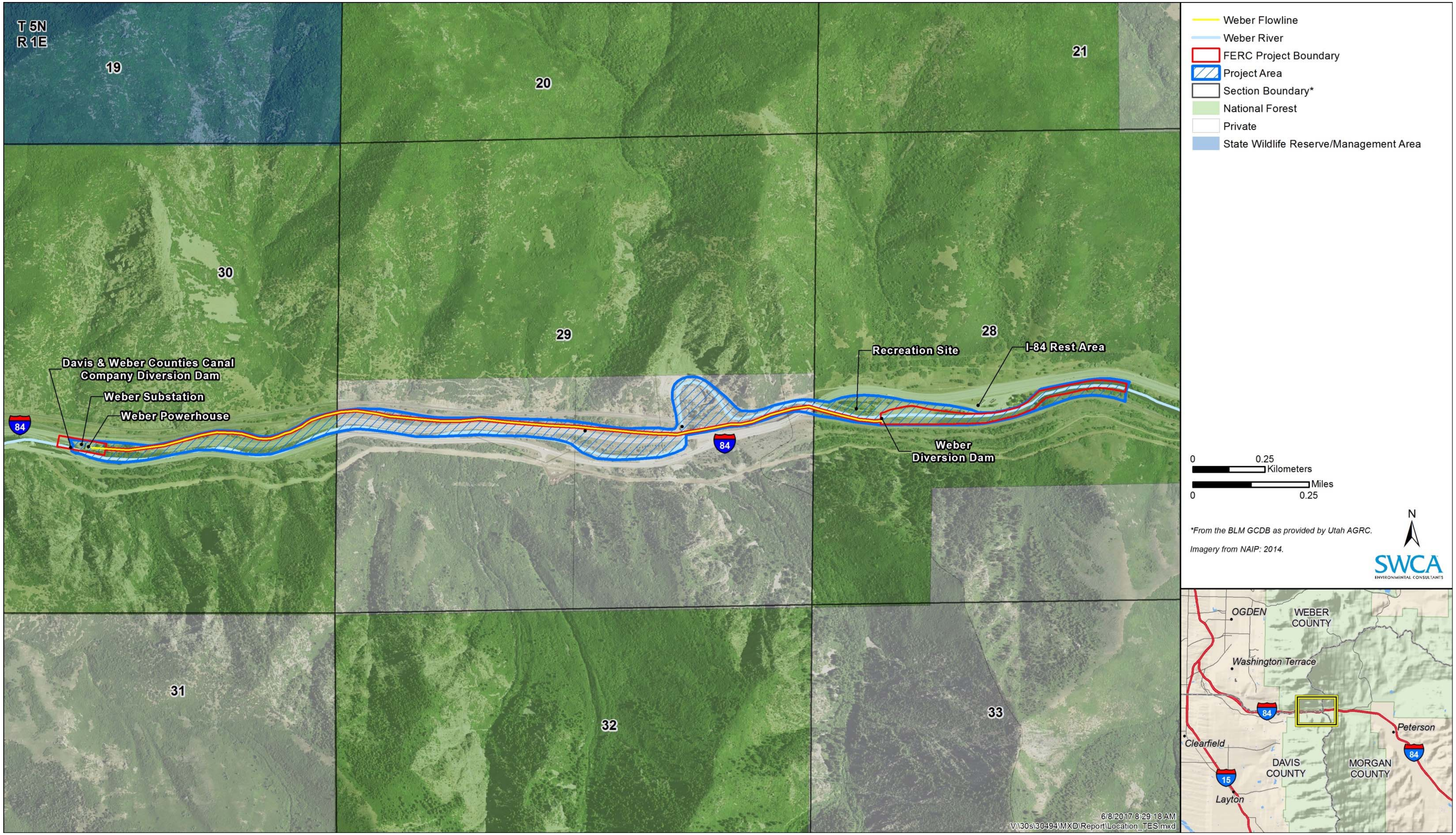

Figure 1. Project Area.

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2.0 PURPOSE

After assessing the results of the PAD, PacifiCorp developed the *Final Study Plan Water Resources* (Final Study Plan) (PacifiCorp 2016). The Final Study Plan has two components: 1) an analysis of hydrology, including information regarding the flow regime in the Project Area, and 2) a proposed water quality study plan. This water resources technical report for the Weber Project is a report of the water quality study plan, because that was the only portion of the approved Final Study Plan that specified new Project Area studies (rather than analysis of existing information).

The water quality study plan was developed 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 operation on water quality and to address the specific Clean Water Act Section 401 water quality certification standards to ensure that the federally permitted or licensed activities are conducted in a manner that complies with applicable discharge and water quality requirements to maintain the chemical, physical, and biological integrity of waters of the United States within the state. As stated in the water quality study plan, the applicable discharge and water quality requirements are based on the beneficial uses and associated Utah water quality standards assigned by the Utah Department of Environmental Quality (UDEQ) Division of Water Quality to the portion of the Weber River within the Project Area (PacifiCorp 2016).

3.0 PROCEDURES AND METHODS

This section describes the procedure used to determine the water quality sampling locations, the water quality parameters selected for analysis, the methods used to collect water quality data and samples, the procedures and methods used to analyze the samples, and the methods used to evaluate the results.

3.1 Sampling Locations

In the water quality study plan, PacifiCorp selected three preliminary locations to monitor water quality: 1) upstream of the Weber diversion dam in the eastern portion of the Project Area, 2) downstream of the Weber diversion 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 just upstream of the point where it enters the Davis-Weber Canal. A fourth site was considered immediately upstream of the Weber diversion dam for chlorophyll *a* analysis only.

The precise monitoring locations were selected during a site visit on January 19, 2016. All stakeholders were invited to participate. SWCA Environmental Consultants, PacifiCorp, and UDEQ Division of Water Quality staff attended the site visit. The final four locations (WR01, WR02, WR03, and WR04) were selected to ensure that water quality instrumentation was appropriately placed for the spectrum of annual flow variability, and to ensure that the entire stream channel was represented to the greatest extent possible. WR02 was chosen because there is a septic leach field system located immediately upstream of the Project Area at the Utah

Department of Transportation rest area, and this leach field has the potential for resultant confounding effects. During the site visit, it was determined that because of safety and access issues associated with the Davis & Weber Counties Canal Company (DWCCC) diversion dam as well as the potential for confounding effects associated with the DWCCC diversion dam, WR04 could not be placed downstream of the point where bypass water mixes with powerhouse discharge. The final location for WR04, technically inside and underneath PacifiCorp's Weber powerhouse, was selected instead. At this location, water that has been diverted through PacifiCorp's flowline and powerhouse to generate power is released from the flowline pipe into a chamber that is partially isolated from the river by a low wall, over which the water is discharged back into the river. Additional information regarding the final selected sampling site locations are summarized and described in Table 1 and shown in Figure 2.

Table 1. Sampling Site Locations and Descriptions

Sampling Site	Sampling Site Location Description
WR01	At U.S. Geological Survey station 10136500, Weber River, Gateway, Utah
WR02	Upstream of the Weber diversion dam
WR03	Downstream of the Weber diversion dam, in the bypassed reach of the river, approximately 100 meters upstream of PacifiCorp's Weber powerhouse
WR04	Within PacifiCorp's Weber powerhouse outflow, upstream of the DWCCC diversion dam

3.2 Water Quality Parameters

The water quality monitoring parameters defined in the water quality study plan and evaluated in this report are temperature, pH, specific conductivity, dissolved oxygen (DO), turbidity, and total suspended solids (TSS). Some of these water quality parameters have numeric water quality criteria for the beneficial uses designated by the State of Utah for the Weber River-3 AU[1]. Comparison of the water quality results collected for these parameters to Utah's numeric water quality criteria is one of the primary goals of the water quality study plan. Although TSS and specific conductivity do not have numeric water quality criteria, they lend additional insight into the water quality of the Weber River-3 AU. In addition to these water quality parameters, PacifiCorp elected to monitor chlorophyll *a* to assess algal biomass throughout the Project Area as a good faith effort to contribute to the overall understanding of water quality in the Weber River. Algae, as represented by chlorophyll *a*, is the primary food source for the bluehead sucker (*Catostomus discobolus*), a Utah state species of special concern, and it is important to understand how algae varies both spatially and temporally in the river.

The methods used to collect water quality data and water samples involved the use of sondes and water quality grab samples for laboratory analysis. A summary of the methods used to collect these data and the types of water quality parameters collected and analyzed at each monitoring location are provided in Table 2.

[1] 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.

Figure 2. Water quality sampling site locations.

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Table 2. Methods Used and Types of Water Quality Parameters Recorded or Collected at each Sampling Location

Sampling Site	Data Collection Method	Water Quality Parameters
WR01	Sonde	Temperature, pH, specific conductivity, DO, and turbidity
	Grab	TSS and Chlorophyll *a*
WR02	Grab	Chlorophyll *a*
WR03	Sonde	Temperature, pH, specific conductivity, DO, and turbidity
	Grab	TSS and Chlorophyll *a*
WR04	Sonde	Temperature, pH, specific conductivity, DO, and turbidity
	Grab	TSS and Chlorophyll *a*

Note: TSS grab samples were submitted to American West Analytical Laboratories for analysis; chlorophyll *a* grab samples were submitted to the Utah Department of Health Division of Laboratory Services for analysis.

3.3 Water Quality Sondes

Sondes were placed in the Weber River at WR01, WR03, and WR04. So that the data would be representative of the stream channel of the entire Project Area, the sondes at WR01 and WR03 were placed in the thalweg of the river (or deepest point that channels most of the flow), and at WR04, the sonde was placed in the powerhouse catch basin, as noted above in Section 3.1).

The sondes were placed inside an approximately 20-foot-long, 4-inch-diameter plastic pipe that was field screened by drilling 1-inch holes to allow water to pass through. The pipes at WR01 and WR03 were placed on a slope into the river and were anchored to the bank. The pipe at WR04 was placed vertically into the catch basin within the powerhouse and secured to the ladder that leads to the discharge flow below the powerhouse floor. The sondes were programmed to record temperature, pH, specific conductivity, DO, and turbidity data on 15-minute intervals. Sonde data were retrieved once a month from February 2016 to January 2017. Per stakeholder agreement, data for WR04 (below the Project Area) were collected only when the Project was operational. The Project was not operational in February 2016, December 2016, and January 2017.

3.4 Grab Samples

Grab samples were collected for laboratory analysis of TSS and chlorophyll *a* once a month from February 2016 to January 2017. Samples for both parameters were collected at the four locations with the following exceptions. TSS was not sampled at WR02 (WR02 was sampled for chlorophyll *a* only), and grab samples for TSS and chlorophyll *a* were not taken at WR04 in February 2016 and January 2017 because the powerhouse was offline and water in the catch basin was frozen. In total, 34 grab samples were analyzed for TSS and 46 grab samples were analyzed for chlorophyll *a*.

Grab samples were collected using the UDEQ Division of Water Quality standard operating procedures (UDEQ 2013a, 2013b, 2014). Grab samples were submitted to American West

Analytical Laboratories (in Salt Lake City) for TSS analysis, and to the Utah Department of Health Division of Laboratory Services for chlorophyll *a* analysis.

3.4.1 Total Suspended Solids

TSS was monitored monthly at WR01, WR03, and WR04. TSS refers to the amount of solid material suspended in the water. It differs from turbidity in that it provides the actual weight of suspended matter. High TSS in a waterbody can often mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water. These pollutants may attach to sediment particles on the land and be carried into waterbodies with stormwater. In the water, the pollutants may be released from the sediment or travel farther downstream. High TSS can also result in a decrease of light penetration into the water column, an increase in water temperatures, and a decrease in DO (Murphy 2007).

3.4.2 Chlorophyll a

Chlorophyll *a* was monitored monthly at the four monitoring sites described above. Chlorophyll *a* is a measure of the amount of algae growing in a waterbody. It can be used to classify the trophic condition of a waterbody. Algae is a natural part of freshwater ecosystems; however, too much algae can cause problems such as decreased levels of DO when algae is dead and decaying and biological oxygen demand is high. Some algae also produce toxins that can be a public health concern when found in high concentrations. One of the symptoms of degraded water quality condition is the increase of algae biomass as measured by the concentration of chlorophyll *a*. Waters with high levels of nutrients from fertilizers, septic systems, sewage treatment plants, and urban runoff may have high concentrations of chlorophyll *a* and excess amounts of algae (U.S. Environmental Protection Agency 2016).

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

SWCA adhered to the quality assurance and quality control (QA/QC) procedures described in Section 4.2.3 of the Final Study Plan (PacifiCorp 2016), and as described in the UDEQ standard operating procedures for parameter collection, to ensure that the data were reliable and accurate and that they attained appropriate quality standards. SWCA conducted the following to adhere to the QA/QC procedures:

- Water quality sondes were calibrated and serviced on a monthly basis to ensure that sondes were recording data properly. All sondes were calibrated according to manufacturer's instructions, and batteries were replaced during the monthly checks.
- Before collecting grab samples, sample containers were acquired from American West Analytical Laboratories for TSS analysis. Filter collection pads for chlorophyll *a* analysis were obtained from the Utah Department of Health Division of Laboratory Services.
- Once collected, grab samples were kept on ice and delivered to each state-certified laboratory within the appropriate holding time and under the standard chain-of-custody protocols.

4.1 Calibration and Operation of Sondes

Sondes were calibrated and serviced on a monthly basis when data were downloaded. The servicing of the sondes included replacing batteries, cleaning all probes, replacing wiper blades, and examining the sondes for any damage or leakage. Calibration of the sondes was conducted according to YSI procedures and using YSI calibration standards.

4.2 Grab Sample Collection, Preservation, Analysis, and Custody

Grab samples (see Table 2) were collected from the thalweg of the river using clean collection bottles. Water from the collection bottles was then poured into bottles provided by the laboratory. All sample bottles were placed in a cooler on ice until they were delivered to their respective laboratories. All samples were submitted to the laboratories within their respective holding times. TSS samples were analyzed by American West Analytical Laboratories in Salt Lake City, Utah. Water samples for chlorophyll *a* analysis were poured into a filtration device, and the sampled water was hand pumped through a glass fiber filter. This filter was then wrapped in aluminum foil, sealed in a plastic bag, and placed in a cooler on ice. Chlorophyll *a* samples were analyzed by the Utah Department of Health Division of Laboratory Services in Taylorsville, Utah.

4.3 Duplicate Grab Samples

Per standard protocol, one duplicate sample was collected for every 20 grab samples collected. Table 3 shows the results of duplicate samples and the original sample results for TSS (in milligrams per liter [mg/L]) and for chlorophyll *a* (in micrograms per liter [µg/L]).

Table 3. Results of Original and Periodic Duplicate (every 20) Grab Samples for Total Suspended Solids and Chlorophyll *a*

Parameter	2016							
	April		August		October		December	
	Original	Duplicate	Original	Duplicate	Original	Duplicate	Original	Duplicate
TSS (mg/L)	4.40	5.60	N/A	N/A	3.20	3.20	N/A	N/A
Chlorophyll *a* (µg/L)	19.30	22.50	1.39	0.41	N/A	N/A	1.13	1.13

N/A = not applicable

Analytical precision was evaluated using relative percent difference (RPD) between the original and the duplicate results using the following equation:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

where,

RPD = Relative Percent Difference (as %)

$|X_1 - X_2|$ = Absolute value (always positive) of $X_1 - X_2$

X_1 = Original sample concentration

X_2 = Duplicate sample concentration

In general, an RPD of less than or equal to 20% typically serves as a recommended rule of thumb for aqueous samples. Table 4 shows the relative percent difference between those two numbers.

Table 4. Relative Percent Difference between Original and Duplicate Grab Samples for Total Suspended Solids and Chlorophyll *a*

Parameter	2016			
	April	August	October	December
TSS (mg/L)	24%	N/A	0%	N/A
Chlorophyll a (µg/L)	15%	109%	N/A	0%

N/A = not applicable

One duplicate sample collected for chlorophyll *a* in August 2016 was well above the recommended 20% RPD (109%). Therefore, the sample results for chlorophyll *a* collected in August 2016 at WR02 were excluded from the analysis. One duplicate sample collected for TSS in April 2016 was above the recommended 20% RPD (24%); however, because this exceedance was marginal, SWCA determined that these TSS data were acceptable to include in the analysis.

4.4 Validation and Reconciliation

Data generated by the state-certified laboratories were subject to the internal contract laboratory QA/QC processes before they were released. Data are assumed to be valid because the laboratories adhered to their internal QA/QC plan. Data recorded by the sondes are considered valid and usable because QA/QC procedures and processes were applied, evaluated, and determined acceptable.

The approach used to identify outliers in the sonde data was based on the statistical methods used to build a box plot. The box plot method for identifying outliers was developed by Tukey (1977) and makes no distributional assumptions, nor does it depend on a mean or standard deviation. Instead, the box plot method relies on calculating the lower quartile, upper quartile, inter-quartile range, lower extreme, and upper extreme of a dataset. This method for identifying outliers was applied to all data recorded by the sondes. Data determined to be outliers were rejected and not used in preparation of this report.

In addition, laboratory results that reported below the detection limit were to be reported as half the detection limit for the purpose of statistical analysis.

After data validation and database construction, data were statistically summarized for the following statistical calculations:

- Minimum
- Maximum
- Average
- Standard deviation

5.0 RESULTS

Statistical summaries, comparison to State of Utah water quality standards, and Project impacts on water quality for sonde data and grab samples are provided in the following subsections. The raw data are available in digital format upon request to SWCA's Lindsey Kester by email at lkester@swca.com or by telephone at 801-322-4307.

5.1 Water Quality Sonde Results

Statistical summaries for each of the parameters recorded by the sondes are presented in the sections below, followed by a discussion and graph of the results.

5.1.1 Temperature

The statistical summaries for the water temperature sonde data are provided in Table 5. Temperature recorded at the three sampling sites follows a typical seasonal pattern (Figure 3). Monthly average temperatures for the water temperature sonde data are provided in Table 6. Similar to the water quality data presented in the Final Study Plan for the Weber River-3 AU (PacifiCorp 2016), temperatures recorded at WR03 slightly exceed the State of Utah water quality standards for temperature (20 degrees Celsius [°C]) on 15 days between July 21, 2016, and August 8, 2016. Overall, the Project does not appear to affect water temperature.

It should be noted that the Weber River is designated as a cold water fishery (3A), for which maximum temperature change should not exceed 2°C. From WR01 (above project) to WR03 (downstream of the Weber diversion dam), there is no change in average temperature. From WR01 and WR03 to WR04 (cement catch basin in powerhouse below pipeline diversion), the average temperature change is 0.1°C when compared to the 8 months of data that all sites have in common, and 1.9°C when the 8 months of data available for WR04 are compared to the 12 months of data (including the 3 coldest months of the year) that were collected at WR01 and WR03 (see Table 5). Although this larger average change in temperature may suggest a potential impact to temperature from the water diversion, it is an artifact of the data collection set. That is, the average for WR04 is based on 8 months of data (by agreement with the stakeholders, data were not collected and therefore were not available for 3 months when the powerhouse was offline or the 1 month when there was a sonde malfunction), whereas the averages for WR01 and WR03 are based on 12 months of data. The averages for the same 8 months of data at WR01 and WR03 are more comparable to and in fact negligibly different from the WR04 average (these averages are shown in parentheses in Table 5).

Monthly averages show that temperature decreases from WR01 to WR03 and WR04 in some months and increases in others. The change is never greater than 1°C.

Table 5. Statistical Summaries for the Temperature Sonde Data in Degrees Celsius

Sampling Site	Minimum	Maximum	Average	Standard Deviation
WR01	-0.2	19.8	9.7 (11.5)*	5.7
WR03	-0.3	20.9	9.7 (11.8)*	5.8
WR04	0.0	20.0	11.6	4.4

* To provide a more comparable number, the temperatures in parentheses represent the average for the 8 months when WR04 data were available.

Table 6. Monthly Averages for the Temperature Sonde Data in Degrees Celsius

Sampling Site	2016											2017
	February	March	April	May	June	July	August	September	October	November	December	January
WR01	3.51	6.49	9.21	11.48	14.24	16.67	17.45	14.97	11.01	6.71	2.18	1.37
WR03	3.70	6.37	9.18	11.46	15.02	16.87	17.09	14.72	10.12	5.66	1.78	0.98
WR04	ND	6.35	9.06	11.10	ND	17.51	17.59	15.17	10.99	7.33	ND	ND

ND = no data

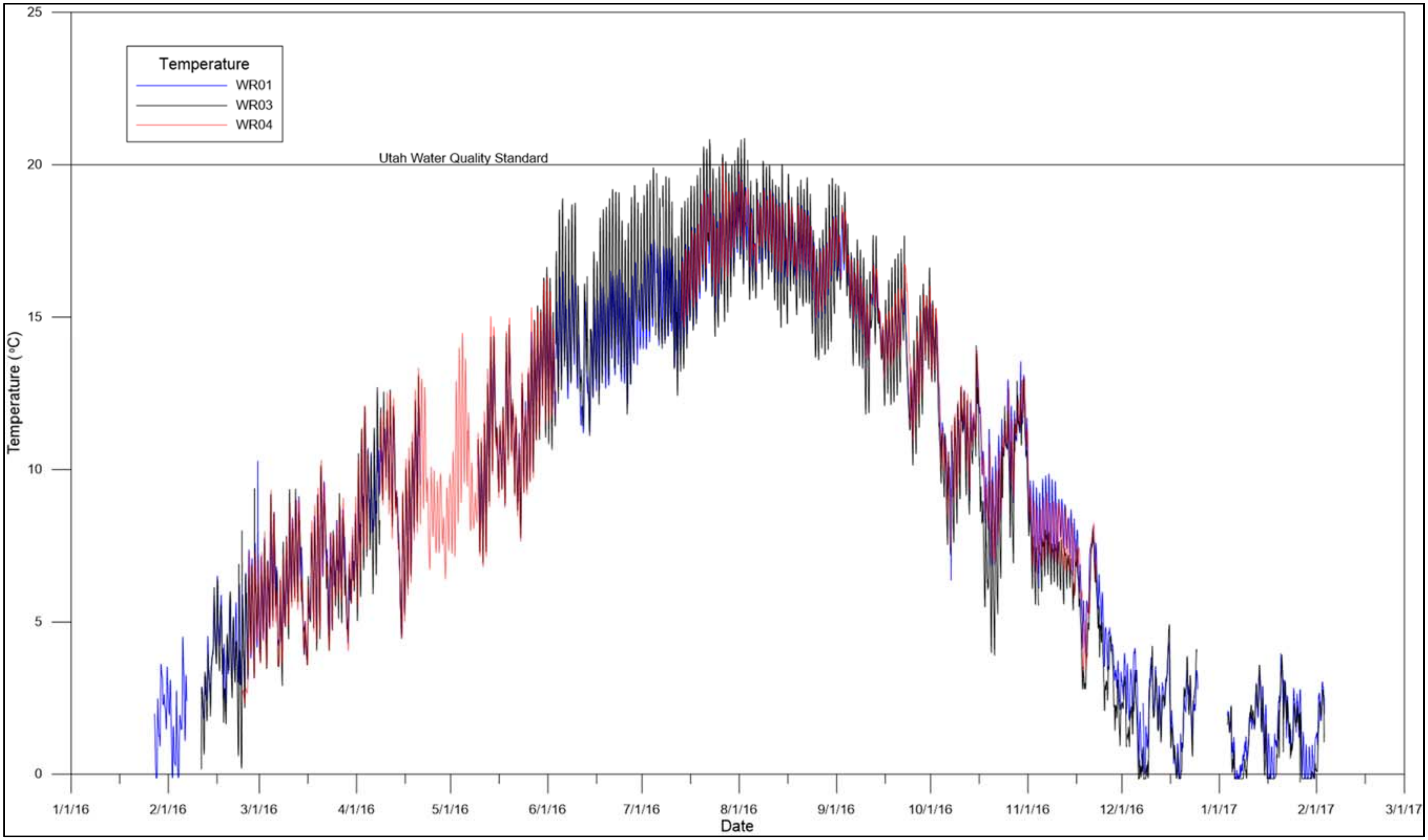

Figure 3. Water temperature sonde data.

Note: Data gaps are a result of the powerhouse being offline or from periodic sonde malfunctioning and associated data error, as are typical for long-term water quality field studies.

5.1.2 pH

The statistical summaries for the pH sonde data are provided in Table 7. pH data recorded at all sampling sites follow the same general trend (Figure 4) and are within the State of Utah water quality standard (6.5–9.0). The Project does not appear to affect pH.

Table 7. Statistical Summaries for the pH Sonde Data

Sampling Site	Minimum	Maximum	Average	Standard Deviation
WR01	7.5	8.8	8.1	0.2
WR03	7.8	8.9	8.3	0.2
WR04	7.8	8.9	8.2	0.2

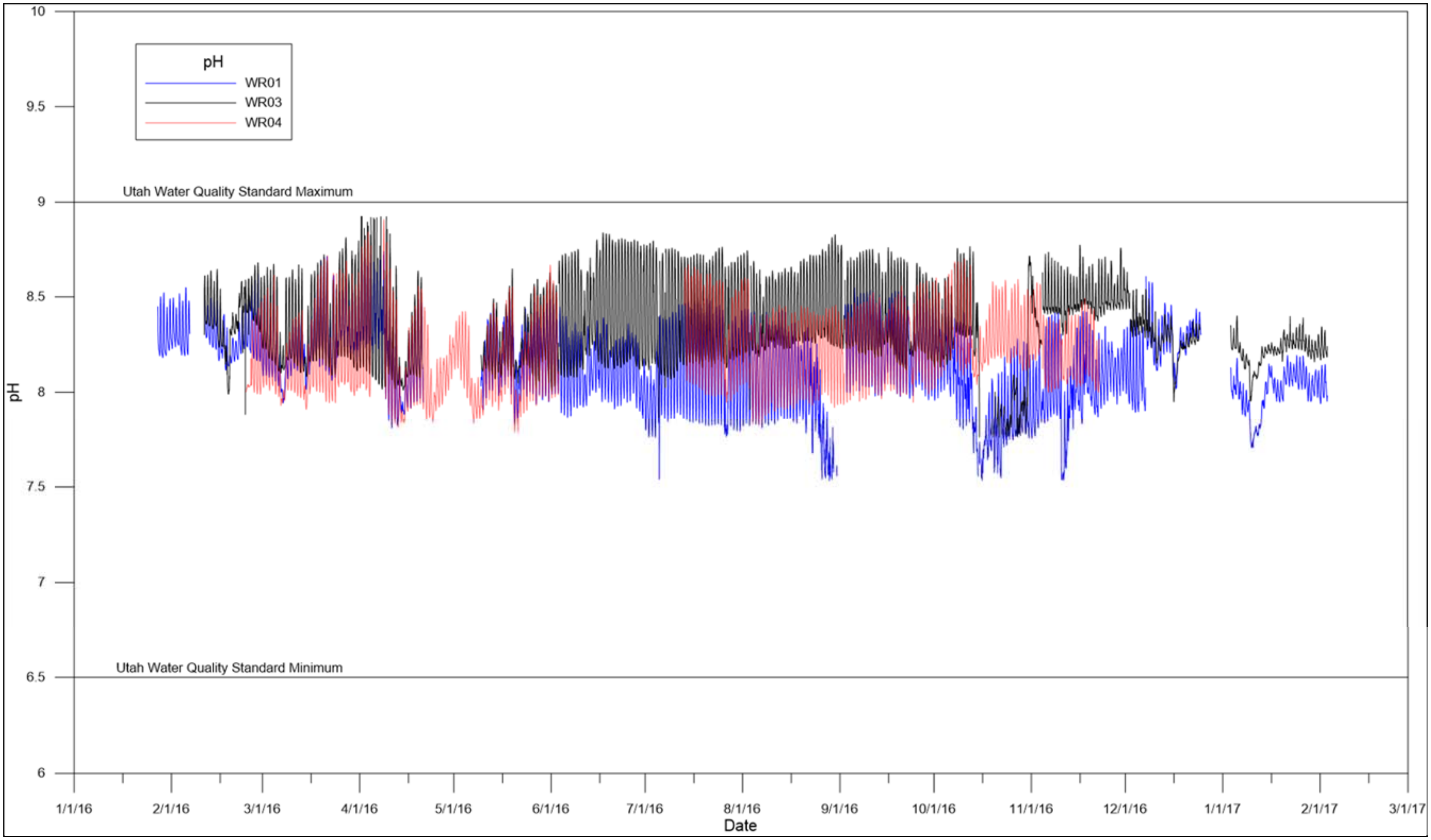

Figure 4. pH sonde data.

Note: Data gaps are a result of the powerhouse being offline or from periodic sonde malfunctioning and associated data error, as are typical for long-term water quality field studies.

5.1.3 Specific Conductivity

The statistical summaries for the specific conductivity sonde data are provided in Table 8. In general, specific conductivity at all sampling sites appears to be influenced by seasonal Weber River flows (Figure 5). Monthly average specific conductivity sonde data are provided in Table 9. As expected, high flows tend to dilute the salinity of the water, therefore lowering the specific conductivity. The Project does not appear to affect specific conductivity.

Table 8. Statistical Summaries for the Specific Conductivity Sonde Data in microSiemens

Sampling Site	Minimum	Maximum	Average	Standard Deviation
WR01	234	977	615	129
WR03	221	864	567	127
WR04	198	766	542	147

Table 9. Monthly Averages for the Specific Conductivity Data in microSiemens

Sampling Site	2016											2017
	February	March	April	May	June	July	August	September	October	November	December	January
WR01	703.07	601.70	444.09	433.40	576.98	535.62	529.18	608.93	701.34	722.89	696.96	751.33
WR03	578.11	502.34	374.49	320.16	495.46	591.24	612.11	627.36	628.69	701.93	660.29	646.04
WR04	ND	499.27	328.96	321.34	ND	616.67	601.43	623.67	681.82	711.37	ND	ND

ND = no data

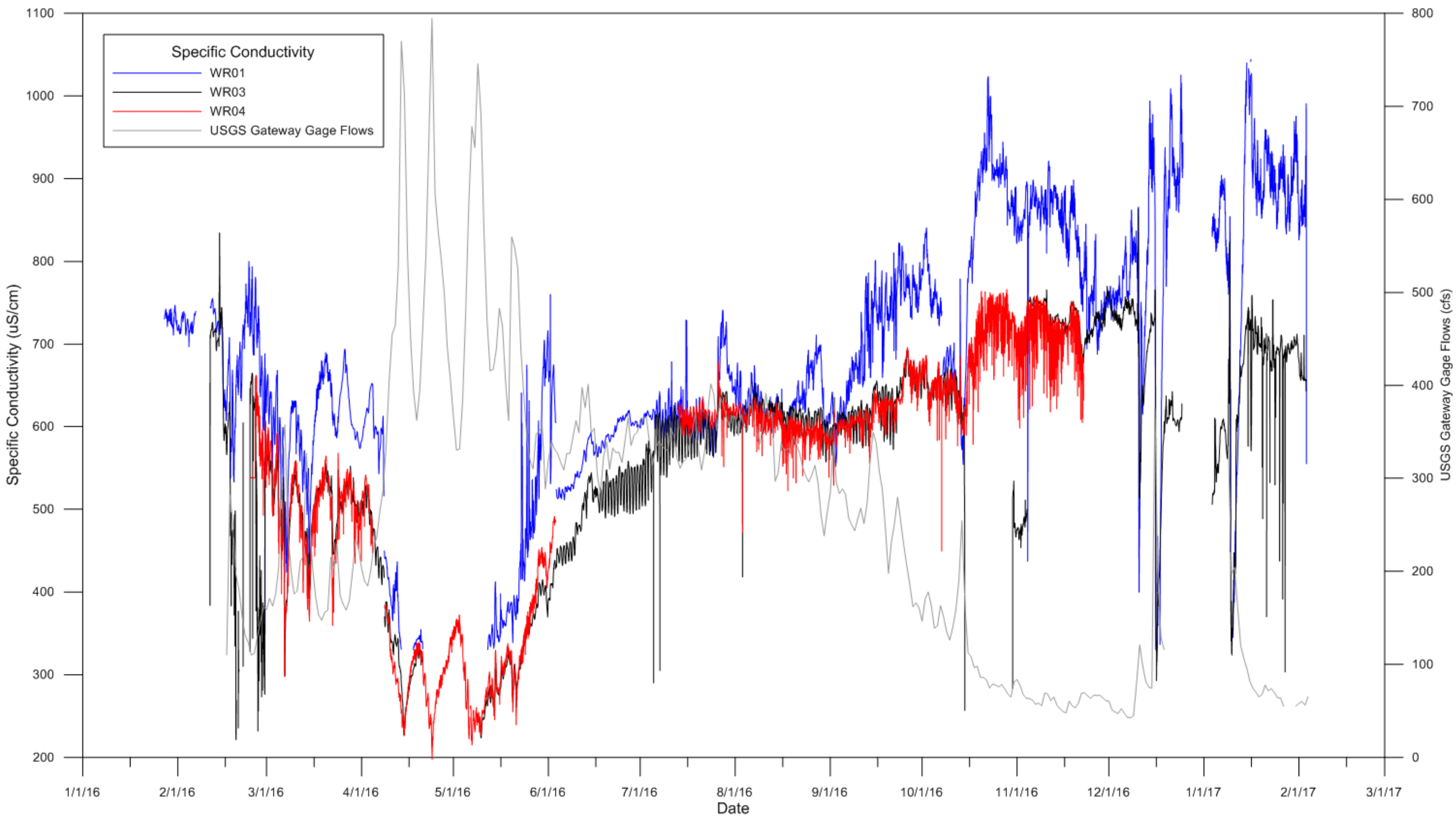

Figure 5. Specific conductivity sonde data.

Note: Data gaps are a result of the powerhouse being offline or from periodic sonde malfunctioning and associated data error, as are typical for long-term water quality field studies.

5.1.4 Dissolved Oxygen

The statistical summaries for the DO sonde data are provided in Table 10. DO concentrations recorded at WR03 and WR04 followed the same general trend (Figure 6). DO concentrations recorded at WR04 were equal to or above the State of Utah water quality criteria (minimum 30-day average of 6.5 mg/L). Similarly, DO concentrations recorded at WR03 were equal to or above the water quality criteria, except for a few instances in late September and early October when DO concentrations in the water flowing past WR01 station (above the Project Area) were extremely low.

DO concentrations measured at WR01 (above the Project Area) had a wide range of fluctuations. Initially it was thought that the probe calibration may have drifted; however, as shown on the graph, the probe was calibrated periodically throughout the monitoring period, and DO concentrations continued to fluctuate (see Figure 6). Next it was thought that temperature variations could be responsible, but that was also tested, and no correlation was observed. It is postulated that there is a pollutant source above WR01 that is periodically depressing DO at WR01. Overall, the Project appears to stabilize DO fluctuations as well as increase DO concentrations.

Table 10. Statistical Summaries for the Dissolved Oxygen Sonde Data in Milligrams per Liter

Sampling Site	Minimum	Maximum	Average	Standard Deviation
WR01	0.6	14.6	8.7	3.3
WR03	5.4	13.9	9.7	1.4
WR04	6.5	12.4	9.4	1.1

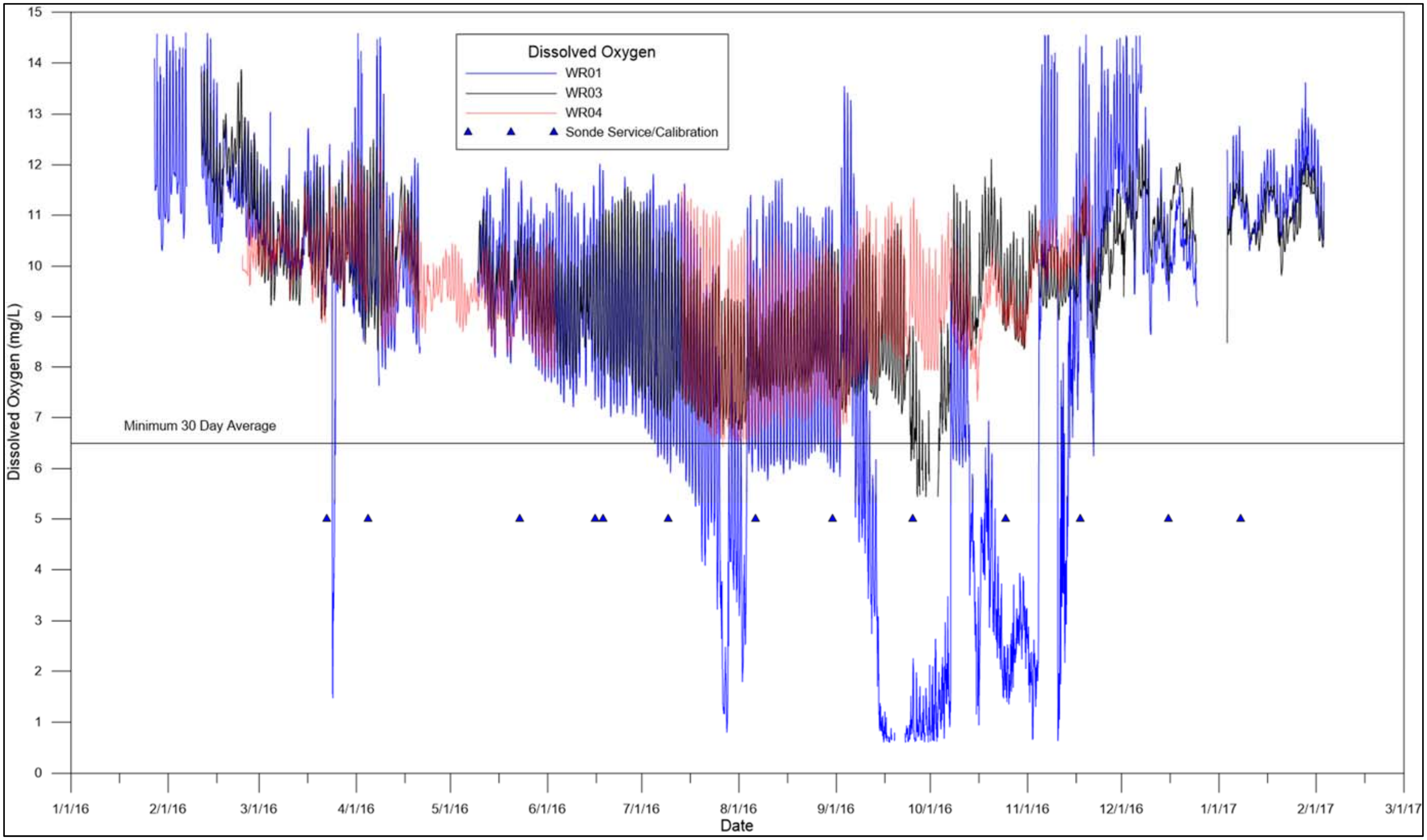

Figure 6. Dissolved oxygen sonde data.

Note: Data gaps are a result of the powerhouse being offline or from periodic sonde malfunctioning and associated data error, as are typical for long-term water quality field studies.

5.1.5 Turbidity

The statistical summaries for the turbidity sonde data are provided in Table 11. The three sampling sites follow the same general trend for turbidity. The minimum value of 3.5 nephelometric turbidity units (NTU) at the powerhouse is most likely the result of there being no opportunities for deposition in the diversion pipe. Furthermore, the water turbulence caused by the turbine in the powerhouse suspends sediment. It is also worth noting that the maximum at WR01 (74.8 NTU) is outside the Project Area (Figure 7). The turbidity standard for a 3A cold water fishery states that the turbidity increase must be less than or equal to 10 NTUs, and the data here meet this standard. For these reasons, the Project does not appear to affect turbidity.

Table 11. Statistical Summaries for the Turbidity Sonde Data in Nephelometric Turbidity Units

Sampling Site	Minimum	Maximum	Average	Standard Deviation
WR01	0.0	74.8	15.4	14.0
WR03	0.0	69.3	18.1	14.4
WR04	3.5	62.3	17.6	12.0

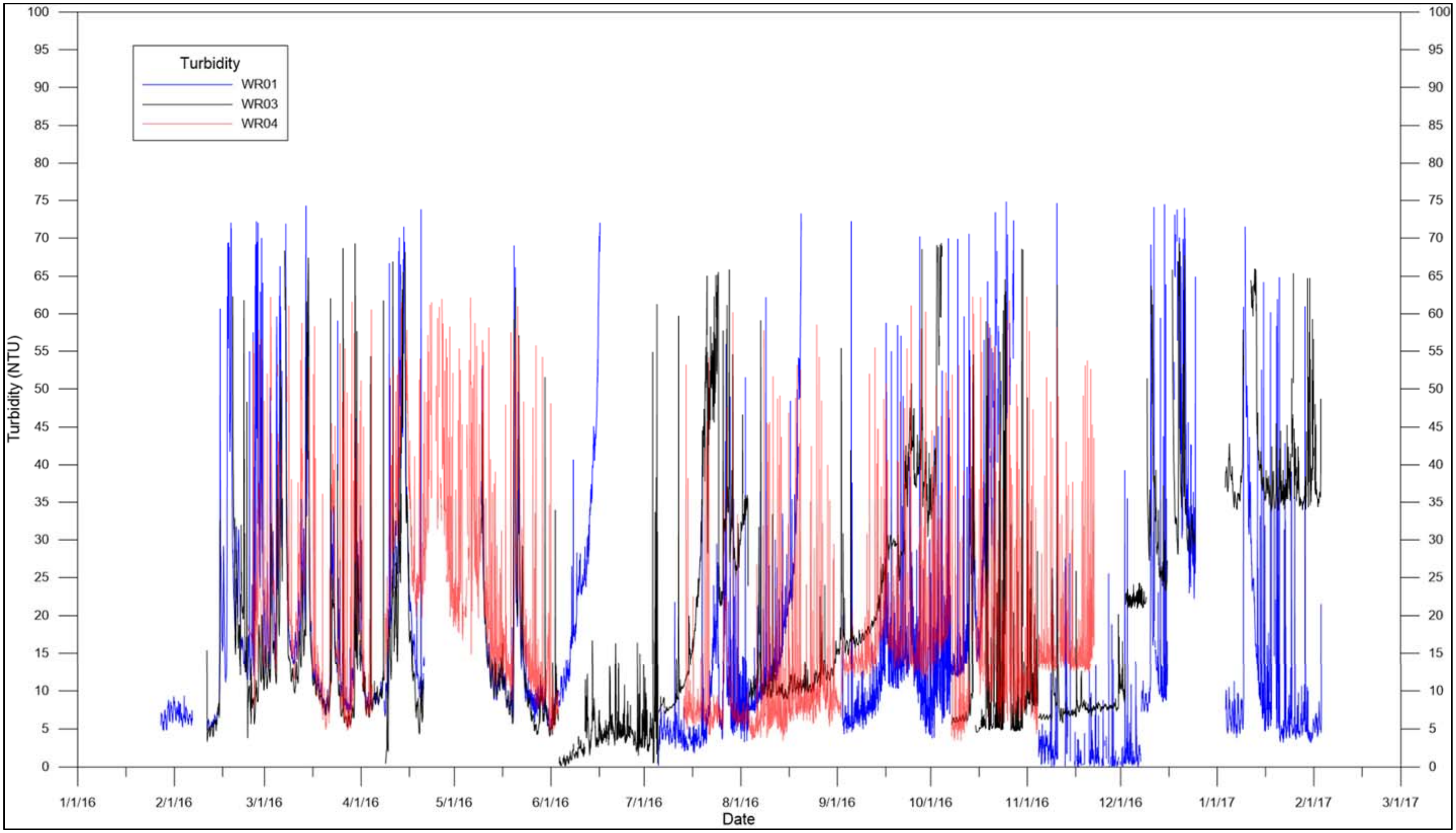

Figure 7. Turbidity sonde data.

Note: Data gaps are a result of the powerhouse being offline or from periodic sonde malfunctioning and associated data error, as are typical for long-term water quality field studies.

5.2 Grab Sample Results

5.2.1 Total Suspended Solids

Grab sample results for TSS are provided in Table 12.

Table 12. Grab Sample Data for Total Suspended Solids

Date	WR01	WR03	WR04
02/02/16	4.4	7.6	Powerhouse offline
02/29/16	7.2	17.2	19.6
04/08/16	4.4	1.5	3.2
05/06/16	18.0	25.6	22.8
06/03/16	11.6	1.5	8.0
07/05/16	10.8	5.2	9.6
08/03/16	7.6	5.6	6.4
09/02/16	8.8	3.6	14.4
10/03/16	3.2	1.5	5.6
11/04/16	8.4	1.5	1.5
12/02/16	1.5	1.5	1.5
01/03/17	20.4	13.2	Frozen-Powerhouse offline
Minimum	1.5	1.5	1.5
Maximum	20.4	25.6	22.8
Average	8.9	7.1	9.3
Standard Deviation	5.7	7.7	7.4

Note: The values in red are less than the laboratory detection limit. The value entered is half the detection limit.

TSS concentrations at all sampling sites follow the same general trend (Figure 8). TSS appears to be directly related to flows and peaks during spring runoff (see Figure 8). TSS is higher in the Project Area (WR03 and WR04) during spring runoff, but is less than upstream (WR01) for the duration of the year, except for an increase of 5 mg/L at WR04 between August 1, 2016 and October 7, 2016. For the same reasons described above for turbidity (i.e., reduced opportunities for deposition in the diversion pipe and water turbulence caused by the turbine in the powerhouse), TSS is expected to be higher at WR04. For these reasons, at times, the Project may appear to increase TSS; however, this increase is expected to settle out and resemble the concentrations observed at WR03.

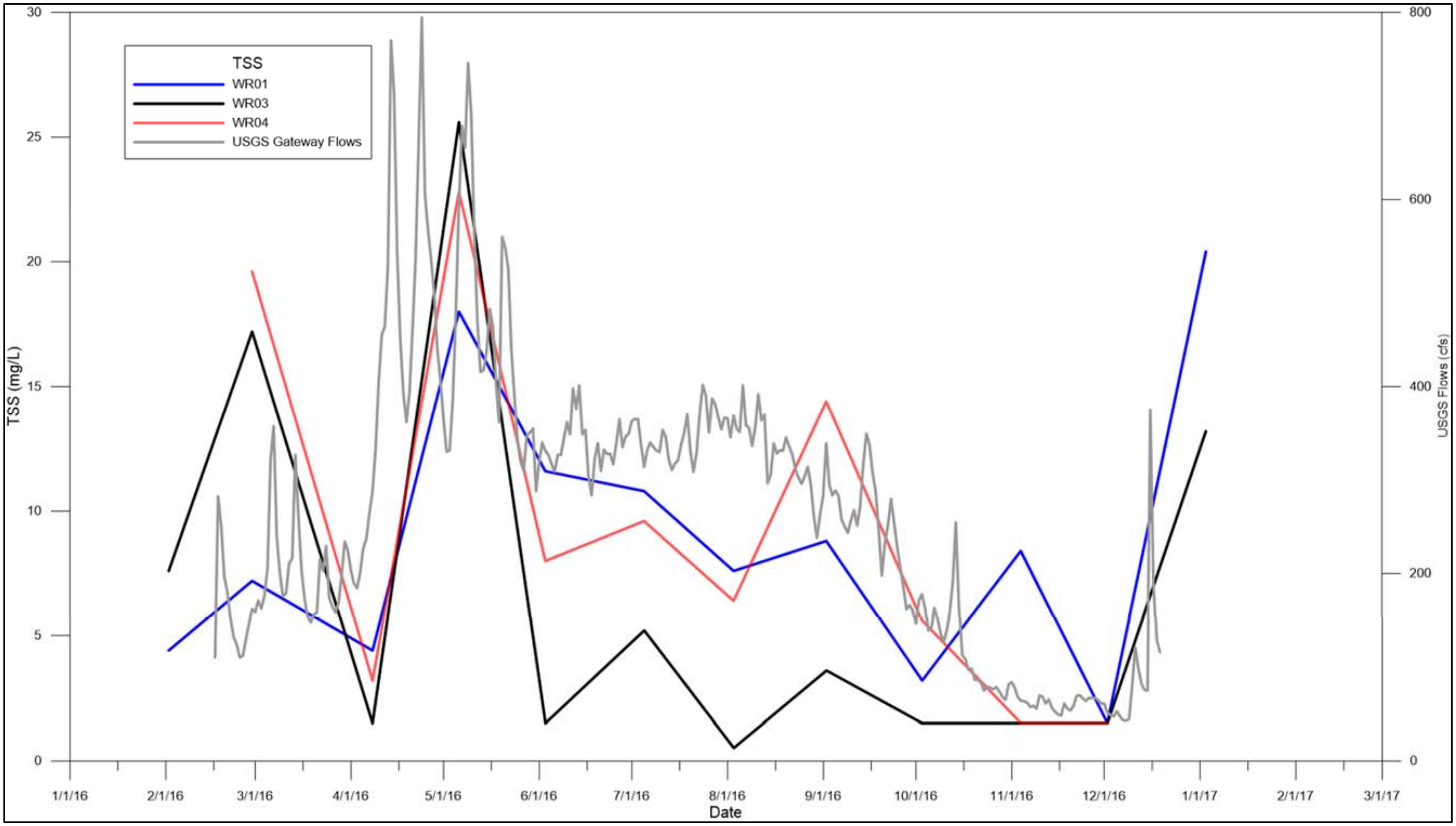

Figure 8. Total suspended solids grab sample data.

5.2.2 Chlorophyll a

Grab sample results for chlorophyll *a* are provided in Table 13.

Table 13. Grab Sample Data for Chlorophyll *a*

Date	WR01	WR02	WR03	WR04
02/02/16	3.80	3.60	7.10	Powerhouse offline
02/29/16	1.70	1.50	3.40	3.10
04/08/16	19.30	23.70	5.50	23.50
05/06/16	3.90	5.20	0.80	4.20
06/03/16	3.50	0.20	1.90	2.70
07/05/16	0.60	0.05	1.70	0.05
08/03/16	1.66	Excluded*	0.05	0.71
09/02/16	0.05	0.05	2.31	0.51
10/03/16	0.74	0.51	0.51	1.19
11/04/16	2.32	1.16	0.05	0.05
12/02/16	0.79	1.13	0.05	0.48
01/03/17	1.24	0.11	1.81	Frozen-Powerhouse offline
Minimum	0.05	0.05	0.05	0.05
Maximum	19.30	23.70	7.10	23.50
Average	3.30	3.38	2.10	3.65
Standard Deviation	5.20	6.94	2.24	7.12

Note: The values in red are less than the laboratory detection limit. The value entered is half the detection limit.

*The sample collected on 8/3/16 at WR02 was excluded because the duplicate sample was outside the acceptable range of precision.

Chlorophyll *a* concentrations at all sampling sites follow the same general trend (Figure 9), except at WR03, which cannot be explained. However, similar to TSS, there is a spike in chlorophyll *a* concentrations during spring runoff for WR01, WR02, and WR04. At this same time, Chlorophyll *a* should be suppressed. After spring runoff, chlorophyll *a* concentrations at all sampling sites follow the same general trend. For this reason, the Project does not appear to affect chlorophyll *a*.

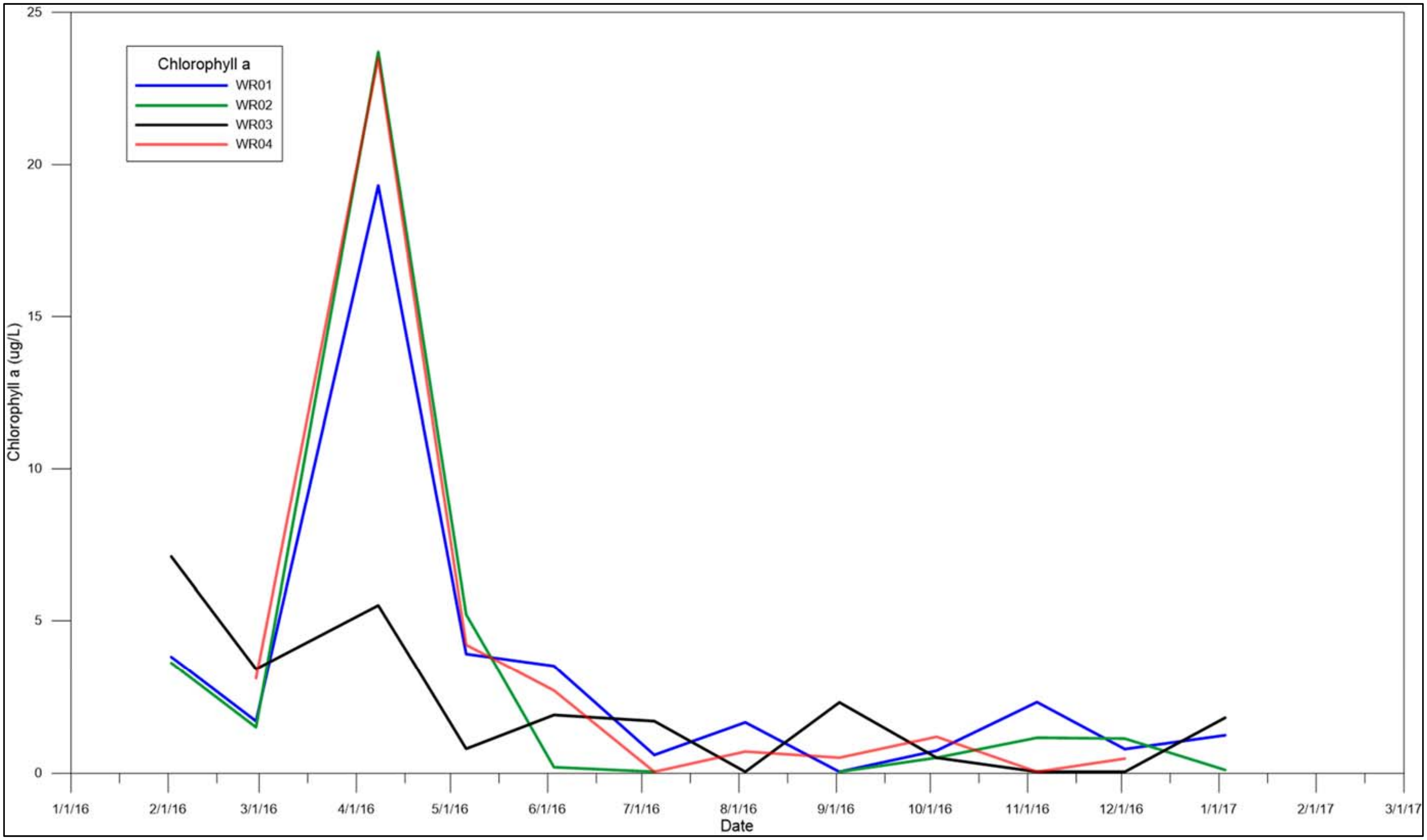

Figure 9. Chlorophyll *a* grab sample data.

6.0 CONCLUSIONS

Water quality can be affected by all types of hydroelectric projects with diversion infrastructure; however, the Weber Hydroelectric 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 buildup, although limited dredging may occur periodically on an as-needed basis. Historically, when dredging has occurred, any dredged materials were removed and disposed of at an off-site location. Any future dredging would continue the practice of off-site removal.

In addition, the existing minimum instream flows in the Project Area appear to be protective of the fishery, including species of special concern. The Utah Division of Wildlife Resources (UDWR) rates the Project reach of the Weber River as Class IIIB, a quality fishery with species of special concern (Bonneville cutthroat trout [*Oncorhynchus clarki utah*] and bluehead sucker). Bonneville cutthroat trout is also listed as a sensitive species.

There are no proposed changes to the hydrologic regime of the Weber River resulting from the continued operation of the Project, and there are no other Project operations that are known to affect the water quality parameters evaluated in this report. In summary, the water quality results collected in 2016 and early 2017 show that all sampling sites largely follow the same general trend, with the exception of DO at WRO1 and chlorophyll *a* at WR03. The results also indicate that Project operations do not appear to substantially affect water resources in the Project Area, with the possible exception of improved DO in the Project reach.

The water quality results demonstrate that the beneficial uses and associated State of Utah water quality standards are being met. PacifiCorp expects that given the results of the recent water quality monitoring, during the new license period, the Project will comply with the Clean Water Act Section 401 water quality certification program through UDEQ to ensure that the federally permitted and licensed activities for continued operation of the Weber Hydroelectric Project are conducted in a manner that complies with applicable discharge and water quality requirements in order to maintain the chemical, physical, and biological integrity of the Weber River, which is a portion of the waters of the United States within the state of Utah.

7.0 LITERATURE CITED

Murphy, S. 2007. General Information on Solids. Available at: http://bcn.boulder.co.us/basin/data/NEW/info/TSS.html. Accessed March 8, 2017.

PacifiCorp. 2015. *Weber Hydroelectric Project FERC No. 1744 Pre-Application Document*. May 2015. Prepared by PacifiCorp Hydro Resources, Salt Lake City, Utah.

———. 2016. *Final Study Plan Water Resources*. March 2016. Weber Hydroelectric Project FERC Project No. 1744. Prepared by PacifiCorp Hydro Resources, Salt Lake City, Utah.

Tukey, J.W. 1977. *Exploratory Data Analysis*. Reading, Massachusetts: Addison-Wesley.

U.S. Environmental Protection Agency (EPA). 2016. Indicators: Chlorophyll a. Available at: https://www.epa.gov/national-aquatic-resource-surveys/indicators-chlorophyll. Accessed August 16, 2016.

Utah Department of Environmental Quality (UDEQ). 2013a. *Standard Operating Procedure for Filtering Water Column Chlorophyll-A Samples.* Salt Lake City, Utah: Division of Water Quality.

———. 2013b. *Standard Operating Procedure for Collection and Handling of Escherichia Coli Samples*. Salt Lake City, Utah: Division of Water Quality.

———. 2015. *Standard Operating Procedure for Collection of Water Chemistry Samples*. Salt Lake City, Utah: Division of Water Quality.

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Water Resources Technical Report

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
Comments on the Draft Technical Report (Review period Apr. 28 – May 29, 2017)			
RS/WRWUA		Change the name of Davis-Weber Canal Company dam. "Davis and Weber Counties Canal Company diversion". It's not truly a dam, especially when we have it wide open through the fall and winter and early spring. This would be in the text as well as the figures. ***Note***: Facility title subsequently revised on figures in all technical reports to "Davis & Weber Counties Canal Company diversion dam" per 6/6/2017 discussion and agreement with commenter. Stated concern is that the structure may be misconstrued as a full spanning dam. Agreed to retain "diversion dam" nomenclature for continuity between reports.	Davis-Weber Canal revised to Davis & Weber Counties Canal Company (DWCCC). "Diversion dam" nomenclature retained.
Comments on the Preliminary Draft Technical Report (Review period Mar. 15 – Apr. 14, 2017)			
KL/UDWQ	Section 5.1.5 Turbidity	I suggest also looking at the change in turbidity between site WR03 and WR04. For the 3A cold water fishery, the turbidity standard states that the turbidity increase must be less than or equal to 10 NTUs. Looking at the average change between those two sites may also provide compelling information.	Added discussion of this standard and comparison between sites. Also added clarification on averages.
KL/UDWQ	Section 5.1.1 Temperature	I suggest also looking at the change in temperature between site WR03 and WR04. For the 3A cold water fishery, the temperature standard states that the maximum temperature change is 2°C.	Added discussion of this standard and comparison between sites; clarified changes between sites based on when measurements were made.
PT/UDWR	N/A	The Utah Division of Wildlife Resources has reviewed the Draft Water Resource Technical Report for PacifiCorp's Weber Hydroelectric Project Re-licensing ALP. We have no comments on the plan and we recommend approval. We thank you for the opportunity to review this plan.	N/A

FINAL
FISHERIES TECHNICAL REPORT

WEBER HYDROELECTRIC PROJECT RELICENSING
FERC PROJECT NO. 1744

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June 30, 2017

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1.0 INTRODUCTION

PacifiCorp owns and operates the Weber Hydroelectric Project—Federal Energy Regulatory Commission (FERC or Commission) Project No. 1744—on the Weber River in Weber, Morgan, and Davis counties, Utah. The current FERC license will expire May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. The Project has a generating capacity of 3.85 megawatts (MW) and is located partially on federal lands managed by the Wasatch-Cache National Forest (Intermountain Region 4, Utah), 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 FERC Alternative Licensing Process (ALP) for the Project on May 29, 2015.

During preparation of the PAD, PacifiCorp evaluated existing information on general aquatic resources and aquatic threatened, endangered, and sensitive species within the Project Area to inform analysis of Project impacts on these resources.

The PAD and subsequent Weber Final Fisheries Study Plan (PacifiCorp 2016) identified two special status aquatic species: the Bonneville cutthroat trout (*Oncorhynchus clarki*) and the bluehead sucker (*Catostomus discobolus*). Both species are known to occur within the Project vicinity and were the focus of the Fisheries Study Plan to evaluate the potential for upstream movement, as well as any potential risk of downstream entrainment through the Project turbine. A Fisheries Working Group (FWG) was formed during Project scoping that consisted of any stakeholders interested in participating in development and implementation of the Fisheries Study Plan. This group is made up of members from FERC, Utah Division of Wildlife Resources (UDWR), U.S. Fish and Wildlife Service (USFWS), Trout Unlimited (TU), U.S. Forest Service (USFS), and Utah Department of Environmental Quality (UDEQ).

The Fisheries Study Plan called for PacifiCorp to provide the results of two studies: an upstream fish passage engineering feasibility study and a study of fish migration downstream of the Project. Results of the first study, titled "Study One - Upstream Fish Passage Conceptual Design Report," provides a feasibility study of alternatives and a conceptual design with design criteria for an upstream passage facility at Weber dam. Study One is summarized in Section 5 of this report and appended in its entirety in Appendix A. The second study, titled "Study Two - Fish Migration Downstream of the Project," includes three phases, although only two were initially contemplated in the Fisheries Study Plan. Phase One of Study Two of the Fisheries Study Plan called for PacifiCorp to conduct a test to identify fish survival through the flowline and turbine using three sizes of hatchery trout. Phase Two of Study Two involved the use of a camera to determine how many and the approximate size range(s) of native fish that may actually be entrained at the Weber intake. When Phase Two could not be completed as planned, a Phase Three was agreed to by the FWG and added to the planned studies. Discussions of each of the Study Two phases can be found in Section 6 of this report.

2.0 BACKGROUND

The Weber Hydroelectric Project is owned and operated by PacifiCorp. Constructed originally by Utah Light and Rail Company in 1910 and acquired by Utah Power and Light in 1944, the Project was issued its most recent license on June 28, 1990. That license expires May 31, 2020. PacifiCorp (2015a) filed a PAD on May 29, 2015, indicating its intent to relicense.

The Weber hydroelectric facility includes the following components:

(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 penstock 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 double runner Francis turbine with 17 buckets per side (34 total), 3.7-foot diameter runner, runner speed of 360 rpm and peripheral runner velocity of 72.5 feet/sec;
(5) 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)

The diversion dam is located approximately 2.5 miles east of the mouth of Weber Canyon (Figure 1). The gatehouse structure containing the penstock intake leading to the powerhouse is located on the southern shoreline of the Project forebay.

During scoping consultations, one of the major fisheries issues that arose concerned potential impacts on upstream and downstream movement past the diversion structure. Passage implications for two sensitive species in the Project Area, bluehead sucker and Bonneville cutthroat trout, were of principal interest.

Concerns about entrainment and mortality of these two species in the Project's turbines led the working group, composed of PacifiCorp and interested federal, state and private stakeholders, as detailed above in Section 1.0, to recommend that two studies be undertaken to evaluate potential impacts. The first part of Study Two (Phase One) involved the release and recapture of different size groups of hatchery rainbow trout (*Oncorhynchus mykiss* and tiger trout (brown trout - brook trout hybrids *Salmo trutta x Salvelinus fontinalis*) through the penstock and turbines to estimate associated mortality. That study was conducted and documented by PacifiCorp in July 2016. The second portion (Phase Two of Study Two) utilized an underwater camera to identify and count fish as they passed through the penstock (PacifiCorp 2016). That study took place starting in early August of 2016 and was conducted by RedFISH Environmental. The physical characteristics of the Project infrastructure where the camera was placed limited the effectiveness of the monitoring system. Although multiple adjustments were made in the study design and camera placement over the next six weeks, the results were incomplete, inconclusive, and did not meet the study objectives. Thus, on September 14, 2016, the FWG agreed preliminarily to modify the study approach and conduct a qualitative desktop analysis to evaluate entrainment and mortality potential at the Project (Phase Three). Phase Three of Study Two was also completed by RedFISH Environmental.

Section 6 of this report describes the results of the studies undertaken during Phases One, Two and Three of Study Two.

3.0 PROJECT AREA

For the purposes of these studies, 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 map. The Project Area is the area that contains all Project features (encompassing the FERC Project Boundary as defined above), and that extends out for the purposes of characterization and analysis from the farthest edge of the Project Boundary, and 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.

4.0 STUDY AREA

The Study Area includes the Project reservoir from just upstream of the Utah Department of Transportation (UDOT) rest area and extending downstream to the Project dam and the Project bypass reach from the dam to the powerhouse discharge. From the discharge point, the water immediately enters the Davis & Weber Counties Canal Company (DWCCC) diversion, and fish monitoring did not extend into that unrelated project area (Figure 1).

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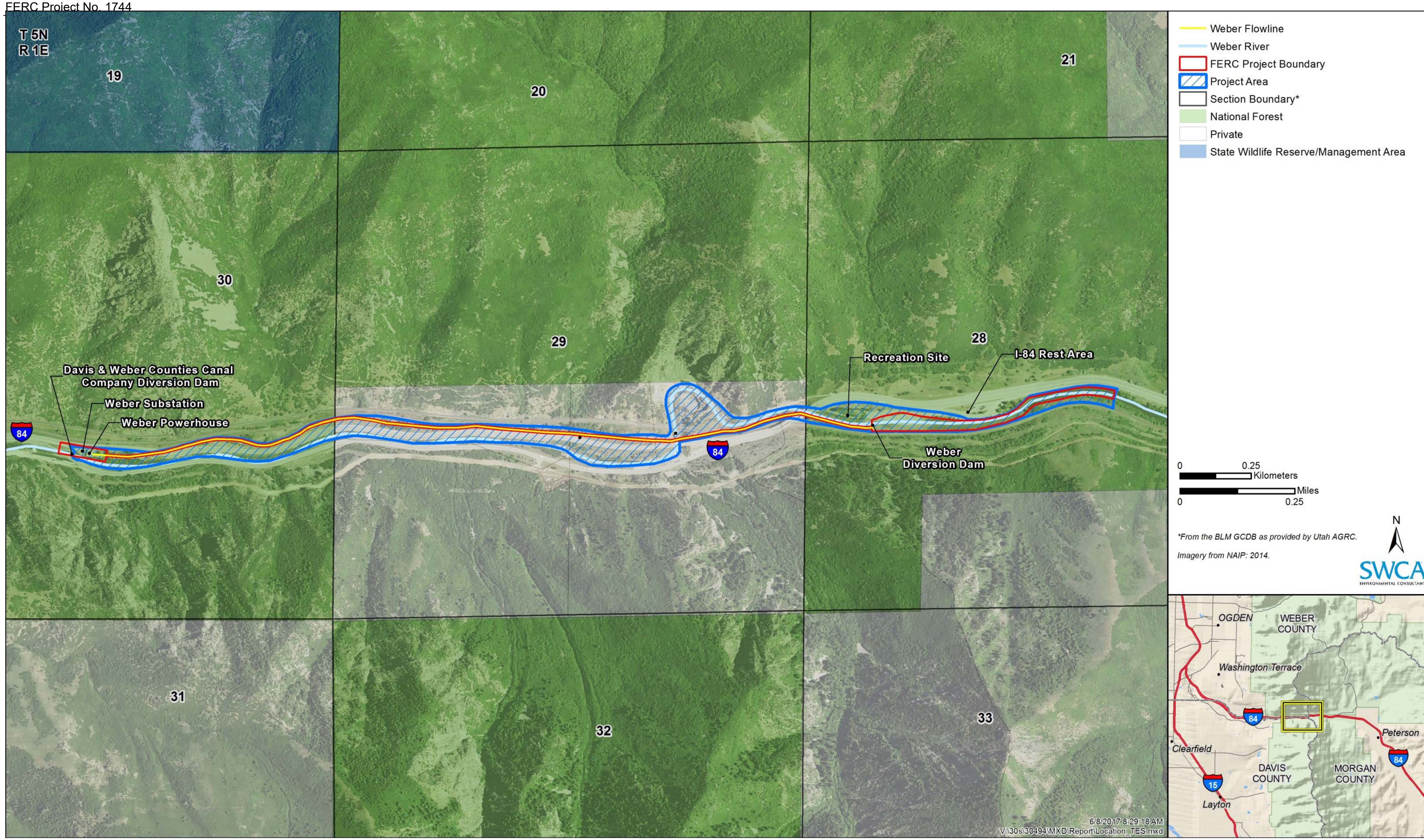

Figure 1. Weber Hydro Relicensing Project location and features.

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5.0 STUDY ONE: UPSTREAM FISH PASSAGE CONCEPTUAL DESIGN STUDY

PacifiCorp, in conjunction with the FWG, has designed a new upstream fish passage facility to pass Bonneville cutthroat trout (*Oncorhynchus clarkii)* and bluehead sucker (*Catostomus discobolus*) at the Weber Hydroelectric Project diversion dam. Four distinct types of fishways were investigated as potential options. Variations on two of these types of fishways resulted in a total of six options that were considered in an alternatives analysis performed with input from PacifiCorp and the FWG (see Appendix A).

One of the objectives of the FWG was to work together to come to consensus on a recommended fish passage design alternative for detailed consideration in the FERC relicensing process. The step-wise process used for the FWG to achieve this objective consisted of the following (dates refer to various meetings in person or via conference call of the FWG during the process):

1. Develop design criteria – Initiated on March 7, 2016 and finalized on July 13, 2016.
2. Develop and workshop draft alternatives for upstream fish passage and select a recommended upstream fish passage alternative (traditional vertical slow fishway) – May 4, 2016.
3. Amend the recommended upstream fish passage alternative to include supplemental attraction flow provided via the existing minimum flow gate and historic fish passage flume – June 2, 2016.
4. Finalize the conceptual design for the recommended upstream fish passage alternative (traditional vertical slot fishway with supplemental attraction flow provided via the existing minimum flow gate and historic fish passage flume) – July 13, 2016.

As a result of this collaborative process, the FWG selected a vertical slot fish ladder on the right bank adjacent to the existing ice sluice/fishway. The conceptual design drawings for the preferred alternative have been prepared and are included in Appendix C of the Conceptual Design Report (Appendix A of this report).

6.0 STUDY TWO: FISH MIGRATION DOWNSTREAM OF THE PROJECT

PacifiCorp proposed a phased approach to investigating downstream fish passage at the Weber Project. Phase One of Study Two was conducted on July 19, 2016 at a point where the Weber River hydrograph was at or near the tail end of spring run-off. Phase One, which is the basis for this report section, was a pilot project where three size classes of test fish (3-inch, 6-inch, and 12-inch) consisting of sterile, triploid trout were adipose clipped and sent down the Weber penstock to determine the extent of injury and overall survival. If low levels of injury were observed (as determined by the FWG and further defined below), then Phase Two of Study Two would not be necessary. Depending on the outcome of Phase One, Phase Two planned for the use of an acoustic or infrared camera to determine how many and which approximate size range(s) of native fish may actually be entrained at the Weber intake. That is, if Phase I determined that significant fish numbers could be injured by going through the turbine, then the next phase was to determine which, if any, fish were actually being entrained. Once it became clear that the Phase Two study could not be completed as anticipated, the FWG met, discussed, and approved a qualitative Phase Three study instead that would primarily analyze the existing Weber turbine, intake configuration, and pipeline specifications, as well as other literature and studies to help further refine all information possible to help address the issue of whether entrainment at the Weber Project is a significant risk for, especially, the two fish species of concern, Bonneville cutthroat trout and bluehead sucker.

6.1. Study Two Phase One: Turbine Mortality Field Study

Methods

Investigators secured a group of triploid rainbow trout from two local (UDWR) hatchery facilities. A group of approximately 100 fish from each of the three size classes were used in this study. The 6-inch and 12-inch were rainbow trout (*Onchorynchus mykiss*) and the 3-inch fish were tiger trout (*Salmo trutta x Salvelinus fontinalis*). These fish were marked with an adipose fin clip since no other trout in the area are likely to have this mark and so that the study personnel could distinguish the test fish from trout already residing in the study area. Prior to implementation of Phase One of Study Two, members of the FWG agreed on several *a priori* directives regarding the study:

1) Only fish recaptured after going through the Weber turbine would be used to inform the study results; that is, unrecovered fish would not be used to draw inferences regarding the potential effects of the turbine on fish.
2) A minimum recovery of 30 percent of the fish placed in the Project flow line was desired to form inferences regarding the potential effects of the turbine on fish.
3) Of recovered fish, negative impacts (defined as a maximum of 10 percent descaling or more severe injury such as pop-eye or other wounds/trauma) to 30 percent or more of the fish would result in additional discussion with the FWG to determine next steps.

The Weber penstock is 9,107 feet long and the estimated velocity is approximately 11.7 feet per second (fps), so it was estimated to take about 13 minutes for water and fish to travel through the entire penstock and turbine. Each fish group released was preceded by an application of fluorescent green dye and followed by placement of 30 radishes. The radishes have the same buoyancy as fish so it was thought they could provide some indication of when all the fish had passed. A time-lapse video produced by TU documents the various fish releases, recovery efforts, and shows the effect of the green dye.

Prior to any releases, all fish were measured to the nearest fork length (mm)[1] and adipose fins were clipped. Test fish sizes are listed in Appendix B. Beginning with the two larger-sized trout,

[1] Fork lengths are reported in millimeters (mm) in this report, in accordance with standard fisheries practice; most other measurements are reported in imperial units.

40 of each size class were introduced to the penstock intake behind the intake rack at the vent stack. Then 40 of the 3-inch tiger trout were released last followed by 30 radishes. A plunger device was used to force fish into the penstock flow thus preventing them from holding in the vent stack. After a period of about 30 minutes, the second batch of 30 fish of each size class was released preceded by dye and followed with 30 radishes. Since there was a need to give collectors time to work in the tailrace, the last batch of fish, dye and radishes was released about 1.5 hours later with 30 fish of each size class and 30 radishes.

Results

During placement of the fish, the Weber Project turbine was operating at nearly full load (311 cubic feet per second [cfs]) through release of the last batch of fish. A group of about 15 field crew had set up block nets and fyke nets prior to the first release. In addition, a raft equipped for electrofishing and a second support raft were in position in the powerhouse tailrace area where they alternated between electrofishing and a two-person SCUBA team continually looking for and collecting test trout, also from the tailrace area. About one hour after the last fish release (and six hours after the initial fish release), the plant was shut down and commercial divers entered the discharge chamber of the turbine draft tube to look for fish while the rest of the biologists entered the tailrace/lower river with nets and electrofishing gear to collect as many test fish as possible. All fish captured were recorded as either alive or dead and examined for injury and descaling.

Table 1 lists the results of the fish capture, which ranged from 15 to 54 percent. The fewest recaptures were observed in the 3-inch size class with only 15 fish recovered. Of those, five were moribund resulting in 33 percent mortality. Forty-seven 6-inch trout were recaptured and 22 of those were mortalities resulting in 46 percent mortality. Finally, 54 12-inch fish were recaptured with 46 of those recorded as mortalities resulting in 85 percent mortality. All live fish were kept in a live pen until the test period was over to determine if there was any delayed mortality.

Table 1. Recapture Results from the Weber Project Tailrace

	3-Inch Size Group	6-Inch Size Group	12-Inch Size Group
Recaptured	15	47	54
Mortalities	5	22	46
Percent mortality	33%	46%	85%

Participants noted that it appeared that the study was biased towards recovery of injured or dead fish, especially in the larger size classes. That is, numerous individuals of the smallest size class were not recovered, although they were observed alive and swimming by divers in both the river and the powerhouse tailrace sections. In addition, the efficiency of recapture resulting from electrofishing the smallest fish was very low.

On July 29, 2016, and following dissemination of the Phase One preliminary results, members of the FWG who wanted to observe the intake gate area, flow configuration, and current velocity visited the dam to observe the inside of the intake gate house immediately prior to a meeting that same day to discuss next steps.

Given the higher-than-acceptable threshold results of the Phase One test, and following the FWG discussion on July 29, the group decided to proceed to Phase Two of the study plan, which was to install a camera at the flowline intake to observe native fish behavior upstream of the penstock and to observe whether or not native fish were actually being entrained by the Weber Project.

6.2. Study Two Phase Two: Turbine Entrainment Visual Assessment

Methods

In this phase, investigators installed an underwater fish monitoring system to determine the number of fish that may be entrained, species composition, and their approximate size. Camera features and specifications are listed below:

Features

- Full waterproof enclosure
- Waterproof cable
- Stand-alone power with continuous maintenance-free operation for up to 2 weeks with one 12V deep-cycle battery
- H.264 HD DVR - time and date-stamped video recorded to SD card (32 GB)
- Variable frame capture rates (1-30 fps) and motion detection to remove periods of inactivity to reduce data processing time

Specifications

- True color image sensor: SONY 1/3" CMOS color
- Infrared lighting: 27 850 nm FEDs
- Effective pixels: 976 (H) x 582 (V)
- Resolution: 700 TVL lines
- Camera housing dimensions: 25.4(W) x 22.9(H) x 19.1(D) cm
- Operating temperature: -10 ~50 °C

The camera was mounted on a custom frame in the surge pipe (the same location where fish were put into the flowline for Phase One of Study Two) facing downward through the opening into the penstock. The mount was secured such that the camera could capture as much of the penstock pipe area as possible (Figure 2; also Photograph 1, Appendix C).

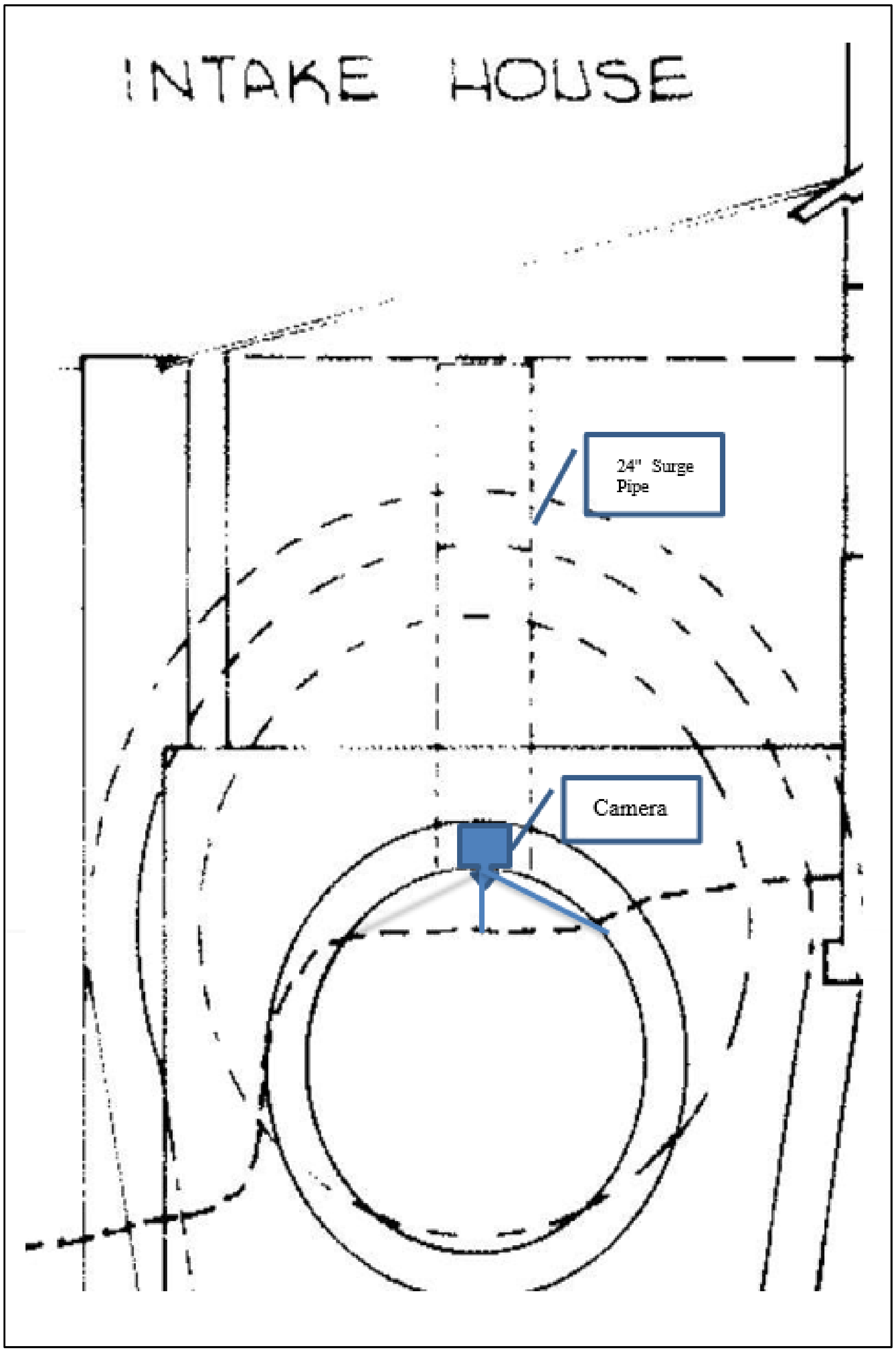

Figure 2. Diagram of the location where the underwater monitoring system camera was installed in the surge pipe of the penstock.

The camera was set to record fish entrained through the penstock intake using video capture regulated with motion detection sensors. When the sensors were triggered, the camera would record video for 10 seconds, giving processors adequate frames to positively identify fish species. The system was installed at the surge pipe on August 9, 2016. Due to the high degree of turbulence at this location, motion detection sensors were not effective and the video image was indistinct and limited. Dark conditions in the penstock also prompted the system to record using built-in infrared lights, which restricted the camera field of view. Consequently, on August 19, 2016, the camera was relocated to an opening between the trash rack and the penstock and mounted on a new custom frame (Photograph 2, Appendix C). Although the camera field of view improved at this location, turbulence and debris continued to render the system ineffective. Alternate camera locations and positions were identified, discussed, and rejected (primarily for not meeting study objectives) during the period August 19 to September 2, 2016.

On September 2, 2016, PacifiCorp and RedFISH staff tested the underwater monitoring system by systematically placing 100 fish in front and behind the intake trash rack, as well as in close proximity and in line with the camera (Photograph 3, Appendix C). Fish were rainbow trout hatchery mortalities (4-7 inches in total length) provided by the UDWR. The monitoring system was set to record continuously and video captured was downloaded weekly until October 19, 2016 when the system was removed from the Project after final consensus was reached with the FWG at a consultation meeting earlier that day.

Results

The underwater monitoring system recorded 7,288 files (62.8 GB file size) from August 9 - 19, 2016 at the first location and 59,105 files (91.4 GB file size) from August 16 - October 19, 2016 at the second location. Although this type of underwater monitoring system has been widely used on a variety of fisheries monitoring projects in low visibility situations, local conditions precluded the effective operation of the system. The camera field of view at the first location was limited to approximately 3 feet due to turbulent flow and light conditions. The camera field of view improved slightly at the second location (4–6 feet) but given the longer distance from the camera to the penstock intake (about 8 feet at the leading edge), it was not possible to effectively assess fish entrainment of the entire penstock. In addition, only four of the 100 fish used to test the system at the second location were captured by the camera. The identified fish were part of a batch of 20 fish that were individually placed directly in line with the camera (Photograph 3, Appendix C). None of the other test fish placed in front or behind the intake trash rack were captured by the camera.

Highly turbulent flow and light conditions at both locations also triggered the motion detection feature of the monitoring system. As a result, the system recorded a very large volume of files. Given the results of the test run at the second location, it was determined that processing the recorded video files was not practical, cost-effective, and most importantly, unlikely to yield accurate fish entrainment data.

Given these incomplete and inconclusive results, and after assessing all identified potential alternative camera locations and alignments, the FWG agreed to modify the study approach and instead conduct a qualitative desktop analysis to evaluate entrainment and mortality potential at the Project (Phase Three of Study Two). This study phase was not originally anticipated by the FWG, and was not included in the approved Final Fisheries Study Plan (PacifiCorp 2016).

6.3. Study Two Phase Three: Turbine Entrainment and Survival Literature Analysis

Methods

The primary objective of Phase Three was to qualitatively evaluate entrainment and mortality potential of Bonneville cutthroat trout and bluehead sucker at the Weber Hydroelectric Project. This analysis was not intended to determine quantitative estimates of Weber-specific project entrainment and mortality as the information required to complete that task could not be collected as planned in Phase Two. Rather, the intent was to provide a qualitative assessment of relative risk to target species using information from Project Area studies and published literature on other hydroelectric systems and entrainment studies. A number of physical and biological factors may affect fish entrainment and mortality. Much of the Phase Three analysis accounts for those factors, how they could affect fish in the Weber River, and how they relate to measured entrainment and mortality at other hydroelectric projects.

Results

Fish Community

Fish species known to occur in the Project Area include Bonneville cutthroat trout (*Oncorhynchus clarkii utah*), rainbow trout (*O. mykiss*), brown trout (*Salmo trutta*), bluehead sucker (*Catostomus discobolus*), mountain sucker (*C. platyrhynchus*), Utah sucker (*C. ardens*), mottled sculpin (*Cottus bairdii*), speckled dace (*Rhinichthys osculus*), longnose dace (*R. cataractae*), mountain whitefish (*Prosopium williamsoni*), redside shiner (*Richardsonius balteatus*) and common carp (*Cyprinus carpio*) (PacifiCorp 2015a). Other species that have been collected in the Weber River and may occur in the Project Area include Paiute sculpin (*C. beldingii*), Utah chub (*Gila atraria*), green sunfish (*Lepomis cyanellus*) and yellow perch (*Perca flavescens*) (Budy et al. 2014). Most of the species are native except for rainbow trout, brown trout, green sunfish, yellow perch and common carp. Hybridization of Bonneville cutthroat with rainbow trout has occurred in the past. Although there appear to be few specimens in the Project Area, hybrids are typically removed by biologists when they are encountered (PacifiCorp 2015a). While any resident species may become entrained by the Project, Bonneville cutthroat trout and bluehead sucker are a concern at this time due to their affinity to the Weber River upstream and downstream of the Weber Project dam, their reduced population numbers throughout their range, and their Utah State sensitive status.

Previous surveys by UDWR found that brown trout, cutthroat trout and mountain whitefish comprise more than 95 percent of all game fishes in the reach bypassed by the Project. Stocking of brown trout was discontinued several years ago. The Weber River and its tributaries in the

Project Area are classified by the State of Utah as Class IIIB, meaning it is a quality fishery that includes species of special concern. Management is directed toward improvement of these species in particular (PacifiCorp 2015a).

Bonneville Cutthroat Trout

Biology and Life History: Bonneville Cutthroat Trout

Bonneville cutthroat (Photograph 4, Appendix C) is one of 14 subspecies of cutthroat trout recognized as native to interior portions of western North America (Behnke 1992). Fish may be found in a variety of different environments ranging from small headwater streams to rivers and streams at lower elevations to lakes or reservoirs. Individuals feed primarily on aquatic invertebrates and terrestrial insects during their lives (May et al. 1978), but may consume small fish once they attain sufficient size (Lentsch et al. 2000). Growth is largely a function of temperature and productivity.

Maturity is reached generally by Age 2 for males and Age 3 for females. Bonneville cutthroat in Birch Creek, a small tributary in southcentral Utah, became mature in their second year upon reaching about 134 mm as males and 147 mm as females (May et al. 1978); however, maturity typically occurs at a larger size in adfluvial and fluvial populations where resources are more plentiful and growth rates are higher, such as in the Weber River. Spawning occurs in late spring when temperatures range from about 4-10ºC (May et al. 1978) and chiefly during May and June, although elevation, temperature and life history strategy can influence the exact timing (USFWS 2001). This species can achieve considerable size in the Weber River. Biologists working on the area consider Bonneville cutthroats in the Weber to exhibit a fluvial life history when they exceed 300 mm in total length (Thompson, personal communication, 2017).

Larval emergence occurs typically during mid to late summer. Precise timing depends largely on when spawning occurs and stream temperatures. Larvae are poor swimmers and migrate or drift downstream, settling into lower velocity habitats along the stream margins. As the fish grow, they soon occupy more mid-channel habitats (Nielson and Lentsch 1988).

Bonneville cutthroat exhibit four distinct life history adaptations: lacustrine (spawning/rearing occurs in lakes); adfluvial (adults live in lakes, spawn in lake tributaries); fluvial (live in mainstem rivers and spawn in tributaries); and resident (entire life history remains in smaller stream). Past studies indicate a population can exhibit more than one life history strategy, such as a stream population including both fluvial and resident components (Colyer et al. 2005; Randall 2012).

Habitat fragmentation from the construction of diversions and other human activities has caused many populations of fluvial Bonneville and other native cutthroat to decline or disappear. As a result, there are relatively few remaining fluvial Bonneville cutthroat populations for study. One such study examined movement of radio-tagged adults in the Thomas Fork of the Bear River in Idaho and Wyoming in relation to a diversion structure. Home ranges were more extensive above the structure than below it; however, the researchers noted attempts to ascend the structure in the spring. Substantial portions (>50%) of both groups were mobile (>1 kilometer [km] movement) with median home ranges of about 2 km even during the fall and winter periods, contrary to the relatively sedentary behavior that was expected initially. During spring, some fish had moved as far as 86 km into tributaries of the Thomas Fork, presumably for spawning (Colyer et al. 2005). Related work documented post-spawning movements of similar magnitude in the spring of up to 82 km, but fish remained relatively sedentary in the summer when movements did not exceed 0.5 km. They also reported that 23 percent of the radio-tagged fish eventually became entrained in an irrigation diversion (Schrank and Rahel 2004). Stream resident populations appear to move far less than fluvial populations, particularly during fall and winter (Hilderbrand and Kershner 2000). Budy et al. (2007) observed site fidelity in the majority of cutthroat tagged during their study in the Logan River, Utah, but also noted substantial movements of some individuals up to 34 km.

Conservation Status: Bonneville Cutthroat Trout

Bonneville cutthroat were present historically throughout the Bonneville Basin, which was covered by Lake Bonneville during the Pleistocene Epoch up to about 30,000 years ago. The lake encompassed parts of Idaho, Wyoming, Nevada and Utah. After the lake retreated, cutthroat populations became restricted to headwater streams and lakes. Numbers have dwindled in recent years due to various human activities, raising concerns among resource agencies regarding the species' future prospects (Lentsch et al. 1997).

Because of declining populations, Bonneville cutthroat trout were listed as a Tier I Sensitive Species by UDWR. They have also been afforded Sensitive Species status by the USFS Intermountain Region and the U.S. Bureau of Land Management (BLM). In 1992 and 1998, they were unsuccessfully petitioned for listing under the Endangered Species Act (ESA) (Lentsch et al. 2000). Most recently, on September 9, 2008, the USFWS again concluded there was insufficient cause to list it as either threatened or endangered under the ESA (Federal Register 2008).

Continuing threats include: 1) water development projects resulting in changes in the timing, magnitude, and duration of stream flows; 2) degraded aquatic habitat and water quality; 3) riparian habitat loss; 4) interruption of migratory corridors by man-made barriers; and 5) competition with, predation by, and hybridization with nonnative fishes (Lentsch et al. 2000). Potential impacts on upstream and downstream movement of Bonneville cutthroat is a principal concern of agencies regarding PacifiCorp's Project, but other issues exist in the basin that may affect these species. For example, brown trout have been found to hinder performance (McHugh and Budy 2005) and movement (McHugh and Budy 2006) and affect distribution of Bonneville cutthroat (De la Hoz and Budy 2005).

In addition, natural factors such as drought and fires have also been shown to impact Bonneville cutthroat through vegetation community change, water quality impacts, and other mechanisms (Hepworth et al. 1997; White and Rahel 2008). Frequency and severity of these events may be exacerbated by ongoing, human-induced climate change, which could further threaten coldwater species like Bonneville cutthroat well into the future (Williams et al. 2007; Haak et al. 2010).

To protect Bonneville cutthroat from further decline and foster recovery, the State of Utah implemented a Conservation Agreement and Strategy in 1997 (Lentsch et al. 1997). A Range-wide Conservation Agreement and Strategy was later drafted in 2000 (Lentsch et al. 2000). To facilitate management efforts in Utah, its known range was separated into five Geographic Management Units (GMUs) extending from Bear Lake in its northern distribution to the Virgin River Basin in the south. Within the Project Area, they have been placed into the Northern Bonneville GMU which includes the following drainages: Weber River, Ogden River, Jordan River and Provo River/Utah Lake. PacifiCorp's Project occurs in the Lower Weber reach, which also includes a number of tributaries such as Strawberry, Jacob's, Peterson and Gordon creeks. In total, 39 conservation populations were identified in Utah in 1997, only a few of which were known to be genetically pure at that time (Lentsch et al. 1997).

Conservation actions recommended to guide recovery efforts in Utah included: 1) surveys to document population status and life history; 2) genetic analysis to determine purity; 3) reconnecting and enhancing important habitats; 4) nonnative fish control; 5) reintroduction via broodstock stocking or transplants; and 6) continued monitoring (Lentsch et al. 1997). Of these, the first three activities have been undertaken in the Northern Bonneville GMU at present.

Project Area Studies: Bonneville Cutthroat Trout

UDWR, USFWS, Utah State University (USU), TU and various other partners have collaborated on research and improvement projects in recent years to better understand and expand Bonneville cutthroat trout populations in the Weber River. A collaborative investigation initiated by UDWR, USU and TU in 2011 began documenting population structure, genetics, survival probability and adult migratory movements because of its relevance to population viability and persistence.

Using multiple-pass electrofishing, a population estimate of 405 (95% CI, 310-584) Bonneville cutthroat occurring from the Project powerhouse diversion downstream to the Lower Weber Diversion was obtained in 2011 (Budy et al. 2014). Generally, there appears to be a trend toward increasing densities of BCT moving upstream from the canyon mouth into the tributaries above the powerhouse diversion (Table 2). Length-frequency histograms for fish in the Weber River indicated the smallest individual collected from 2011-2013 was about 100 mm TL and the largest 550 mm (Figure 3). The average was about 300mm.

Table 2. Population Estimates with 95% Confidence Intervals of Bonneville Cutthroat Trout in Three Mainstem Sections of the Weber River, Utah, in 2011 and 2012

Year and Weber River Section	Sampled Distance	Electrofishing Passes	Sampling Dates	Population Est. (N hat)	95% Confidence Intervals
2011 Section 03 Lower Weber Diversion upstream to Powerhouse Diversion	Combined 1.8 of 4.4 km	2 and 3 (combined)	15 Nov, 17 Nov, 29 Nov, 14 Dec	405	310–584
2011 Section 04 Powerhouse Diversion upstream to Peterson Creek confluence in Weber River, plus portions of multiple upstream tributaries	11.7 km	4	20 July, 21 July, 26 Jul, 12 Aug	877	684–1,124
2012 Section 02 Canyon mouth upstream to Lower Weber Diversion	Lower 19 km of 20 km reach	2	19 June, 21 June	139	66–672
2012 Section 04 Powerhouse Diversion upstream to Peterson Creek confluence in Weber River, plus portions of multiple upstream tributaries	9.5 km	2	8 Aug, 16 Oct	1,296	911–2,069

Note: Modified from Budy et al. 2014.

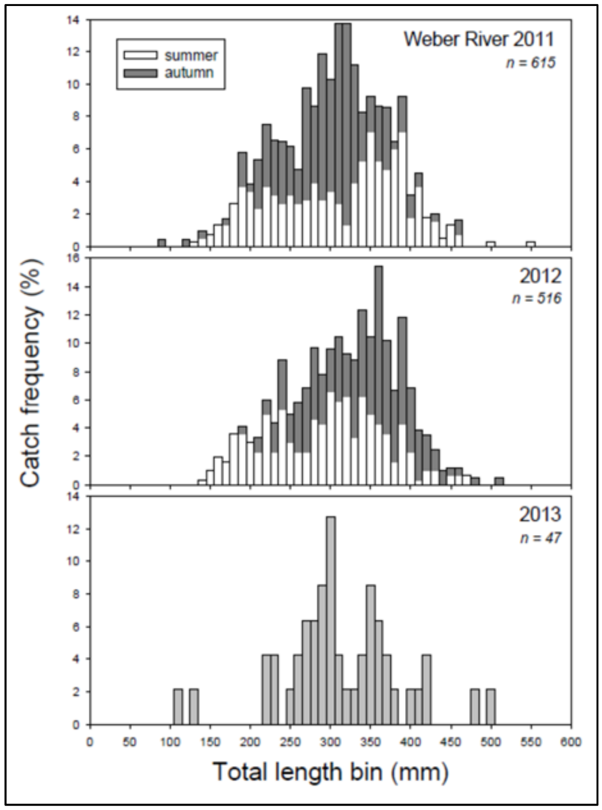

Figure 3. Bonneville cutthroat trout length-frequency histograms in the Weber River within the Project vicinity (from Budy et al. 2014).

During this study, from 2011 to 2013, researchers also implanted a total of 1,671 Bonneville cutthroat with passive integrated transponder (PIT) tags and documented movements in the Weber River from the canyon mouth and among tributaries located just upstream of the Project using passive instream arrays (PIAs) installed in a number of the tributaries. There was frequent use of tributaries by the mainstem population for spawning and movement between the tributaries, suggesting a sizable fluvial life history component still exists in the Weber River and may play an important role in the population's long term viability. Manmade barriers exist in all of the major tributaries, although some appear passable under certain conditions. Those on Strawberry and Gordon creeks are impassable (Budy et al. 2014), but efforts are underway to restore connectivity (Thompson 2015). Genetic mixing between mainstem and tributary populations was evident based on mitochondrial and otolith analysis, however, both appear largely pure (Budy et al. 2014).

Recent UDWR tagging studies demonstrated that 28 Bonneville cutthroat moved upstream past the Weber powerhouse diversion during spawning migrations in 2013 and 2014 (PacifiCorp 2015a). Only three pathways are available to accomplish this: 1) an old historic fishway on the north side of the river; 2) the spillway; and 3) a low-flow gate on the south side of the diversion. At lower flows, the first two pathways do not appear to be feasible due to a large terminal drop at the fishway with very high velocities throughout and insufficient depths across the spillway

(Photograph 5, Appendix C). Trout are commonly observed by PacifiCorp personnel attempting unsuccessfully to ascend the fishway outflow. It is also likely that at higher river flow/stage conditions both would remain impassable. The low-level gate is the most likely possibility when open, and the timing of movements from past studies suggest it could have been utilized, though there has been no field verification of the exact pathway (PacifiCorp 2015a). These questions may be less relevant now because PacifiCorp is coordinating with resource agencies and other stakeholders to design and build a new fish ladder as part of relicensing mitigation (PacifiCorp 2015a, 2016). However, it is important to note that the low-level gate will remain a component of the overall fish passage plan at Weber dam, by functioning as the passage route during periods when the forebay is down and the fish ladder is therefore inoperable (see also details in Study One, Appendix A).

Bluehead Sucker

Biology and Life History: Bluehead Sucker

Bluehead suckers have a bluish head and bluish-gray to olivaceous dorsum (Photograph 6, Appendix C). They are basically facultative herbivores, using their disc-shaped mouths to scrape algae from rocks; although as larvae they consume small invertebrates, diatoms and zooplankton. Benthic invertebrates, detritus and other organic matter are consumed opportunistically later in life, comprising a substantial portion of their diet. They may be found in a variety of cool to warm lotic systems from small streams to large rivers (Sigler and Sigler 1987; UDWR 2006a).

Depending on their size, adults spawn over gravel or cobble substrate during the spring and early summer. Maturity is reached typically by their second to fourth year in populations occupying larger rivers, where individuals may live up to 20 years. In smaller rivers including some headwater streams, fish sometimes mature earlier and longevity may be reduced (Douglas et al. 2009), although other studies have found maturation occurs by about the same time and fish may live as long as those in larger rivers (Sweet 2007).

Spawning usually takes place when stream temperature reaches about 16ºC (UDWR 2006a) and has been estimated as occurring in the Upper Colorado River Basin between about 18º and 24ºC (Ptacek et al 2005). However, studies in the Big Sandy River, Wyoming, indicated spawning from mid-May to early June when mean daily temperatures ranged from about 8.5º to 11ºC. Spawning time was estimated using back-calculations from larval growth rates (Zelasko et al. 2011). An early study suggested bluehead suckers in the Weber River have a rather protracted spawning period based on gonadal index, extending from early May to late July (Andreasen and Barnes 1975). During that time period, average daily temperatures in the Weber River between 1995 and 2006 ranged from about 12º to 20ºC (PacifiCorp 2015a).

Habitat use differs according to life stage, with larvae and young-of-year fish occupying low velocity habitats along stream margins after drifting some distance from spawning areas. Seasonal timing of larval emergence and drift is contingent on when spawning occurs and temperature-dependent egg development. As bluehead suckers grow, they often relocate to higher velocity habitats with greater cover (UDWR 2006a), though some research indicates use of pools with rocky substrate year-round (Sweet and Hubert 2010). Bluehead suckers do not thrive in impounded waters, tending to utilize habitats more swift than many other suckers (UDWR 2006a). An intensive fish habitat and habitat selection study in the San Juan River indicated bluehead sucker selected towards slackwater habitat. This was characterized as low velocity habitat usually along inside margin of river bends, shoreline invaginations, or immediately downstream of debris piles, bars or other in-stream features, but deeper than shoals (>25 cm) (Bliesner et al. 2010). The same study indicated this species selected against backwater, shoal, run, and riffle habitat. Generally, adult bluehead sucker occurrence is correlated with habitats where cobble substrate is dominant; most likely due to their feeding habits. Juvenile occurrence can be negatively affected by partially desiccated sections of river (Bower et al. 2008).

Bluehead sucker movements can vary by season. During spring, adult bluehead suckers generally shifted downstream in a Colorado River tributary with distances ranging from about 16 to over 64 km. Such movements coincided with high runoff flows. Fall and winter were typified by little movement (<2 km). Summer was also a relatively sedentary period, though some fish moved some distance back upstream (Sweet and Hubert 2010). PIT-tagged bluehead suckers have been observed moving downstream over low-head, boulder irrigation diversions (Compton 2007). Overall, the literature regarding adult bluehead sucker movements is limited, but generally indicates they may be quite sedentary or undergo substantial migrations depending on the system (Ptacek et al. 2005). They have also been documented utilizing their suction-like mouth to maintain position in response to increasing current (Aedo et al. 2009).

Conservation Status: Bluehead Sucker

Bluehead suckers have been listed as a Species of Concern in Utah. Historically, they occurred in Utah in mainstem rivers and tributaries of the Colorado River Basin (Colorado, San Juan and Green Rivers), the Snake River Basin and the Bonneville Basin. Abundance and distribution have been reduced substantially throughout its range in recent history for a variety of reasons. Habitat alterations, habitat fragmentation, dams and diversions, regulated river flows, land use activities, water quality changes and nonnative fish introductions have been factors in their decline (Ptacek et al. 2005; UDWR 2006a). Within the Colorado Basin, it is estimated that they have experienced at least a 50 percent decline in their distribution from historical levels (Bezzerides and Bestgen 2002) and that level of decline has likely occurred throughout its entire range (UDWR 2006a).

To avoid further decline and potential federal listing, a Range-wide Conservation Agreement and Strategy was implemented in 2006. Among the recommended conservation actions were to: 1) conduct population surveys; 2) examine life history and habitat needs; 3) genetically characterize populations; 4) maintain and enhance important habitats; 5) control nonnative fishes where feasible; 6) expand populations; and 7) continue monitoring populations in the longer term (UDWR 2006a).

Project Area Studies: Bluehead Sucker

Genetic studies have confirmed that bluehead sucker populations in the Upper Snake, Bear and Weber Rivers are distinct from those in the Colorado River Basin, and as such, are deserving of protection (Douglas et al. 2009). Concomitantly, various efforts have been undertaken recently by UDWR, USU and others to better understand demographics, life history and habitat requirements of Weber River bluehead suckers.

Webber et al. (2012) assessed bluehead sucker population size, survival rates and movements in two Weber River reaches from 2006 to 2009. Reach 1 was between Rockport Reservoir and Echo Reservoir. Echo Dam is about 46 km upstream of the project diversion. Reach 2 was located between the irrigation diversion just downstream from the Project powerhouse and another irrigation diversion near the city of Ogden. Each reach was about 20 km. Brown trout population size was also estimated in each section due to its predatory habits. Populations were surveyed via raft electrofishing using multiple passes.

The bluehead sucker population >150 mm long in Reach 2 (357; 95% CI 191-984) during 2008 was not statistically different from that in Reach 1 (225; 95% CI 141-416) in 2007 based on confidence intervals. However, increasing the number of electrofishing passes from two to four in Reach 2 in 2008 increased the population estimate to 546 (CI 95% 423-772) and improved variance around the estimate. From that perspective, the researchers posited that the population size was significantly greater in Reach 2 than in Reach 1, although densities were similar at about 0.7 to 0.9 per 1,000 m^2. Brown trout >200 mm were far more numerous than suckers with estimates of 9,995 in Reach 1 and 2,125 in Reach 2 (Webber et al. 2012).

Size distributions were markedly different between reaches. Reach 1 was dominated by larger fish averaging about 450mm (Figure 4). Few fish <400mm were captured and none were <200 mm long, suggesting poor recruitment. In contrast, multiple age classes were found in Reach 2. The smallest sexually mature suckers were about 400 mm in length (Webber et al. 2012). Earlier surveys by UDWR in 2006 had also indicated few juvenile bluehead sucker in Reach 2. A group of about 20 adults discovered near Coalville had prompted UDWR (2006b) to recommend future surveys be conducted.

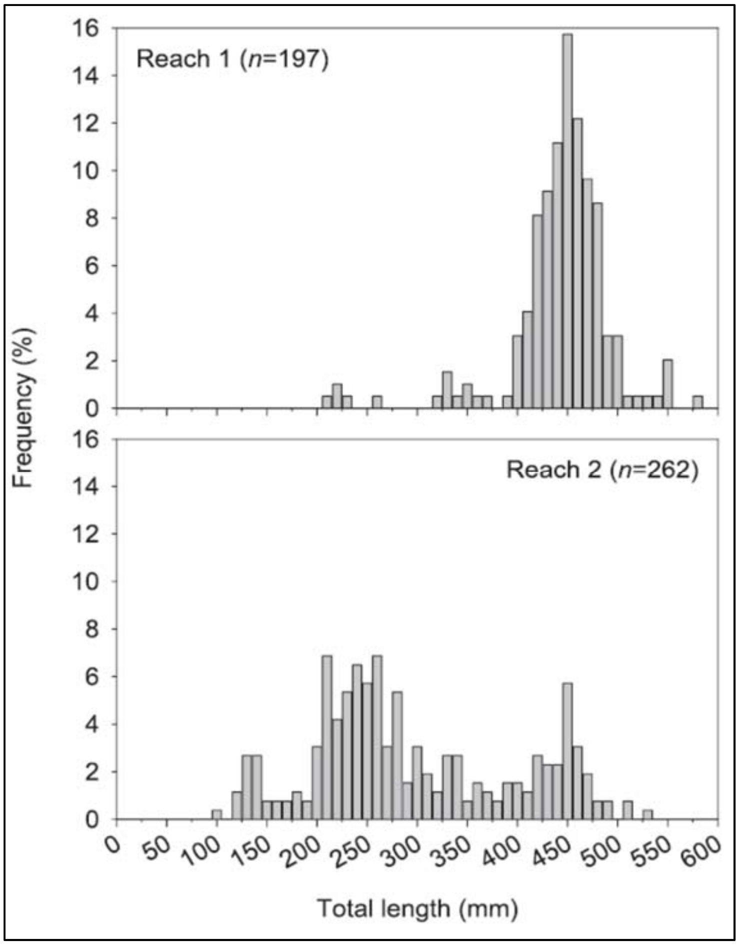

Figure 4. Bluehead sucker size structure in the Weber River, 2006–2009 (from Budy et al. 2014).

Movements of PIT-tagged suckers (all >150mm) were evaluated using a passive antenna in Reach 1 only from September to March. The greatest movement recorded was 2.6 km upstream. Nearly all movements were <1 km (62%) and during September. Most detections (88%) occurred at night (Webber et al. 2012). To our knowledge, there have not yet been any studies directed towards movements of adult bluehead sucker during the spawning season (i.e., late spring and early summer) in the Weber River.

Annual mean survival in Reach 1 was estimated at 77 percent (95% CI 39-95%) using a combination of the PIT-tag sightings and population survey data. That rate was considered relatively high by the researchers and was stable over the three years of the study (Webber et al. 2012).

More recent estimates conducted by UDWR and TU in 2012 (Burnett et al. 2013) indicated a somewhat lower number of bluehead suckers in Reach 2 of about 150 than obtained by Budy et al. (2014). However, generally the research conducted to date indicates that the population below the Project, from the canyon mouth to the Ogden River confluence, is somewhere in the hundreds and is experiencing some limited recruitment. Bluehead suckers are known to occur upstream from the hydroelectric diversion, but population estimates have only been conducted between Echo and Rockport reservoirs. To what extent spawning and recruitment occur upstream from the project to Echo Dam is not understood at this time.

Current efforts by USU researchers have been directed at identifying spawning areas in the lower section of the Weber River (i.e., below the canyon mouth) during late spring and quantifying habitat in these spawning reaches to assess what factors may limit recruitment. Researchers have also determined numbers of young-of-year suckers in low velocity habitats in that portion of the river. Abundance was positively associated with maximum backwater depth (Bryan Maloney, USU Fish Ecology Lab, pers. comm.). Low velocity habitats along the river margins are relatively rare in the river upstream from the Project due to much channelization, higher gradient and altered hydrology. However, the impoundment upstream from the Project diversion may provide suitable rearing habitat for bluehead suckers.

Fish Entrainment Literature Review

Entrainment into hydroelectric turbines has long been acknowledged as a potentially significant source of mortality for fishes migrating downstream. Entrainment may be defined as "the unintended diversion of fish into an unsafe passage route" (NMFS 2008). Many studies have attempted to quantify numbers of fishes passing through turbines (FERC 1995; Franke et al. 1997). These studies commonly involve the use of netting to capture fish as they exit the powerhouse. In recent years, most evaluations of entrainment involved desktop analysis where the results of prior studies were used to estimate these rates (AIC 2005; Geosyntec Consultants 2005; Progress Energy 2005). In synthesizing the results of prior field studies, a key emphasis has been to try to identify which factors may be correlated with fish entrainment.

FERC (1995) undertook probably the most comprehensive effort to compile and evaluate fish entrainment at hydroelectric projects. They reviewed dozens of studies and, based on their independent assessment and interviews with entities that conducted the studies, selected 45 sites with suitable information upon which to base their analysis of factors that affected entrainment.

Factors that may influence fish entrainment include (EPRI 1992; FERC 1995; Franke et al. 1997):

- intake screen bar spacing
- intake screen approach velocity
- intake location
- impoundment characteristics
- plant flow
- fish species
- fish size

Intake Screen Bar Spacing

Intake screens at hydroelectric facilities are essentially angled trash racks used to restrict the intrusion of coarse floating debris into the penstock, thereby reducing potential damage to the turbines. Such screens can vary considerably in bar spacing from one to as much as 10 inches, though smaller intervals of about 1-3 inches are more common at small- to medium-sized projects (EPRI 1992; Winchell et al. 2000). The intake bar spacing at Weber is ≤1.5 inches across the entire intake area.

Screen spacing appeared to have no significant effect on either absolute or flow-adjusted entrainment rate according to linear regression analyses conducted by FERC (1995). That held true even when only full flow tailrace netting studies were used (hydroacoustic and partial tailrace netting studies were excluded due to unreliability of results) and when analyses were binned by basin. The researchers postulated that the preponderance of small fish in the catch at all sites might account for their findings because they could easily fit through the entire range of screen openings.

FERC (1995) also performed more intensive statistical tests using Pearson correlations, principal components analysis and multiple regression. Average entrainment rate was highly correlated ($r=0.956$) with screen spacing, but multiple regression showed no significant effect of screen spacing ($P>0.05$).

Winchell et al. (2000) summarized results of 39 field studies and found interesting relationships between bar opening and size of fish entrained. Most entrained fish (~80%) occurred in the smallest size group (≤4 inches) where screen openings were ≥3 inches (Figure 5). Lower percentages (60-70%) of this size group were entrained where bar spacing was one to about three inches, even though fish of this size should easily pass through the screen. Where bars were further apart, about 35 percent of fish were ≤4 inches compared to about 20 percent that were >4 inches in length. On average, about 70 percent of entrained fish were ≤4 inches and about 90 percent were ≤8 inches regardless of screen size. About 99.5 percent were ≤15 inches. Entrainment of fish >15 inches was rare even where screen openings were wide enough to accommodate fish of that size. Occasionally, fish are captured during entrainment studies that appear too large to have fit through the intake screen. Some speculated reasons for this may be that partial-flow netting was used which can allow infiltration by these fish from below the net, or that there may be gaps or certain areas of the screen more widely spaced than those near the surface (EPRI 1992).

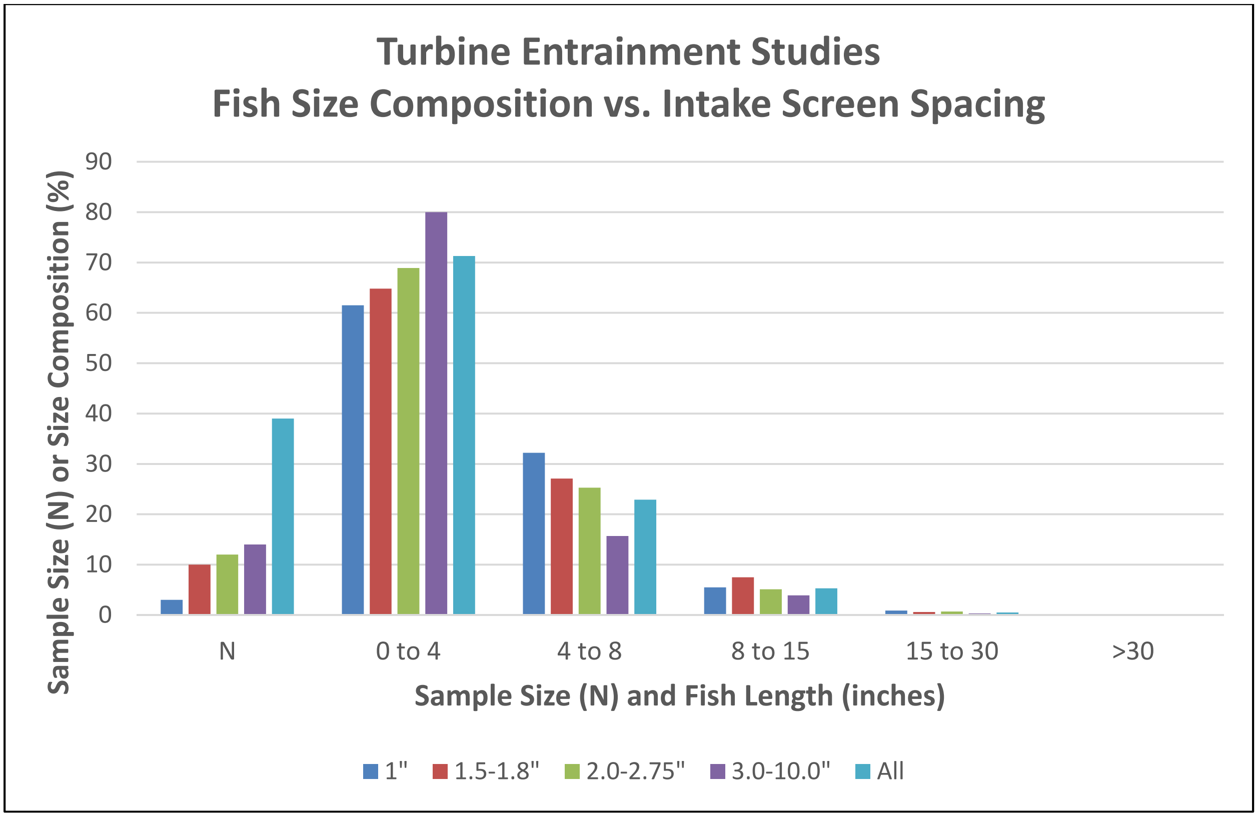

Figure 5. Size composition of all entrained fishes from 39 studies in relation to intake screen opening (shown as the legend on the bottom of the graph – e.g., blue is a 1" bar opening) (figure derived from tabular data by Winchell et al. 2000).

Why considerably fewer larger (4–8 inches) than smaller (0–4 inches) fish were entrained in wider screens where both size groups would easily pass may have some relation to engineering considerations. Determination of bar spacing during screen design is often dependent on what the theoretical approach velocity will be. At sites where relatively high velocities are anticipated, larger openings are often prescribed so there will be less force imposed and less debris accumulation on the screen. Under those conditions larger fish may have a greater ability to avoid entrainment due to superior swimming ability (FERC 1995). This explanation is speculative, however, and other factors such as life history may also be important (EPRI 1992).

Intake Screen Approach Velocity

Approach velocity is usually measured about 3 inches in front of the screen. To minimize potential fish impingement, velocities should be kept within cruising speeds of target fish (OTA 1995). FERC (1995) analyzed entrainment catch at dozens of hydroelectric sites and found no significant effect of approach velocity on fish entrainment rates using exploratory regression analysis. However, correlation analysis indicated a high positive association between average entrainment rate and approach velocity (r=0.996). Approach velocity and screen spacing were positively cross-correlated. The researchers did emphasize that correlations are meant to depict associations and do not infer predictive capabilities. Furthermore, highly leveraged sites (i.e., those where most of the entrainment occurred) were not parsed from the dataset and therefore could have had disproportionate influence on the results. Velocity immediately in front of the intake rack at Weber was measured at 1.0-1.5 fps; still photos and video footage of fish in front of the Weber intake rack were taken in 2016.

Intake Location

Various configurations for powerhouse intake location may include forebay versus power canal, shoreline versus center dam, and shallow versus deep. FERC (1995) found very mixed, site-specific results during its analysis of the aforementioned entrainment database. However, it appeared that projects with forebay intakes located in shallow water along the shoreline had relatively high entrainment overall. Several sites with vegetation in shallow water located in close proximity to the intake had relatively high entrainment rates of sunfishes and juveniles of larger sized species using the forebay as rearing habitat. At Weber the intake is located at the deepest part of the relatively shallow forebay (approximately 14 feet maximum), and extends from near the south edge of the impoundment approximately 20 feet to the north (but still south of the centerline of the Project diversion dam).

Impoundment Characteristics

The results of exploratory regression analysis of the extensive fish entrainment database showed no effect of reservoir area, reservoir volume or reservoir length on entrainment (FERC 1995). More intensive analysis showed significant effects of reservoir size and volume, but none for reservoir length. These results were obtained after binning the sites into multiple categories by dominant fish assemblage and applying flow-adjusted entrainment rates. Despite these approaches, there was still high variability in the data between sites and it was apparent that a few high-leveraged sites highly influenced the results. The researchers concluded that their analysis was unable to produce reliably, statistically significant trends between entrainment and the physical variables they evaluated. Weber's forebay consists of a relatively shallow, linear, 8-surface-acre impoundment.

Plant Flow

FERC (1995) found no significant relationships between plant flow and either raw or flow-adjusted rates of entrainment. That being said, entrainment is often estimated at proposed or existing hydroelectric sites using flow-based entrainment rates from prior studies (Geosyntec 2005; Normandeau Associates 2009; Duke Energy 2008), something which is both generally discouraged (FERC 1995) yet often still accepted by the FERC during project licensing and relicensing. The Weber plant flow under full load is 320 cfs.

Fish Species

Pelagic fishes like trout and whitefish are typically more predisposed to entrainment than benthic fishes like suckers, dace and sculpin. Migratory species are usually more at risk than non-migratory species. Generally, many of the species found upstream are found in the entrainment catch, but often in different percentages than in the upstream population. FERC (1995) found no consistent relationship between the upstream reservoir fish assemblage and the species composition of the entrainment catch. However, both FERC (1995) and EPRI (1992) pointed out that biases inherent in different, inconsistent gear types used to survey the upstream populations likely played a major role in the findings. As noted previously, the primary fish species of concern at the Weber Project are Bonneville cutthroat trout and bluehead sucker.

Fish Size

The majority of entrained fishes tend to be relatively small. Over the broad range of sites that have been studied about 70 percent were <4 inches in length and nearly 95 percent were <8 inches (EPRI 1992; FERC 1995). Of the 40 sites evaluated for size composition, FERC (1995) reported that 23 were dominated (≥75%) by fish ≤6 inches. The remaining 17 sites were dominated by fish >6 inches; however, 10 of these may have been compromised by the use of partial-flow netting to quantify entrainment, which can allow intrusion of larger fish into the net from the tailrace. ERPI (1992) summarized some of these same entrainment studies and reported that in some cases more than 90 percent of the fish were <4 inches and at most sites the majority were <8 inches (Table 3). Results of the Phase One study indicated the least mortality or injury to the smallest size class (3-inch) of fish tested.

Table 3. Size Distribution of Entrained Fish from Nine Comprehensive Studies

Project and Location	Size Distribution	Trash Rack Spacing
Kleber Michigan	46% <100 mm 96% <200 mm	3 inches
Prickett Michigan	84% <4 inches 99% <8 inches	Not provided
Tower Michigan	50% <100 mm 82% <200 mm	1 inch
Centralia Wisconsin	95% <100 mm	3.5 inches
Pine Wisconsin	49% <100 mm 94% <200 mm	None upstream of netting site
Wisconsin River Division Wisconsin	96% <100 mm	2 3/16 inches
Thornapple Wisconsin	58% <4 inches 85% <8 inches	1 11/16 inches
Escanaba Dam #1 Michigan	59% <5 inches 93% <7.5 inches	1 ¾ inches
Escanaba Dam #3 Michigan	75% <5 inches 96% <7.5 inches	1 ¾ inches

Note: From EPRI 1992.

Francis Turbine Mortality Literature Review

Francis turbines are typically installed at sites where head is relatively high and runners are situated high above the tailwater, operating at high speeds (Eicher et al. 1987). Many hydroelectric projects utilize high head to generate power, and therefore, are typically fitted with Francis units. Accordingly, many of the sites that have been evaluated for turbine passage survival utilize this type of turbine. Generally, survival tends to be lower in Francis turbines than Kaplan turbines. Kaplan turbines have fewer blades, operate at slower speeds and are used at lower head sites than Francis turbines.

Two basic types of mortality transpire from turbine passage: direct and indirect mortality. Direct mortality is the immediate killing of fish typically due to contact with one of the turbine components, shear forces, turbulence, grinding, cavitation, or pressure effects (Coutant and Whitney 2000). Indirect mortality is delayed death occurring as a result of injury suffered during passage, usually measured over about a 48-hour period (Cada 2001; Bickford and Skalski 2000).

Indirect mortality can further decrease survival beyond direct mortality, but is frequently not measured. Winchell et al. (2000) analyzed the EPRI (1997) database to evaluate indirect mortality over a 48-hour period following turbine passage. They eliminated all studies where control group survival did not exceed 90 percent and immediate survival was relatively low. Indirect mortality increased by about 3-4 percent over direct mortality. Geosyntec (2005) assessed indirect mortality at 10 sites from the same database. Indirect mortality decreased immediate survival from 95 to 92 percent for a 3 percent reduction over 48 hours. Bickford and Skalski (2000) analyzed smolt survival data from turbine passage in the Snake-Columbia River Basin and likewise estimated a 3 percent additional indirect mortality.

Fish survival through Francis turbines has been evaluated (Amaral 2001; Normandeau Associates 2012) and summarized (Eicher et al. 1987; EPRI 1992; FERC 1995; Franke et al. 1997) in a number of studies. Subsequently, various factors have been analyzed for their potential effect on survival. Among these are:

- turbine type
- turbine discharge
- number of blades or buckets
- runner blade angle
- peripheral runner speed
- operating efficiency
- intake depth
- fish species
- fish length
- fish trajectory

We restricted our analysis to the following more commonly implicated and relevant parameters.

Peripheral Runner Speed

Eicher et al. (1987) found that mortality increased significantly as runner speed increased (Figure 6). His results were based on 14 sites. Runner speed is generally accepted to be a major contributing factor in fish mortality for Francis turbines (EPRI 1992; Franke et al. 1997), which are intended to be operated at relatively high speeds. We compiled data from Franke et al. (1997) comprising 33 sites including 12 of 14 indicated above. Our analysis likewise showed a negative trend for runner speed on survival (Figure 7). Dispersion in the data is due to the range in mortality rates at each site arising from a number of factors including fish species, size and operating conditions. It is important to note that although absolute runner speed is significantly correlated with mortality, relative speed (i.e., rpm) is not (Eicher et al. 1987).

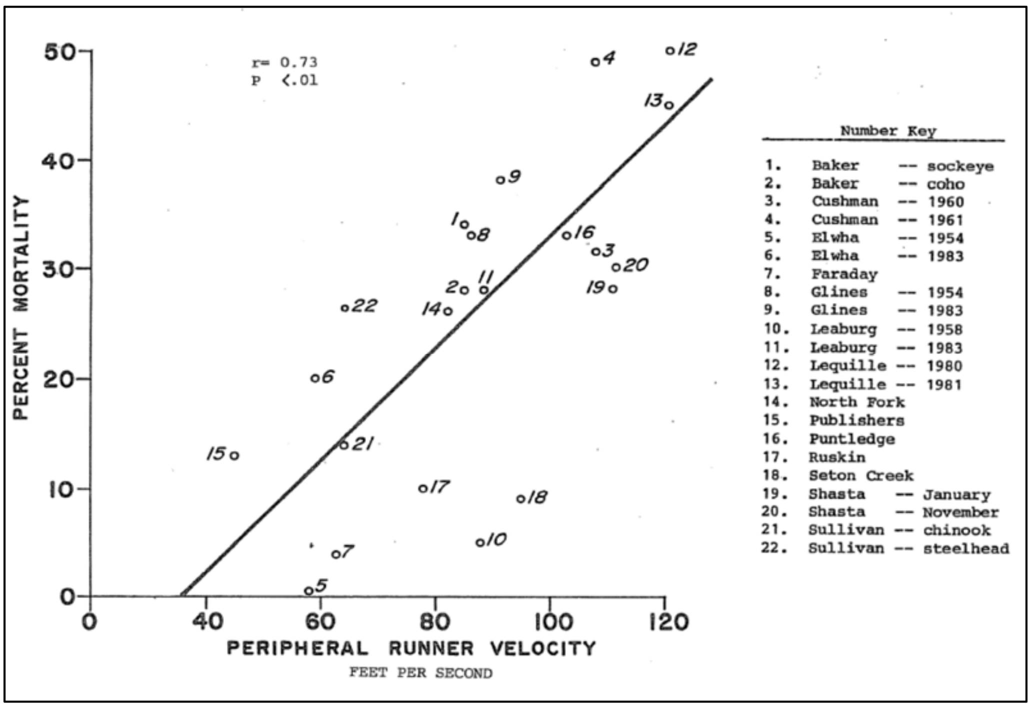

Figure 6. Relationship between runner speed and mortality for Francis turbines (from Eicher et al. 1987).

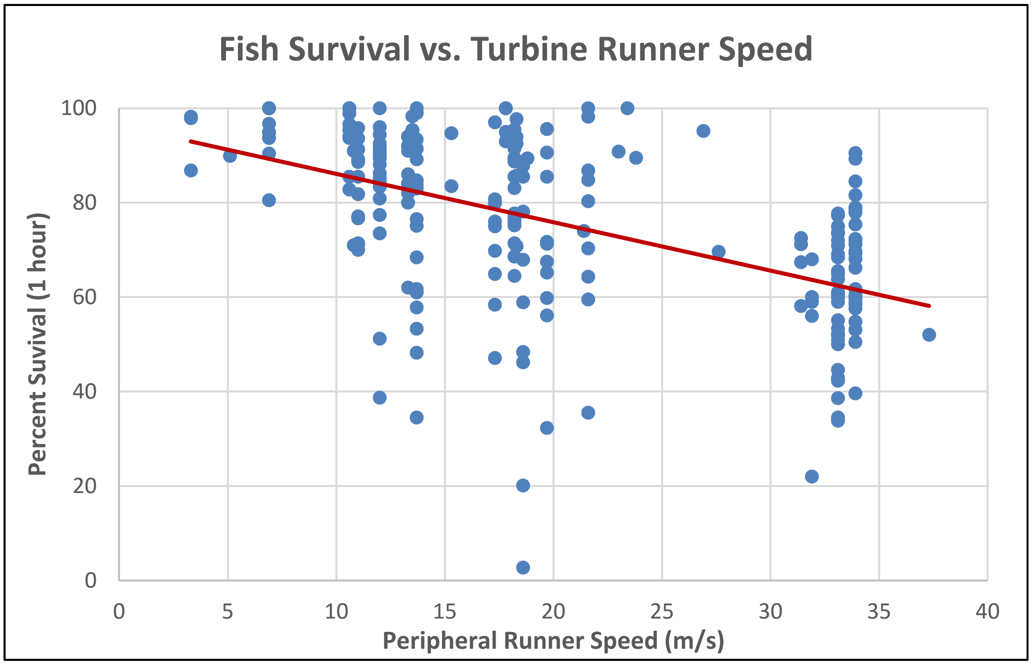

Figure 7. Relationship between runner speed and fish survival (figure derived from tabular data in Franke et al. 1997).

Head

Head by itself does not impact fish survival (Eicher et al. 1987; Franke et al. 1997), although head does appear to be positively correlated with mortality (Figure 8). However, the principal effect of head is on runner speed, with higher net heads resulting in increased peripheral speed of the runner (Figure 9); and runner speed is correlated with survival in Francis turbines. This is a critical although somewhat confusing distinction. Greater mortality with increasing head may also be an artifact of pressure-related effects, as noted below, though this an issue only with deep water intakes (Coutant and Whitney 2000).

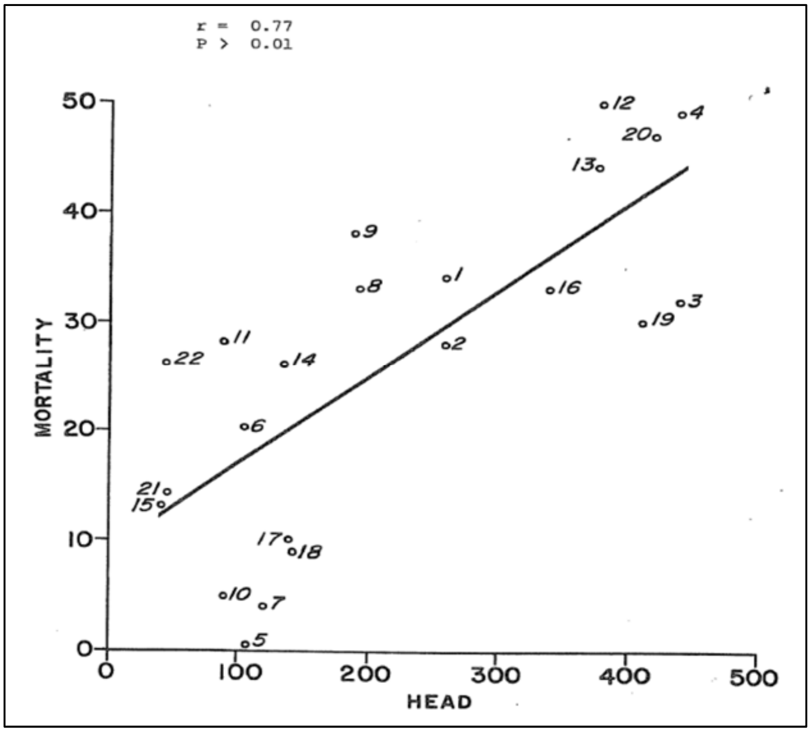

Figure 8. Relationship between head and mortality for Francis turbines (from Eicher et al. 1987).

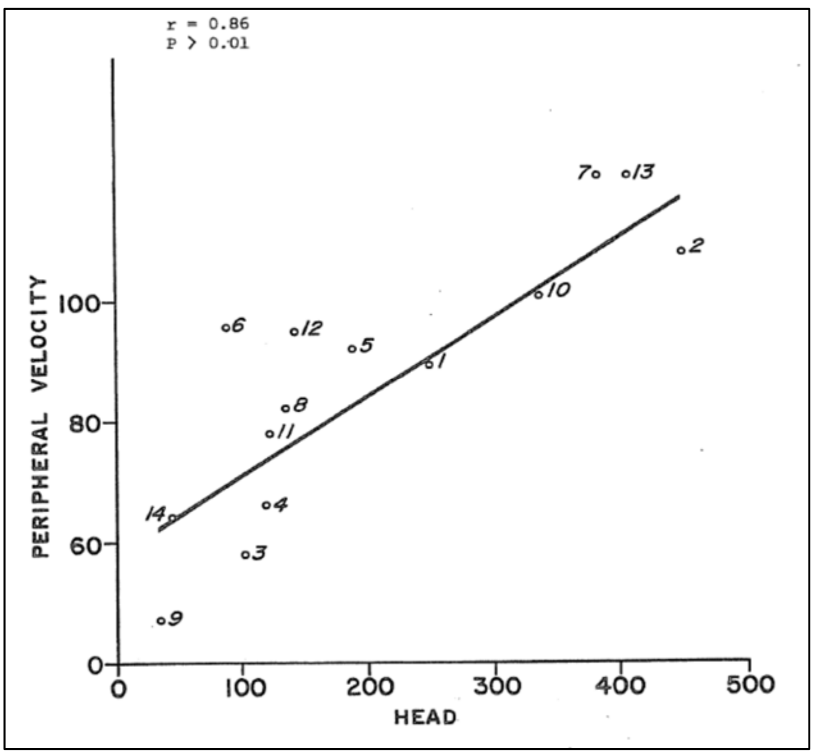

Figure 9. Relationship between head and runner speed for Francis turbines (from Eicher et al. 1987).

Intake Depth

Intakes located at greater depths may cause higher mortality if fish are subjected to rapid decompression during passage through the powerhouse. That effect is related not just to the intake depth and net head, but also to negative pressures that may exist posterior to the turbine buckets. Fishes lacking a connection from the swim bladder to the gut (termed physoclistous) are more vulnerable to such effects because they are unable to vent excess bladder air via the mouth. These are typically bottom dwellers. Physostomous fishes possess this connection and are typically surface oriented, but may still be harmed by pressure effects (Eicher et al. 1987). Burst or extruded swim bladders, internal hemorrhaging and bulging eyes are common signs of pressure-related effects. Magnitude and rapidness of the pressure change are critical factors in the degree of injury that may occur. One study concerning yellow perch suggested the pressure differential must exceed 10m, or one atmosphere of pressure, before deleterious effects are observed (Cada 1990). Longer penstocks such as the one at Weber with greater travel times may facilitate pressure acclimation so harmful effects are avoided (Franke et al. 1997).

Operating Efficiency

Operating efficiency is widely identified as a key factor in fish survival (Eicher et al. 1987; Coutant and Whitney 2000; Cada and Rinehart 2000). Some parameters related to efficiency include operating at the optimal turbine setting, wicket gate opening, runner speed, and gaps between the blades and other turbine components (Eicher et al. 1987). When operated under more optimal settings usually closer to the design settings, potentially harmful turbulence, cavitation and shear forces are minimized. The magnitude of these forces appears to be correlated with efficiency, which in turn can impact survival. However, these interrelated forces generally come into play only at the extreme ends of operating conditions, which are typically realized on only rare occasions at most sites. Plant operators generally avoid such circumstances because cavitation can damage turbine components (Cada and Rinehart 2000).

Fish Species

Generally, salmonids (trout, salmon) are among the hardier groups with respect to turbine survival and clupeids (shad, herring) are among the most sensitive. Very limited information is available regarding catostomids (suckers). White suckers are among the most studied of catostomids and typically experience somewhat intermediate survival compared to these other two families, although among all groups there is tremendous influence of other variables such as operating conditions and fish size (Eicher et al. 1987).

Fish Size

Generally, larger fish experience higher mortality from turbine passage than smaller fish. This is true for both Francis and Kaplan turbines (EPRI 1992; Eicher et al. 1987; Franke et al. 1997). Equations used to estimate fish mortality for both turbine types use fish size as a direct multiplier, illustrating that it is highly influential. Such equations commonly incorporate the size-based potential for strike as fish pass through the runner as a criterion for determining mortality (Eicher et al. 1987). However, cavitation, shear forces and pressure changes are other parameters that can harm fish. Figure 10 illustrates the hypothetical relationship between various turbine-related causes of mortality in relation to size (up to the largest marine mammals) based on extrapolated research involving tidal power projects. Potential for mechanical strike increases with size exponentially while pressure effects disproportionately harm smaller fish (Coutant and Whitney 2000). Within the range of sizes common to most river systems (i.e., 2-40 cm), the relationship is closer to linear. That is consistent with research on river-based turbine studies (Eicher et al. 1987; Franke et al. 1997). Cavitation affects all sizes fairly uniformly across most sizes of fish that would occur in most river systems. Shear forces appear to be most problematic for juveniles of larger sized species. Little is known about effects on larvae (Coutant and Whitney 2000).

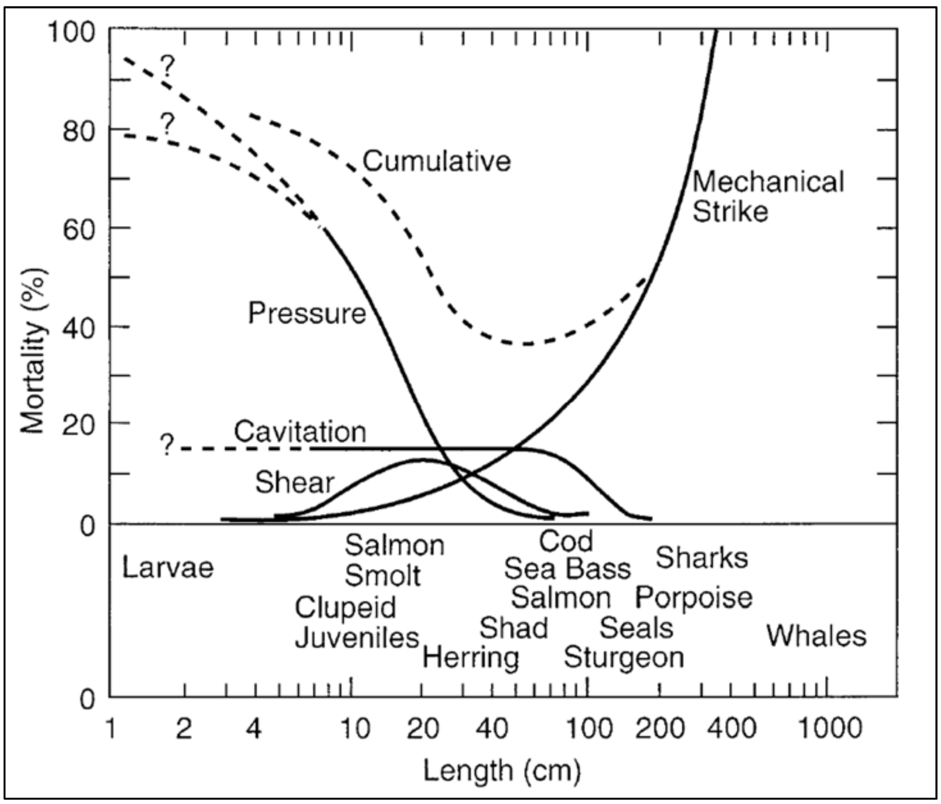

Figure 10. Hypothetical distribution of mortality and its causes from passage through hydraulic, low-head turbines in relation to body length of aquatic organisms (from Coutant and Whitney 2000).

Mortality of larval fish from turbine passage is very difficult to measure, but has been estimated at <5% in bulb-type turbines based on equations relating sized-based probability of contact (Cada 2011). Still, the innate fragility of larval fish may raise the potential for injury from other effects (Figure 10).

6.4. Study Two: Discussion of Potential Entrainment at the Weber Project Specifically

Turbine Mortality

The recommended operating flows for the Weber Project turbines minimize hydraulic impacts from shear, turbulence and cavitation. Correspondingly, potential fish mortality due to such effects should be minimized for the size of fishes with the highest entrainment potential (fish ≤8 inches). According to PacifiCorp, there are areas of turbulence within the penstock at junctures where sections are joined together. Such areas could conceivably cause minor injuries as fish travel toward the powerhouse at an estimated 11.7 fps.

Net head is relatively high at 185 feet; however, intake depth is shallow and the pipeline length at 9,107 feet is almost two miles long, thus reducing the effect of head. These conditions are not conducive to pressure change effects and no pressure-associated injuries were observed during the Phase One turbine mortality study. We conclude that potential cavitation, turbulence, shear and pressure effects should be relatively low, or in some cases nonexistent. Under these conditions, entrainment mortality should be due primarily to blade strike. Although head pressure should have no direct relationship to mortality, it does have a positive effect on runner speed.

Runner speed is positively and significantly correlated with fish mortality. The Weber Project has a runner speed of about 73 fps (22 m/s) and is roughly in the midrange of velocities tested for fish survival (10–120 fps, or 3–36.5 m/s) at 33 other sites with Francis turbines. Based on runner speed alone, survival at the Weber Project is estimated at about 70 percent (Figure 7). Survival is likely influenced by species and sizes of fish as well as the unique physical characteristics of each site. Fish size may be the single most important of these. Entrained fish at the Weber Project are expected to be smaller fish that would likely experience better survival.

Turbine passage studies performed during Phase One suggested that survival for larger-sized trout (average length 285 mm) was relatively low at 15 percent compared to an average rate of 70 percent for comparably sized fish (range 290-420 mm) from studies at other sites using Francis turbines (Franke et al. 1997). One factor that may influence survival is the relatively high number of buckets (34) at the Weber Project compared to those from other studies (13-17). The Weber Project turbine is a double-runner design, with 17 buckets per side. Double-runner Francis turbines may be used to generate additional speed at sites where head is too low for one runner (Gordon 2003). No test results for double-runner Francis turbines were identified in the literature. Based on field tests, Franke et al. (1997) considered the number of buckets to effect survival of intermediate sized fish (150 mm), with an increase in buckets from 13 to 25 potentially reducing survival from about 95 to 90 percent. Survival of intermediate sized fish (average length 166 mm) at the Weber River during the Phase One study was estimated at 54 percent. Survival of small fish (<100mm) could not be assessed during the Phase One study due to the inability to recover surviving fish swimming in the tailrace, although it is noteworthy that both dive teams observed numerous, small (3-inch test class tiger trout) fish swimming in the tailrace and the river below, apparently unharmed; these fish are also known to be less affected by electrofishing recovery tactics. Minimal survival rate was estimated at 67 percent, but was based on recapture of only 15 of 100 fish released. It is possible that small fish survival at the Weber Project is similar to rates observed at other Francis turbine sites.

Another factor that may influence mortality of larger fish at the Weber Project is runner diameter (3.7 feet or 1.1 m). Runner diameter in the reviewed literature was between 1.4–4.7 m (Franke et al. 1997). A smaller runner diameter may leave limited space between the buckets for fish to pass through. Finally, Francis turbines are somewhat more susceptible to cavitation (and potentially increased fish mortality) than other turbine designs. Running below a 50 percent load for long periods may increase cavitation risk (RIVERS 2014).

Entrainment

Like most riverine fishes, Bonneville cutthroat and bluehead sucker exhibit life history characteristics that render certain life stages vulnerable to entrainment at hydropower or irrigation diversions on the Weber River. Bonneville cutthroat in the Weber River exhibit both resident and fluvial strategies, moving from the river to various tributaries and even between tributaries during spawning. UDWR has documented adult fish moving upstream past the Project diversion. In the event these or other adult fish attempt to move downstream past the diversion, through the intake (rather than through the historic fishway, the spill gates, or the low-level gate when open, all of which potentially allow safe downstream passage) there is a potential risk of entrainment into the Project turbines. Larvae, young-of-year and other juvenile cutthroat may also travel downstream during certain times of the year and likely do so, although this has not been studied in the Weber River. Adult suckers may undergo spawning and other migrations of varying distances and have been documented in the Weber River below the Project. Downstream movement of larvae or juvenile fish appears likely based on studies in other basins which renders these fish potentially susceptible to entrainment at the Weber Project, if one of the three safer routes is not utilized.

Fish entrainment at hydroelectric projects has not been measured at many sites due to a variety of factors, one of which is the potential difficulty of meeting study objectives and high costs to conduct an in-depth study. While there is no overriding concern by the agencies about entrainment and mortality at this time, there is still interest by the FWG to have some understanding of what might occur based on the existing body of knowledge.

Studies that have attempted to evaluate entrainment encompass sites with a wide range of physical factors (i.e., intake locations, intake screen design, operating conditions, reservoir features, etc.) and fish communities. These factors have hindered past efforts to isolate individual variable effects. Indeed, agencies often require operators to evaluate entrainment over several years to incorporate a range of operating and hydrologic conditions due to the high variability inherent at each site.

With these caveats in mind, it is still worthwhile to consider how the Weber Project compares to other sites regarding entrainment-related parameters. As noted, the intake screen spacing at diversion projects can vary between one and 10 inches, but appears to have little effect on smaller-sized fish (<8 inches) which are entrained in the greatest numbers at most sites. Bar spacing at the Weber Project varies between 1.25 and 1.5 inches (Photograph 7, Appendix C). Fish <8 inches can easily pass through the intake rack. This was confirmed during Phase Two when rainbow trout ranging between 4.5 and 7 inches were released above the rack to evaluate the effectiveness of the camera system to detect fish. At some larger size, girth should prevent fish from passing through the rack. Although we do not know precisely what that size would be for the two species of interest, it is apparent that many if not most adult Bonneville cutthroat (ranging from about 300 mm to more than 600 mm [12 to more than 23.5 inches] in the Weber River project vicinity) and bluehead sucker (ranging from about 350 to 600 mm [13.75 to 23.5 inches]) would be excluded from passing through the Weber intake rack. The Project's rack is close to the 1-inch spacing often recommended as mitigation to prevent entrainment of larger fish (FERC 1995). Additionally, as noted, multiple potential 'safe' paths exist for fish of all sizes migrating downstream at the Weber Project.

Approach velocity to the intake screen is often not measured or reported at sites where entrainment has been studied. While no significant relationship has been found with entrainment rates, approach velocities measured just above the Weber Project trash rack in mid-summer ranged from 1–1.5 fps. This is within the range typically prescribed to reduce head loss, vibration, and debris accumulation and provide better safety margins for errant recreationists (Wahl 1992). Ideally, velocities should be kept within the cruising speeds of the species of concern to reduce impingement potential (OTA 1995), and it follows logically that this should also apply to entrainment. Prolonged swimming speeds in the range of 1–1.5 fps have been documented for Bonneville cutthroat that varied in standard length between 40–70 mm (1.5-2.75 inches) (Aedo et al. 2009) (Figure 11). Most young-of-year cutthroat should be able to swim against currents in front of the Weber intake rack and potentially escape via burst swimming. Indeed, fish of a wide range in sizes have been observed swimming in front of the Weber intake rack. It is highly likely that, with the exception of larval fish, actual involuntary entrainment is rare at Weber. Juvenile bluehead suckers have been found to have relatively good swimming ability as well. Ward et al. (2003) tested fishes native to the southwestern U.S. to determine the velocity at which failure occurred. Bluehead suckers ranged from 61–82 mm (2.4-3.2 inches) total length. Mean failure velocity was about 90 cm (3 feet) per second (Figure 12) and was among the highest for all species tested. This suggests that even young-of-year bluehead suckers should be capable of resisting entrainment based solely upon swimming ability. Yet, both young-of-year cutthroat and suckers may still be vulnerable to entrainment from behavioral downstream movement.

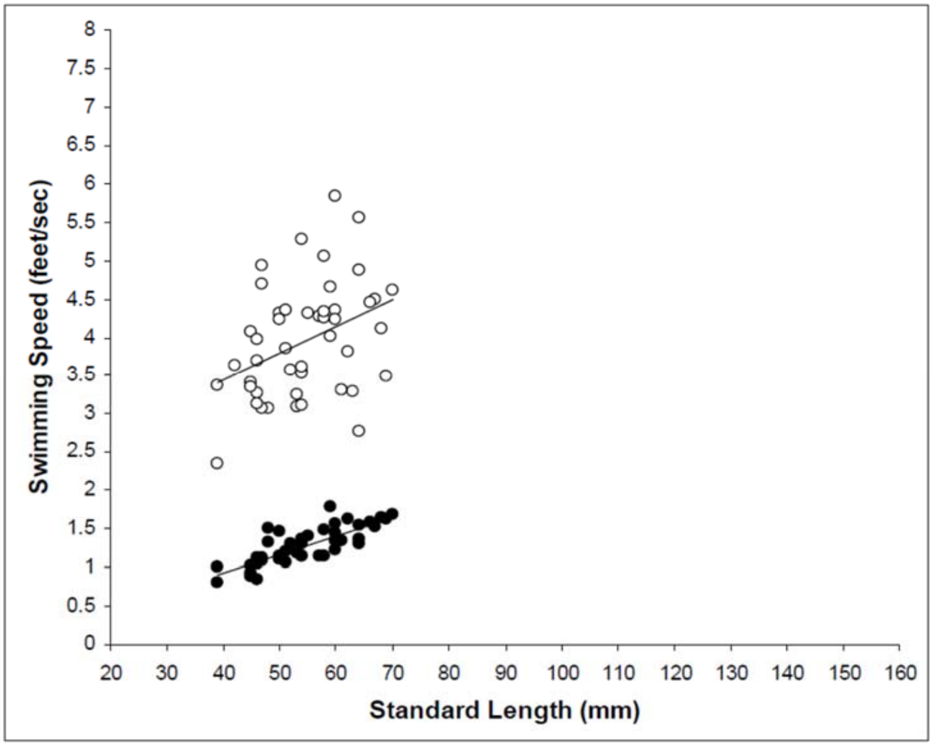

Figure 11. Results of laboratory swimming performance tests for Bonneville cutthroat trout for burst (○) and prolonged (●) swimming (from Aedo et al. 2009).

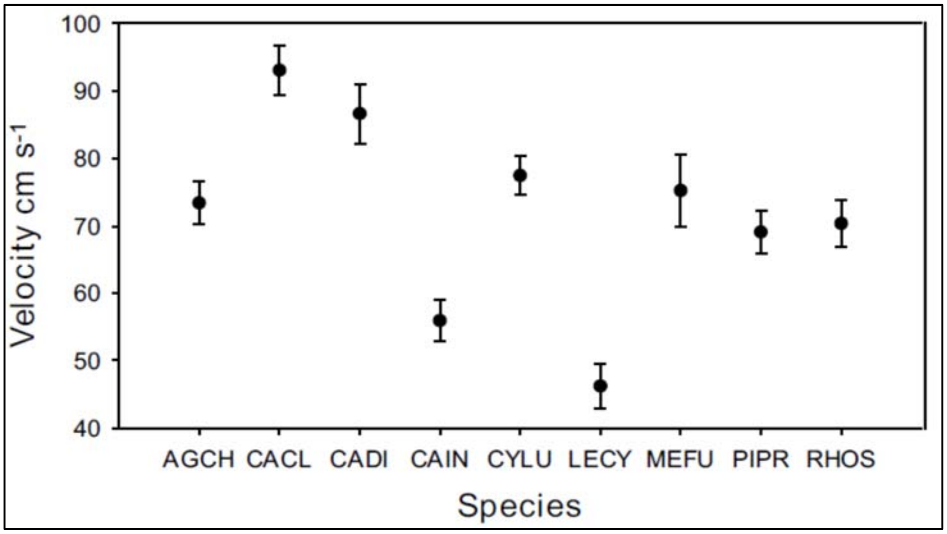

Figure 12. Relative swimming ability of six native and three nonnative fish species of similar size found in Arizona streams. *Each point is the mean velocity for which that species failed to maintain position in laboratory swimming tests. Bars indicate 95% confidence intervals. AGCH = Agosia chrysogaster, CACL = Catostomus clarki, CADI = bluehead sucker (size range 61-82mm), CAIN = Catostomus insignis, CYLU = Cyprinella lutrensis, LECY = Lepomis cyanellus, MEFU = Meda fulgida, PIPR = Pimephales promelas, RHOS = Rhinichthys osculus (from Ward et al. 2003).*

The Weber Project's basic configuration with an intake just downstream of a shallow, narrow reservoir with a high flush rate and shallow intake located along the shoreline may predispose certain fish to relatively higher entrainment rates compared to an intake in a large, deep reservoir at greater depth (Photograph 8, Appendix C). Many juvenile fish move along the shoreline, which may render them more vulnerable to entrainment at the Weber Project if they tend to migrate down the south shore. However, the impoundment above the diversion also contains abundant macrophytes which could serve as rearing habitat and foraging areas for these fish, potentially discouraging further downstream movement.

Research has shown that for many riverine fish species spring and summer are generally the time periods when peak movements of adult and juvenile fishes occur. The two species of concern in the Weber River appear to be no exception based on ongoing studies. Adults move primarily during spring in association with spawning. Juveniles, particularly young-of-year, may be displaced by higher flows during the spring or disperse downstream from potentially more crowded areas in the spring and summer. During those times, entrainment potential is probably greatest. However, with construction of the new ladder and modification of the existing ice sluice as attraction flow coupled with spill, which can occur more often during the higher flow periods, there are several avenues for fish to move downstream without having to go through the turbines.

On average, Weber plant flows are at their highest levels from April through September when peak movements are taking place (Table 4). Although no consistent relationships between hydropower plant flow and entrainment have been found (FERC 1995), there has been some attention devoted to the potential association between diversion flow as a percent of river flow and entrainment for irrigation uses. Entrainment rate increases with flow at certain irrigation diversions (Kennedy 2009; Vogel 2012). The presumption that there is a relationship between these two variables has been used recently to rank the potential of diversions to entrain bluehead suckers and other native fishes in the San Juan and Animas River Basins (Lyons et al. 2016). It seems logical this may also apply to hydroelectric uses.

Table 4. Monthly average Weber River Discharge Relative to Plant Flow from 1966 through 2014

Month	River Discharge (cfs)*	Turbine Discharge (cfs)	Turbine/River (%)
January	231	130	56.3%
February	291	150	51.5%
March	562	219	39.0%
April	949	273	28.8%
May	1,310	296	22.6%
June	1,110	303	27.3%
July	515	296	57.5%
August	423	292	69.0%
September	371	271	73.0%

Table 4. Monthly average Weber River Discharge Relative to Plant Flow from 1966 through 2014

Month	River Discharge (cfs)*	Turbine Discharge (cfs)	Turbine/River (%)
October	232	167	72.0%
November	150	98	65.3%
December	185	108	58.4%

*Weber River discharge from USGS gage 10136500 at Gateway, UT, located about 1.1 miles upstream from Project diversion.

From that perspective, mean Weber Project flow as a percent of river flow has ranged from 22.6 percent in May to 73.0 percent in September during the 1966–2014 period of record (see Table 4). During April–June when adult movements associated with spawning are expected to be at their highest levels, Project flows range from about 23–29 percent of river flows including the three lowest percentages for the entire year. After June, these percentages increase rapidly and substantially as river discharge decreases and plant flows remain fairly constant. This corresponds roughly to the period when fry emergence and downstream movement of larvae and young-of-year may be most likely and raises entrainment risk for these stages of both species of concern.

6.5. Study Two Potential Entrainment Conclusions

Based on our analysis of the biology of species of concern, Project features and the existing entrainment literature we draw the following conclusions:

1) Juveniles of Bonneville cutthroat and bluehead sucker (about 150 mm [8 inches] or less) are most likely to be entrained. However, fish of this size should suffer relatively lower levels of mortality than larger fish, as observed during the Weber Project Phase One study.

2) Young-of-year of both species may have highest entrainment risk during the late spring and early summer when Weber Project flows, as a percentage of river flow, increase rapidly. This coincides with the period when newly emerged fish are most likely to move downstream either behaviorally or in response to relatively high river flows. Other pathways exist for downstream movement, such as the diversion spillway, the historic fishway and the low-level gate, that may be used under certain conditions.

3) Young-of-year and juvenile bluehead sucker appear to be rare in collections well upstream of the Project. Abundance in the Project Area is not well understood at this time. Low numbers of juveniles should reduce the potential numbers of these species that may be entrained.

4) Bonneville cutthroat are known to traverse the Project diversion and spawn in tributaries above the diversion. Potential downstream migration of juvenile trout produced in these

areas is not well understood. These numbers may not be substantial if sufficient resources and suitable habitat exist upstream of the Project, including the impoundment.

5) Entrainment risk should be reduced during the fall and winter when movements of all life stages are lower. This coincides with the period when Project flow (as a percentage of river flow) is at its highest annual levels.

6) Approach velocities to the intake rack (1-1.5 fps) are within the documented prolonged swimming speeds of young-of-year of both species, which may reduce entrainment risk; further, fish of all sizes have been observed swimming freely immediately in front of and along the intake rack.

7) Larger sized fish (mostly adults) of both species (>300 mm [12 inches]) should suffer substantially higher mortality than smaller individuals (about 150 mm [8 inches] or less). However, these are much less likely to be entrained according to previous studies, and by observation at the Project, due to intake bar spacing and downstream-swimming fish orientation.

8) The largest fish (>350 mm [13.75 inches]) are likely precluded from entrainment due to the size of the intake opening (1.5 inches). Individuals of this size are common among adult populations of both species.

9) Overall, entrainment and mortality potential of Bonneville cutthroat and bluehead sucker appears to be relatively low for the Weber Project. Entrainment and mortality risk at unscreened irrigation diversions, such as the DWCCC diversion dam just below the power plant, may be greater for these populations. This is due to the high percentage of river flow removed and the presumably high mortality levels of entrained fish.

7.0 REFERENCES CITED

AIC (Acres International Corporation). 2005. Fish Entrainment and Mortality Study: Niagara Power Project FERC No. 2216. Prepared by Acres International Corporation. Prepared for New York Power Authority.

Aedo, J., Belk, M., and R. Hotchkiss. 2009. Morphology and Swimming Performance of Utah Fishes: Critical Information for Culvert Design in Utah Streams. Report No. UT-09.12. Prepared by Brigham Young University. Prepared for Utah Department of Transportation Research Division.

Amaral, S.V. 2001. Turbine Passage Survival Estimates for the Dunvegan Hydroelectric Project. Prepared by Alden Research Laboratory Environmental Services. Holden, MA. Prepared for Glacial Power, Ltd.

Andreasen, J.K., and J.R. Barnes. 1975. Reproductive Life History of *Catostomus ardens* and *C. discobolus* in the Weber River, Utah. Copeia. 4:643-648.

Behnke, R.J. 1992. Native Trout of Western North America. American Fisheries Society Monograph 6. American Fisheries Society. Bethesda, MD. 275 pp.

Bezzerides, N., and K. Bestgen. 2002. Status Review of Roundtail Chub (*Gila robusta*), Flannelmouth Sucker (*Catostomus latipinnis*), and Bluehead Sucker (*Catostomus discobolus*) in the Colorado River Basin. Larval Fish Lab Contribution 118. Submitted to U.S. Bureau of Reclamation.

Bickford, S.A., and J.R. Skalski. 2000. Reanalysis and Interpretation of 25 Years of Snake-Columbia River Juvenile Salmonid Survival Studies. North American Journal of Fisheries Management. 20:53-68.

Bliesner, R., E.A. de la Hoz, P. Holden, and V. Lamarra. 2010. San Juan River Basin Recovery Implementation Program – Hydrology, Geomorphology, and Habitat Studies. Report for the San Juan River Basin Recovery Implementation Program. 63 pp.

Bower, M.R., Hubert, W.J., and F.J. Rahel. 2008. Habitat Features Affect Bluehead Sucker, Flannelmouth Sucker, and Rountail Chub across a Headwater Tributary System in the Colorado River Basin. Journal of Freshwater Ecology. 23:347-358.

Budy, P., Thiede, G.P., and P. McHugh. 2007. Quantification of the Vital Rates, Abundance, and Status of a Critical, Endemic Population of Bonneville Cutthroat Trout. North American Journal of Fisheries Management. 27:593-604.

Budy, P., Thiede, G.P., McKell, M.D., and P. Thompson. 2014. Weber River Metapopulation and Source-Sink Dynamics of Native Trout and Nongame Fishes. 2013 Performance Report to Utah Division of Wildlife Resources. Sport Fish Restoration, Grant Number: F-135-R, Segment 2. UTCFWRU 2014(4):1–54.

Burnett, P., Nadolski, B., Thompson, P., and S. McKay. 2013. Restoring Life History Diversity to Bonneville Cutthroat Trout and Bluehead Sucker in the Weber River.

http://documentslide.com/documents/paul-burnett-trout-unlimited-ben-nadolski-utah-division-of-wildlife.html.

Cada, G. F. 1990. A Review of Studies Relating to the Effects of Propeller-Type Turbine Passage on Fish Early Life Stages. North American Journal of Fisheries Management. 10:418-426.

Cada, G.F. 2001. The Development of Advanced Hydroelectric Turbines to Improve Fish Passage Survival. Fisheries. 26(9):14-23.

Cada, G.F. 2011. A Review of Studies Relating to the Effects of Propeller-Type Turbine Passage on Fish Early Life Stages. North American Journal of Fisheries Management. 10:418-426.

Cada, G.F., and B.N. Rinehart. 2000. Hydropower R&D: Recent Advances in Turbine Passage Technology. Oak Ridge National Laboratory and Idaho National Engineering and Environmental Laboratory. Prepared for the Department of Energy.

Colyer, W.T., Kershner, J.L., and R.H Hilderbrand. 2005. Movements of Fluvial Bonneville Cutthroat Trout in the Thomas Fork of the Bear River, Idaho-Wyoming. North American Journal of Fisheries Management. 25:954-963.

Compton, R.I. 2007. Population Fragmentation and White Sucker Introduction Affect Populations of Bluehead Suckers, Flannelmouth Suckers, and Roundtail Chub in a Headwater Stream System, Wyoming. M.S. Thesis. University of Wyoming. 149 pp.

Coutant, C.C., and R.R. Whitney. 2000. Fish Behavior in Relation to Passage through Hydropower Turbines: A Review. Transactions of the American Fisheries Society. 129(2):351-380.

De La Hoz Franco, E., and P. Budy. 2005. Effects of Biotic and Abiotic Factors on the Distribution of Trout and Salmon along a Longitudinal Stream Gradient. Environmental Biology of Fishes. 72(4):379-391.

Douglas, M.R., and M.E. Douglas. 2009. Population Genetic Analysis of Bluehead Sucker [*Catostomus (Pantosteus) discobolus*] Across the Species' Range. Draft Final Report. Illinois Natural History Survey. Champaign, IL.

Duke Energy. 2008. Markland Hydroelectric Project FERC No. 2211. Fish Entrainment and Turbine Mortality Analysis Draft. Prepared by Duke Energy Indiana, Inc. and Kleinschmidt Energy and Water Resource Consultants.

Eicher, G.J., Campbell, C.J., Craven, R.E., and M.A. West. 1987. Turbine-Related Fish Mortality: Review and Evaluation of Studies. EPRI AP-5480. Prepared for the Electric Power Research Institute. Palo Alto, CA.

EPRI (Electric Power Research Institute). 1992. Fish Entrainment and Turbine Mortality Review and Guidelines. EPRI TR-101231. Prepared by Stone and Webster Environmental Services, Boston, MA.

EPRI. 1997. Turbine Entrainment and Survival Database – Field Tests. EPRI Report No. TR-108630. Prepared by Alden Research Laboratory, Inc., Holden, MA.

Federal Energy Regulatory Commission (FERC). 1995. Preliminary Assessment of Fish Entrainment at Hydropower Projects: A Report on Studies and Protective Measures, Volume I. Paper No. DPR-10. FERC Office of Hydropower Licensing, Washington DC. June, 1995.

Federal Register. 2008. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Bonneville Cutthroat Trout as Threatened or Endangered. Proposed Ruling by U.S. Fish and Wildlife Service. 73 FR 52235. Issued September 9, 2008.

Franke, G.F., Mathur, D., Hopping, P.N., Headrick, M.R., and Y. Ventikos. 1997. Development of Environmentally Advanced Hydropower Turbine System Design Concepts. Idaho National Engineering and Environmental Laboratory. Prepared for U.S. Department of Energy, Energy Efficiency and Renewable Energy and Hydropower Research Foundation, Inc. Contract No. DE-AC07-94ID13223. Idaho Falls, ID. 456 pp.

Geosyntec Consultants. 2005. Fish Entrainment Evaluation (Aquatics 05) Final Report: Catawba-Wateree Project (FERC No. 2232). Prepared by Geosyntec Consultants. Kennesaw, GA. Prepared for Devine Tarbell and Associates, Inc.

Gordon, J.L. 2003. Turbine Selection for Small Low-Head Hydro Developments. Presentation at "Innovative Small Hydro Technologies", Waterpower XIII, Buffalo, NY. July 29, 2003. http://smallhydro.carbonsd.com/pdf/workshops/cd/2003/technical/Turbine%20selection%20for%20small%20low%20head%20hydro.doc.

Haak, A.L., Williams, J.E., Isaak, D., Todd, A., Muhlfeld, C., Kershner, J.L., Gresswell, R., Hostetler, S., and H.M. Neville. 2010. The Potential Influence of Changing Climate on the Persistence of Salmonids of the Inland West: U.S. Geological Survey Open-File Report 2010–1236. 74 p.

Hepworth, D.K., Ottenbacher, M.J., and L.N. Berg. 1997. Conservation Management of Native Bonneville Cutthroat Trout *(Oncorhynchus clarki utah)* in Southern Utah. Sport Fish Restoration Act Project F-44-R. Utah Division of Wildlife Resources. Publication No. 97-05.

Hilderbrand, R.H., and J.L. Kershner. (2000) Movement Patterns of Stream-resident Cutthroat Trout in Beaver Creek, Idaho-Utah. Transactions of the American Fisheries Society. 129:1160-1170.

Kennedy, P.A. 2009. The Effect of Irrigation Diversions on the Mountain Whitefish (*Prosopium williamsoni*) Population in the Big Lost River. M.S. Thesis. Utah State University. Logan, UT. 55 pp.

Lentsch, L., Converse, Y., and J. Perkins. 1997. Conservation Agreement and Strategy for Bonneville Cutthroat (*Oncorhynchus clarki utah*) in the State of Utah. Publication No. 97-19. Utah Division of Wildlife Resources. Salt Lake City, UT. 73 pp.

Lentsch, L., Toline, C.A., Kershner, J., Hudson, J.M., and J. Mizzi. 2000. Range-wide Conservation Agreement and Strategy for Bonneville Cutthroat *(Oncorhynchus clarki utah)*. Publication No. 00-19. Utah Division of Wildlife Resources. Salt Lake City, UT. 90 pp.

Lyons, D., Farrrington, M.A., Plantania, S.P., and D. Gori. 2016. San Juan and Animas Rivers Diversion Study Draft Final Report. Prepared by American Southwest Ichthyological Researchers. Albuquerque, NM.

Maloney, B. Email communication from Bryan Maloney (M.S. candidate at Utah State University) to Keith Lawrence (RedFISH Environmental) on October 19, 2016.

May, B.E., Leppink, J.E., and R.S. Wydoski. 1978. Distribution, Systematics and Biology of the Bonneville Cutthroat Trout, *Oncorhynchus clarki utah.* Utah Division of Wildlife Resources. Publication No. 78-15.

McHugh, P., and P. Budy. 2005. An Experimental Evaluation of Competitive and Thermal Effects on Brown Trout (*Salmo trutta*) and Bonneville Cutthroat Trout (*Oncorhynchus clarki utah*) Performance Along an Altitudinal Gradient. Canadian Journal of Fisheries and Aquatic Science 62:2784-2795.

McHugh P., and P. Budy. 2006. Experimental Effects of Nonnative Brown Trout on Individual- and Population-Level Performance of Native Bonneville Cutthroat Trout. Transactions of the American Fisheries Society. 135:1441-1455.

NMFS (National Marine Fisheries Service). 2008. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, OR.

Nielson, B.R., and L. Lentsch. 1988. Bonneville Cutthroat Trout in Bear Lake: Status and Management. American Fisheries Society Symposium 4:128-133.

Normandeau Associates Inc. 2009. Claytor Hydroelectric Project Fish Entrainment and Impingement Assessment. Prepared by Normandeau Associates Inc. for Appalachian Power Company. Drewmore, PA and Bedford, NH.

Normandeau Associates. 2012. Estimation of Survival of Juvenile American Shad Passed Through Francis Turbines: RSP 3.2. Conowingo Hydroelectric Project FERC Project No. 405. Prepared by Normandeau Associates. Prepared for Exelon.

OTA (Office of Technology Advancement). 1995. Fish Passage Technologies: Protection at Hydropower Facilities. OTA-ENV-641. U.S. Government Printing Office. Washington, DC. September, 1995. https://www.princeton.edu/~ota/disk1/1995/9519/9519.PDF.

PacifiCorp. 2015a. Weber Hydroelectric Project FERC No. 1744 Pre-Application Document. PacifiCorp Hydro Resources. Salt Lake City, UT. May 29, 2015.

PacifiCorp. 2015b. Weber Hydroelectric Project FERC No. 1744 Draft Study Plans. PacifiCorp Hydro Resources. Salt Lake City, UT. November 18, 2015.

PacifiCorp. 2016. Weber Hydroelectric Project FERC No. 1744 Final Fisheries Study Plan. PacifiCorp Hydro Resources. Salt Lake City, UT. March 2016.

Ptacek, J.A., Rees, D.E., and W.J. Miller. 2005. Bluehead Sucker (*Catostomus discobolus*): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region. Available Online: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5206794.pdf.

Progress Energy. 2005. Yadkin-Pee Dee River Hydroelectric Project FERC No. 2206: Fish Entrainment and Turbine Survival Evaluation for Tillery and Blewett Falls Developments. Prepared by Progress Energy.

Randall, J.W. 2012. The Survival and Growth of Adult Bonneville Cutthroat Trout (*Oncorhynchus clarki utah*) in Response to Different Movement Patterns in a Tributary of the Logan River, Utah. All Graduate Theses and Dissertations. Paper 1396.

RIVERS. 2014. Comparative Study of Small Hydropower Stations. Reclaiming Rivers for Implementation of Vital and Environment – Friendly Renewable Energy Source – RIVERS. http://riversproject.eu/pdf/Comparative%20study.pdf.

Schrank, A.J., and F.J. Rahel. 2004. Movement Patterns in Inland Cutthroat Trout (*Oncorhynchus clarki utah*): Management and Conservation Implications. Canadian Journal of Fisheries and Aquatic Sciences. 61:1528-1537.

Sigler, W.F., and J.W. Sigler. 1987. Fishes of the Great Basin: A Natural History. University of Nevada Press. Reno, NV.

Sweet, D.E. 2007. Movement Patterns and Habitat Associations of Native and Introduced Catostomids in a Tributary System of the Colorado River. M.S. Thesis. University of Wyoming. Laramie, WY. 183 pp.

Sweet, D.E., and W.A. Hubert. 2010. Seasonal Movements of Native and Introduced Catostomids in the Big Sandy River, Wyoming. The Southwestern Naturalist. 55(3):382-389.

Thompson, P. 2017. Personal communication with Paul Thompson, Aquatics Program Manager, Northern Region, Utah Division of Wildlife Resources, regarding the preliminary draft Fisheries Technical Report, December 22, 2016. Provided via email, January 27, 2017.

Thompson, P. 2015. Bonneville Cutthroat Trout and Bluehead Sucker in the Weber River: Endangered Species Act Implications? Weber River Partnership Native Species Presentation. Available Online: http://www.slideshare.net/PaulThompson47/weber-river-partnership-native-species-presentation.

UDWR (Utah Division of Wildlife Resources). 2006a. Range-wide Conservation Agreement and Strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*). Publication No. 06-18. Salt Lake City, UT.

UDWR. 2006b. Three Species: Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), Flannelmouth Sucker (*Catostomus latipinnis*) Monitoring Summary Statewide 2006. Publication Number 08-23.

USFWS (U.S. Fish and Wildlife Service). 2001. Status Review for the Bonneville Cutthroat Trout (*Oncorhynchus clarki Utah*). United States Department of Interior, U.S. Fish and Wildlife Service. Regions 1 and 9. Portland, OR and Denver, CO.

Vogel, D.A. 2012. Evaluation of Fish Entrainment in Nine Unscreened Sacramento River Diversions, 2011. Report prepared for the Anadromous Fish Screen Program, CALFED Ecosystem Restoration Program, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, NOAA Fisheries, and California Department of Fish and Game. Natural Resource Scientists, Inc. January, 2012. 97 pp. plus appendices.

Wahl, T.L. 1992. Trash Control Structures and Equipment: A Literature Review and Survey of Bureau of Reclamation Experience. U.S. Department of Interior. Bureau of Reclamation, Hydraulics Branch, Research and Laboratory Services Division. Denver, CO.

Ward, D.L., Schultz, A.A., and P.G. Matson. 2003. Differences in Swimming Ability and Behavior in Response to High Water Velocities among Native and Nonnative Fishes. Environmental Biology Fishes. 68:87-92.

Webber, P.A., Thompson, P., and P. Budy. 2012. Status and Structure of Two Populations of the Bluehead Sucker (*Catostomus discobulus*) in the Weber River, Utah. The Southwestern Naturalist. 57(3):267-276.

White, S.M., and F.J. Rahel. 2008. Complementation of Habitats for Bonneville Cutthroat Trout in Watersheds Influenced by Beavers, Livestock, and Drought. Transactions of the American Fisheries Society. 137:881-894.

Williams, J.E., Haak, A.L., Neville, H.M., Colyer, W.T., and N.G. Gillespie. 2007. Climate Change and Western Trout: Strategies for Restoring Resistance and Resilience in Native Populations. Working Together to Ensure the Future of Wild Trout. Wild Trout IX Symposium. October, 2007.

Winchell, F., Amaral, S., and D. Dixon. 2000. Hydroelectric Turbine Entrainment and Survival Database: An Alternative to Field Studies. HydroVision Conference, August 8-11, 2000. Charlotte, NC.

Zelasko, K.A., Bestgen, K.R., and K. Hayes. 2011. Drift and Retention of Flannelmouth Sucker (*Catostomus latipinnis)*, Bluehead Sucker (*Catostomus discobolus)*, and White Sucker (*Catostomus commersoni)* in the Big Sandy River, Wyoming. Larval Fish Laboratory, Colorado State University, Fort Collins, CO.

APPENDIX A

Upstream Fish Passage Conceptual Design Report

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STUDY 1:
UPSTREAM FISH PASSAGE
CONCEPTUAL DESIGN REPORT

WEBER HYDROELECTRIC PROJECT
(FERC NO. 1744)

Prepared for:

PacifiCorp
Salt Lake City, Utah

Prepared by:

Kleinschmidt

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October 2016

UPSTREAM FISH PASSAGE
CONCEPTUAL DESIGN REPORT

WEBER HYDROELECTRIC PROJECT
(FERC NO. 1744)

PACIFICORP
SALT LAKE CITY, UTAH

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

PacifiCorp's Weber Hydroelectric Project is located on the Weber River, in Weber, Morgan, and Davis counties in Utah. The Project is partially on federal lands managed by the Wasatch-Cache National Forest and partially on lands owned by the Union Pacific Railroad Company. The Project's license from the Federal Energy Regulatory Commission (FERC) expires in May of 2020, and PacifiCorp is relicensing the Project using the Alternative Licensing Process (ALP), pursuant to 18 CFR Part 5. The ALP is highly collaborative and relies on development of consensus-based protection, mitigation, and enhancement (PM&E) measures that will be evaluated by the FERC during its National Environmental Policy Act (NEPA) review. PacifiCorp engaged Kleinschmidt to evaluate upstream fish passage options at the Weber Hydroelectric Project and develop a conceptual design of a preferred alternative.

The Weber Hydroelectric Project is situated on the Weber River approximately 10 miles southeast of the Ogden, Utah. The concrete diversion dam extends across the river in the north-south direction and consists of two radial gates, a historic but likely ineffective fish passage flume that is used to pass the minimum flow, a low level outlet gate, and a penstock intake structure. A 5-foot to 6.3-foot diameter penstock runs from the intake 9,107 feet downstream to the powerhouse. The powerhouse contains one generating unit with a rated capacity of 3,850 kilowatts (kW).

In anticipation of a new FERC license, PacifiCorp is designing a new upstream fish passage facility to pass Bonneville cutthroat trout (Oncorhynchus clarkii) and bluehead sucker (Catostomus discobolus) at the Weber Hydroelectric Project diversion dam. Four distinct types of fishways were investigated as potential options. Variations on two of these types of fishways resulted in a total of six options that were considered in an alternatives analysis performed with input from PacifiCorp and the Fisheries Working Group (FWG). Working collaboratively with the FWG, the preferred option, which was selected during the alternatives analysis, was developed to a conceptual design level.

2.0 PROJECT OPERATIONS

This section is intended to provide a summary of the existing operations of the Weber Hydroelectric Project and a review of what operational considerations were made during the conceptual design of the upstream fishway at the site. The existing standard operation of the Project is summarized based on discussions with PacifiCorp operations personnel.

2.1 EXISTING OPERATIONS

2.1.1 STANDARD OPERATIONS

The Project currently operates on pond level controls to keep the headpond 3-4 inches below the top elevation of the two radial spillway gates. The top of the radial gates is identified as the normal pond elevation and this elevation was identified as El. 4798.2’ in a survey performed by Diamond Land Surveying, LLC on February 24, 2016. There are no restrictions on the headpond operating level, but the pond is held below an elevation that would cause flooding of the intake house (approximately 8 inches above normal pond). Minimum flows into the bypassed reach are the lesser of 34 cfs or inflow from October 1 – March 1, and 34 – 50 cfs (the range is dependent on the annual runoff forecast) or inflow, whichever is less, from April 1 – September 30. Minimum flows are passed via the historic but likely ineffective fish passage flume on the north side of the spillway, and controlled via an annually calibrated manual slide gate at the upstream end of the flume.

2.1.2 HIGH FLOW OPERATIONS

When flows exceed the combined hydraulic capacity of the turbine (320 cfs[1] normal maximum) and the minimum flow release structure, the water level increases, exceeds the normal pond level and overtops the radial gates. If flows increase and cause the headpond to rise 3-4 inches above the normal pond level, the north spillway gate opens via automated controls to maintain the headpond elevation within 3 or 4 inches of the normal pond level. When the pond level falls to the normal pond elevation, the north gate closes completely. Under high flow conditions, the north spillway gate continues to rise until the water level exceeds the normal pond level by a set

[1] While the normal full load steady state hydraulic capacity of the turbine is 320 cfs, the licensed capacity of the Project is 365 cfs.

point of not more than six inches, at which point an alarm for high water is tripped and operators are dispatched to manually raise the south gate. Manual operation of the south gate continues through the high flow event, after which the south gate is closed and standard operation resumes.

2.1.3 Low Flow Operations

If the headpond falls four inches below the top of the spillway gate, turbine flows are reduced via automated pond level control. Flows are continually reduced until the unit shuts down, at which point all flow is passed through the minimum flow gate (and spillway gates as required). During winter months, the pond level controls are set to maintain a low water set point 12 inches below the normal pond level. Storage at the upstream Echo reservoir typically reduces inflows during the fall and winter months, except during very wet years. In the event insufficient water is expected for generation on a long-term basis (sometimes from mid-October – February or March), the headpond is drawn down and emptied by raising the spillway gates and opening the low level outlet gate. The Weber Project functions in run-of-river mode under all operational conditions, but particularly during low flow operations when the headpond is emptied and the river channel carries water directly to and through the low-flow outlet in the Weber dam. As part of this relicensing process, a future potential operating condition has been agreed to: when the headpond is dewatered, PacifiCorp has committed to ensuring the low-level outlet will operate to allow fish passage when the proposed ladder is non-functioning. Depending on the outcome of this licensing process, this stipulation is expected to become part of the operational requirements of a new Weber Project operating license.

2.2 Conceptual Design Fishway Location and Operation

The proposed location of the new upstream fish passage facility is on the north side of the spillway immediately adjacent to the historic fish passage flume where the minimum flow is released. The proposed layout of the upstream fish passage facility will not affect the existing historic fish passage flume and minimum flow gate. Locating the proposed new fishway on the south side of the river would interfere with the intake, penstock, and railroad; and is therefore not feasible.

Effective upstream fish passage requires an attraction flow, or a quantity of flow that fish can detect and follow into the fishway and upstream past the Project. A portion of the required minimum flow will be passed through the proposed fishway to act as attraction flow and the remainder of the required minimum flow will continue to be passed through the existing minimum flow gate and historic fish passage flume. The entrance to the proposed fishway will be located immediately adjacent to the current minimum flow discharge location, therefore the entire quantity of the required minimum flow will act as attraction flow to guide fish toward the proposed fishway entrance.

2.3 Operational Considerations and Challenges

2.3.1 Gate Prioritization

Currently the north spillway gate is operated for pond level control. However, this means that as the river flow increases above the hydraulic capacity of the turbine, the excess flow will be discharged through the north spillway gate immediately upstream of and adjacent to the proposed fishway entrance. As river flow increases, the north spillway gate will be opened further and further, quickly exceeding the fishway attraction flow that is being released immediately downstream. This operating protocol would effectively “drown out” the attraction flow from the proposed fishway and make it more difficult for fish to find the entrance to the proposed fishway during spill conditions. Because of this, PacifiCorp intends to switch the gate prioritization and use the south gate for pond level control, rather than the north gate. This change in gate prioritization will require some mechanical retrofits to the south spillway gate that will be completed as part of the proposed new fishway construction.

2.3.2 Potential for Limitations on Headpond Fluctuation

Fishways are designed for a range of flow conditions to accommodate passage by target species. The defining parameters of water velocity and water depth within the fishway are generally determined by the headpond elevation. As elevation of the headpond affects the water velocities and water depths in the fishway, the range of fluctuation in headpond elevations must be reviewed to confirm that effective fish passage will be provided throughout the range. Existing standard headpond fluctuations will be incorporated as fishway design criteria. The existing normal range of headpond fluctuation at the Weber Project is considered to be +/- 3 or 4 inches above and below the normal pond elevation. This range of headpond fluctuation would not have a significant impact on the water velocities or water depths within the proposed fishway, therefore no changes are proposed or anticipated for the existing Project operations or range of headpond fluctuations.

2.3.3 MAINTENANCE IMPLICATIONS

Required maintenance related to debris cleaning and handling is anticipated to increase with the installation of the proposed fishway due to the flow obstructions that would be part of the proposed fishway design. The proposed fishway will include a coarse-spaced bar rack at the upstream end and a number of pools and baffles with 12-inch-wide vertical slots. The coarse-spaced bar rack is intended to prevent large debris from entering the fishway and will need to be cleaned regularly to allow fish to freely pass upstream into the reservoir. The coarse-spaced bar racks should filter out most debris that would be large enough to get caught in the 12-inch-wide vertical slots where the fishway flow passes from pool to pool, however the vertical slots and pools within the fishway should be routinely inspected and cleaned of debris as required to maintain effective fish passage.

The proposed fish trap that may be installed at the upstream end of the proposed fishway will likely be constructed of bar rack material with clear spacings close enough to prevent passage of fish. Therefore it will accumulate debris and likely require frequent cleaning when it is in operation. When the fish trap is not in operation it will be raised up out of the water to prevent continued debris collection. Operation of the proposed fish trap and daily maintenance would be completed by members of the FWG (specifically Utah Division of Wildlife Resources and Trout Unlimited); construction and major maintenance of the proposed fish trap would be completed by PacifiCorp.

Cleaning or maintenance efforts may occasionally require temporarily shutting off flow through the proposed fishway, during which time compliance with continuous minimum flow requirements will require adjustment of the minimum flow gate or opening of one of the spillway radial gates.

2.3.4 MINIMUM FLOW COMPLIANCE

Minimum flow compliance is currently achieved via the existing historic concrete fish passage flume, controlled with the slide gate at the upstream end. The slide gate is partially closed to limit flow releases and changes in pond elevation have little effect on flows through the gate opening. The gate is calibrated annually and is operated such that the required minimum flow is passed even when the headpond is at the low end of its range of fluctuation, and a flow quantity slightly higher than the required minimum flow is passed when the headpond is higher in its range of fluctuation. Once the proposed fishway is installed a portion of the required minimum flow will be passed through the proposed fishway to act as attraction flow and the remainder of the required minimum flow will continue to be passed through the existing minimum flow gate and historic fish passage flume. After the proposed fishway is installed a flow evaluation will be done to determine the range of flow through the fishway corresponding to the range of normal headpond fluctuation. Then the existing minimum flow gate will be calibrated to pass the remainder of the required minimum flow.

3.0 DESIGN CRITERIA

This section is intended to provide a summary of the design criteria for the conceptual design of the proposed upstream fishway at PacifiCorp's Weber Hydroelectric Project. During the upstream fish passage conceptual design kick-off meeting held on March 7, 2016 at SWCA's office in Salt Lake City, Kleinschmidt met with the members of the FWG which includes individuals representing the U.S. Fish and Wildlife Services, U.S. Forest Service, Utah Division of Wildlife Resources, Utah Division of Water Quality, Trout Unlimited, FERC, and PacifiCorp. The primary purpose of the meeting was to establish the design criteria for the proposed upstream fish passage facility. Below is a description of the design criteria that was discussed during the kick-off meeting and a second meeting on May 4, 2016 at UDWR's Northern Region office, then finalized and accepted by the FWG at a third meeting on July 13, 2016, also at UDWR's Northern Region office.

3.1 TARGETED FISH SPECIES

Scoping Document 1, completed as part of the ALP, and the subsequent scoping meeting with stakeholders, identified upstream fish passage for Bonneville cutthroat trout and bluehead sucker as a PM&E measure likely to be required in any new license issued for the Project. Bonneville cutthroat trout and bluehead sucker are species of concern present in the Weber River both upstream and downstream of the Project. Although the proposed fishway is intended primarily for adult fish, it is anticipated that all life stages 150 mm and larger will be capable of using the fishway.

3.2 RELEVANT DESIGN CRITERIA

The following table summarizes all of the relevant design criteria for upstream fish passage at the Weber Project.

TABLE 1 UPSTREAM FISH PASSAGE DESIGN CRITERIA FOR THE WEBER PROJECT

(1)	Target Species	Bonneville Cutthroat Trout (BCT) and Bluehead Sucker.
(2)	Life Stage of Target Species	Fishway is intended primarily for adult fish, however it is anticipated that all life stages 150 mm and larger will be capable of using the fishway.
(3)	Fishway Water Velocity Targets (Based on Fish Swim Speed)	Bonneville Cutthroat Trout – 3-5 ft/sec (sustained speed). Bluehead Sucker – 4 ft/sec (sustained speed) or less preferable.
(4)	Design Population	No set design population criteria
(5)	Station Hydraulic Capacity	320-365 cfs
(6)	Minimum Flow	34-50 cfs
(7)	Low Level Gate Hydraulic Capacity	• Approximately 200 cfs under normal pond conditions • When headpond is dewatered the low level gate will pass approximately 100 cfs before water starts to spill over the concrete invert of the open spillway gates.
(8)	Spillway Radial Gate Hydraulic Capacity	Each gate (two total) has a capacity in the range of 2,300 to 2,700 cfs under normal pond conditions.
(9)	Period of Operation of Fishway	Fishway will be in operation anytime the headpond is full. The headpond is dewatered during winter freezing conditions when the river flow is below the turbine operating range. In order for the turbine to operate the river flow must be in the range of 85-95 cfs. The fishway will not be operated during periods when the headpond is dewatered. When the headpond is dewatered the low level outlet gate will be opened to allow fish passage. The following water velocities have been calculated for various flow conditions through the low level outlet gate: Q = 34 cfs ➔ V = 2.7 fps Q = 40 cfs ➔ V = 3.2 fps Q = 50 cfs ➔ V = 4.0 fps Q = 60 cfs ➔ V = 4.8 fps Q = 70 cfs ➔ V = 5.6 fps Q = 80 cfs ➔ V = 6.4 fps Q = 90 cfs ➔ V = 7.2 fps Q = 100 cfs ➔ V = 8.0 fps

(10)	River Flow Operating Range	When the headpond is full the fishway will remain in operation for river flows of 34 cfs to approximately 2,500 cfs. As river flow increases above the turbine capacity the south spillway gate will be opened to pass excess flow. Once the south spillway gate reaches its maximum capacity the north spillway gate will be opened to pass increasing river flows. The fishway entrance will likely be inaccessible to fish once the north spillway gate is opened, due to high velocity and turbulence from the north spillway gate discharge. The north spillway gate is currently used to control the headpond level. Modifications will be made to the south spillway gate operator to allow it to act as the primary gate used to control headpond level.
(11)	Headpond Operating Range	Typical headpond level fluctuation is in the range of 1-3 inches, but may fluctuate as high as 7 inches.
(12)	Diversion Dam Tailwater Operating Range	The normal water surface elevation in the tailwater immediately downstream of the spillway gates is El. 4785.9. Additional information is being gathered to confirm the full range of tailwater elevations across the river flow operating range. The range of tailwater elevations will be available for the final design of the fishway and will not affect the selection of the preferred fishway alternative or the conceptual design of the fishway.
(13)	Entrance Location	North side of river immediately downstream of spillway. Reuse existing opening in retaining wall where minimum flow is currently discharged.
(14)	Exit Location	North side of river within 60 feet upstream of the spillway. Locating the exit further upstream could require additional excavation of sediment in the headpond to provide adequate water depth.
(15)	Minimum Water Depth in Fishway	The minimum water depth at the fishway entrance and exit will be 2.0 ft. Likewise, if a pool type fishway is selected, the minimum water depth in the pools will be 2.0 ft.
(16)	Fish Entrance Gate	Downward opening gate for adjusting attraction flow depth is preferred if tailwater depth is adequate.
(17)	Fishway Entrance Invert Related to Adjacent River Bottom	Fishway entrance will be perched in water column.

(18)	Attraction Flow	34-50 cfs Attraction flow will match the minimum flow requirement.
(19)	Supplemental Attraction Flow System	If fishway is selected that has a conveyance flow capacity less than the 34-50 cfs attraction flow, then a supplemental attraction flow system will be needed.
(20)	Sampling Facility	Fishway will be designed to accommodate a temporary sampling facility (i.e, a removable trap).
(21)	Viewing Window	A viewing window for public outreach may be desired pending feasibility. Considerations will include space constraints, security, ADA accessibility, and cost (shared cost??). Potential alternative would be an underwater camera within the fishway. *Note: Final determination was made at the July FWG meeting to not include a viewing window.*
(22)	Slope of Fishway	• Denil (chute type) Fishway − 1:10 slope • Pool & Weir and Vertical Slot Fishways − 1:10 to 1:20 slope, pending flow and drop/pool • Natural Channel Fishway − 1:20 slope • Velocity criteria will control the slope of the fishway. For pool & weir and vertical slot type fishways the drop per pool will be 9” or less.
(23)	Energy Dissipation Factor ($EDF=\gamma Qh/V$)	If a pool type fishway is selected, then the pools will be sized such that the calculated energy dissipation factor will not be greater than 4.0.
(24)	Debris Handling	Look into feasibility – floating/skirted boom. Angled bar racks.
(25)	Fishway Access	A means of access into the fishway is preferred if feasible.
(26)	Grating Covering Fishway	Serrated bar grating across the top of the fishway is preferred if a structural type fishway is selected.

4.0 ALTERNATIVES ANALYSIS

A summary of the alternatives that were considered for providing upstream fish passage at the Weber Hydroelectric Project is provided in this section. This section also includes a summary of the preferred alternative selection process and discussions that took place during the May 4, 2016 meeting with the FWG at UDWR's Northern Region office.

4.1 UPSTREAM FISH PASSAGE ALTERNATIVES

Based on the design criteria that were agreed upon with the FWG, the four types of fishways described below were considered for providing upstream fish passage at the Weber Project.

Appendix A includes a drawing showing a general plan view of the existing conditions at the Weber Hydroelectric Project. Sketches showing the proposed conceptual layout of the four types of fishways that were considered at the Project are included in Appendix B.

4.1.1 ALTERNATIVE 1 – DENIL FISHWAY

Alternative 1 consists of a concrete Denil fishway along the northern shore of the river, adjacent to the existing spillway. Denil fishways are artificially roughened channels that use regularly spaced baffles to create a zone of low velocity flow that fish can negotiate. Typical Denil fishway baffles are angled upstream at a 45 degree angle and are spaced at 2.5 feet on center. Baffles can be constructed from an array of materials including, wood, aluminum, and fiberglass. Denil fishways are typically in the range of 2-4 feet wide, with 4 feet in width being the most commonly used. Denil fishways are typically constructed with a floor slope in the range of 10-20% (1:10 to 1:5). The conceptual Denil fishway layout proposed for the Weber Project would be 4 feet wide with a slope of 10% (1:10). Conveyance flow through a Denil fishway is typically in the range of 15-35 cfs. To accommodate the proposed fishway attraction flow of 34-50 cfs a supplementary attraction flow system would be required. Supplementary attraction flow for Denil fishways is typically provided via a screened inlet in the floor of the exit channel at the upstream end of the fishway, leading into a pipe which would deliver flow to a diffusion chamber beneath the entrance channel of the fishway, where the supplementary attraction flow would come up through a floor screen and rejoin the conveyance flow coming down the fishway before being discharged at the fishway entrance. The supplementary attraction flow pipe would be equipped with a valve to control the amount of flow and accommodate the varying attraction flow requirement. The entrance to the fishway would be located adjacent to the existing minimum flow discharge and would require cutting an opening in the existing concrete retaining wall. The fishway entrance would be equipped with a downward opening gate used to dewater the fishway and to control the velocity of the flow at the entrance based on varying tailwater levels during fishway operation. The fishway exit would be equipped with an upward opening dewatering gate.

Below are some reference photos of typical Denil fishways.

4.1.2 ALTERNATIVE 2 – POOL AND WEIR FISHWAY

Alternative 2 consists of a concrete pool and weir style fishway along the northern shore of the river, adjacent to the existing spillway. Pool and weir fishways consist of a sequential series of stepped pools that are created by flow control weirs. The conceptual pool and weir fishway layout proposed for the Weber Project would have pools that were approximately 12 feet wide by 12 feet long by 5.5 feet deep. The proposed head drop per pool would be 9 inches. The pool size was estimated assuming an energy dissipation factor (EDF) of 4.0. An EDF of 4.0 is adequate for the weaker swimming fish that may be present at this site. A 1 foot wide by 1 foot tall submerged orifice would also be included at the bottom of each weir to provide passage for bottom-oriented species. The entrance to the fishway would be located adjacent to the existing minimum flow discharge and would require cutting an opening in the existing concrete retaining wall. The fishway entrance would be equipped with a downward opening gate used to dewater the fishway and to control the velocity of the flow at the entrance based on varying tailwater levels during fishway operation. The fishway exit would also be equipped with a downward opening gate used to dewater the fishway and to control the flow through the fishway.

Below are some reference photos of typical pool and weir fishways.

4.1.3 ALTERNATIVE 3 – VERTICAL SLOT FISHWAY

Alternative 3 consists of a vertical slot style fishway along the northern shore of the river, adjacent to the existing spillway. Vertical slot fishways are similar to pool and weir fishways, but instead of a concrete overflow weir to control flow they use a full height vertical slot. The conceptual vertical slot fishway layout proposed for the Weber Project would have pools approximately 12 feet wide by 15 feet long with a depth of 4-6 feet. The proposed head drop per pool would be 9 inches, with flow passing through an 18-inch-wide vertical slot which is typical for weaker swimming fish species. The entrance to the fishway would be located adjacent to the existing minimum flow discharge and would require cutting an opening in the existing concrete retaining wall. The fishway entrance would be equipped with a downward opening gate used to dewater the fishway and to control the velocity of the flow at the entrance based on varying tailwater levels during fishway operation. The fishway exit would also be equipped with a downward opening gate used to dewater the fishway and to control the flow through the fishway.

Below are some reference photos of typical vertical slot fishways.

4.1.4 ALTERNATIVE 4 – NATURAL CHANNEL FISHWAY

Alternative 4 consists of a natural channel fishway along the northern shore of the river, adjacent to the existing spillway. Natural channel fishways typically consist of gravel, boulders, and other common stream bed material placed in a manner that mimics a natural stream. The conceptual natural channel fishway layout proposed for the Weber Project would be approximately 15 feet wide with a slope of 5%. Rock weirs would be positioned along the length of the channel to provide a 9 inch drop per weir. The channel entrance would be located adjacent to the existing minimum flow discharge and would require demolition of some or all of the existing concrete retaining wall. The channel would extend approximately 70 feet downstream before making a 180 degree bend and continuing approximately 140 feet upstream to the headpond. A new concrete flow control structure would be constructed at the exit of the natural channel. Due to the limited space available at the site, sheet pile cut off walls may be required to stabilize the channel.

Below is a reference photo of a natural channel fishway.

4.2 PREFERRED ALTERNATIVE

The four types of fishways described above were initially presented at the May 4, 2016 meeting with the FWG. After some discussion a couple of variations were added to the list of potential fishway alternatives. Below is the list of fishway alternatives that were discussed during the May 4th meeting:

1. Denil Fishway
2A. Pool and Weir Fishway – sized to accommodate the full range of fishway flow
2B. Pool and Weir Fishway – with reduced pool size and additional supplementary attraction flow system
3A. Vertical Slot Fishway – Serpentine style
3B. Vertical Slot Fishway – Traditional style
4. Natural Channel Fishway

Alternative 1, the Denil fishway alternative, was identified as having the smallest footprint and therefore the low cost. However, this alternative was also noted to potentially be the least biologically effective of the alternatives. Therefore, the Denil fishway was not considered as the preferred alternative.

Alternative 4, the natural channel fishway alternative, was identified as likely having similar biological effectiveness as the pool and weir and vertical slot fishway alternatives. It was also agreed that it would be the most aesthetically pleasing alternative, although at the Weber site (adjacent to the freeway and between the parking lot and the Project diversion dam), site aesthetics were determined to be less important than might be the case at other dam sites. However, there was significant concern regarding the stability and durability of the downstream end of the natural channel (below the spill gates) which would be inundated during high flow events, and this could cause scouring and erosion of the natural channel streambed. Disturbance of the natural channel streambed during high flow events would be a significant maintenance concern due to the cost of rehabilitation/reconstruction and the time that the fishway would be out of service if repairs were required. Therefore, the natural channel fishway was not considered as the preferred alternative.

Alternatives 2 and 3, the pool and weir and the vertical slot alternatives, were identified as likely being similar in biological effectiveness, similar in size and cost, and similar in strength/stability being constructed of concrete that would resist the potential scour and erosion due to high flow events. Since there are some vertical slot fishways currently in use in the region and at least one of these vertical slot fishways has been shown to effectively pass bluehead sucker, it was decided that the vertical slot fishway would be the preferred alternative. Further, vertical slot fishways could potentially take the entire minimum stream flow, eliminating the need for any supplemental water system. The differences between alternatives 3A and 3B the serpentine vertical slot fishway and the traditional vertical slot fishway were discussed. The geometry and layout of the traditional vertical slot was preferable to that of the serpentine vertical slot primarily due to the constraints of the site, reduced width at the upstream end of the fishway, and minimizing the distance that the fishway extends upstream into the shallower region of the headpond. Also, the other vertical slot fishways in the region are the traditional style layout. Therefore, Alternative 3B, the traditional style vertical slot fishway was selected as the preferred alternative at the conclusion of the May 4, 2016 meeting with the FWG.

After the May 4th meeting some detailed hydraulic analysis was performed for the selected traditional style vertical slot fishway. During the hydraulic analysis it was identified that a vertical slot fishway would not be able to accommodate the required 16 cfs range of fishway flows (34 cfs to 50 cfs) without a significant head drop (2 ft +/-) at the flow control gate located at the fishway exit. In order to accommodate the proposed range of fishway attraction flows a supplemental attraction flow system would still have to be incorporated into the vertical slot alternative. During the discussions at the May 4th meeting it was identified that a supplemental attraction flow system with screens to prevent the entrainment of fish and debris was not preferred due to the significant cleaning and maintenance that would be required to keep the system operational. Therefore, the idea of using the existing minimum flow gate and historic fish passage flume to provide the supplemental attraction flow was considered. Since the proposed entrance to the vertical slot fishway would be immediately adjacent to the existing minimum flow discharge it was determined that this would provide effective attraction to the proposed fishway entrance. Further, the existing minimum flow discharge is perched above the normal tailwater level which will minimize the ability for upstream migrants to enter the minimum flow sluiceway and be distracted from the proposed fishway entrance.

A subsequent conference call with the FWG was held on Thursday June 2, 2016 to inform them of the results of the hydraulic analysis and get their concurrence with the proposed approach of using the existing minimum flow gate and historic fish passage flume to provide supplemental attraction flow for the preferred traditional vertical slot fishway alternative. The group agreed with the approach and settled on a design flow of 20 cfs through the proposed fishway with the remaining flow to be passed via the existing minimum flow gate and historic fish passage flume. The 20 cfs through the fishway will remain constant with the existing minimum flow gate being used to provide the flow adjustment required to accommodate the varying minimum flow requirement.

5.0 SUMMARY

One of the objectives of the FWG was to work together to come to consensus on a recommended fish passage design alternative for detailed consideration in the FERC relicensing process. The step-wise process used for the FWG to achieve this objective consisted of the following (dates refer to various meetings in person or via conference call of the FWG during the process):

1. Develop design criteria – Initiated on March 7, 2016 and finalized on July 13, 2016.

2. Develop and workshop draft alternatives for upstream fish passage and select a recommended upstream fish passage alternative (traditional vertical slow fishway) – May 4, 2016.

3. Amend the recommended upstream fish passage alternative to include supplemental attraction flow provided via the existing minimum flow gate and historic fish passage flume – June 2, 2016.

4. Finalize the conceptual design for the recommended upstream fish passage alternative (traditional vertical slot fishway with supplemental attraction flow provided via the existing minimum flow gate and historic fish passage flume) – July 13, 2016.

As a result of this collaborative process, the conceptual design drawings for the preferred alternative have been prepared and are included in Appendix C.

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APPENDIX A

GENERAL PLAN VIEW OF EXISTING CONDITIONS

22x34 = FULL SCALE

NOTES:
1. ALL ELEVATIONS IN NAVD 1988 DATUM.

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-	RL	LDS	658-020	04-26-16	1

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WEBER HYDROELECTRIC PROJECT
FISH PASSAGE

EXISTING SITE PLAN

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APPENDIX B

CONCEPTUAL SKETCHES OF FISHWAY ALTERNATIVES

22x34 = FULL SCALE
APPROXIMATE EDGE OF WATER AT NORMAL POND
APPROXIMATE EDGE OF WATER WITH HEADPOND DRAWN DOWN AND RIVER FLOW @ 120 CFS
WEBER RIVER
FISHWAY EXIT
EXIT CHANNEL
SECURITY FENCE
SPILLWAY TAINTER GATES
LOW LEVEL OUTLET GATE
ABANDONED FISHWAY CURRENTLY USED FOR MINIMUM FLOW DISCHARGE
RAILROAD TRACKS
INTAKE BUILDING
PARKING AREA
STEEL WALKWAY
FISHWAY ENTRANCE
ENTRANCE CHANNEL WITH FLOOR SCREEN FOR SUPPLEMENTAL ATTRACTION FLOW
RESTING POOL
EXISTING BUILDINGS
3 SLOPING SECTIONS WITH WOODEN BAFFLES 10% SLOPE (1V:10H)
PENSTOCK
TURNING POOL / RESTING POOL
VIEWING WINDOW
VIEWING ROOM
4.00
18.00
40.00
8.00
8.00
3.00
16.00
40.00
12.00
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FISH PASSAGE
DENIL FISHWAY ALTERNATIVE
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Date Revised 04-26-16
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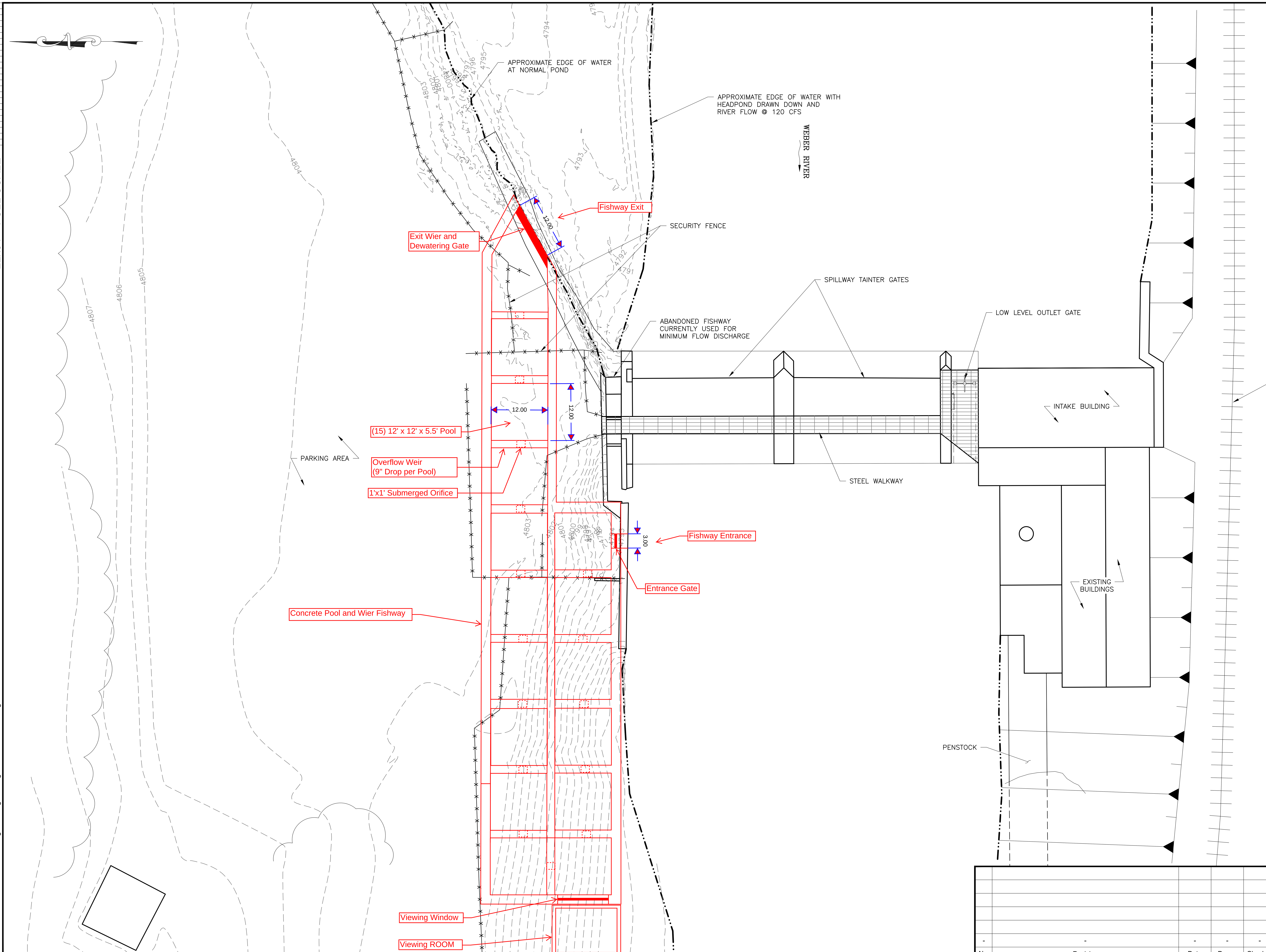

22x34 = FULL SCALE

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WEBER HYDROELECTRIC PROJECT
FISH PASSAGE

POOL & WEIR FISHWAY ALTERNATIVE

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22x34 = FULL SCALE
APPROXIMATE EDGE OF WATER AT NORMAL POND
APPROXIMATE EDGE OF WATER WITH HEADPOND DRAWN DOWN AND RIVER FLOW @ 120 CFS
WEBER RIVER
FISHWAY EXIT
EXIT WIER AND DEWATERING GATE
SECURITY FENCE
SPILLWAY TAINTER GATES
LOW LEVEL OUTLET GATE
ABANDONED FISHWAY CURRENTLY USED FOR MINIMUM FLOW DISCHARGE
RAILROAD TRACKS
BAFFLE
18" WIDE VERTICAL SLOT (9" DROP PER POOL)
INTAKE BUILDING
PARKING AREA
STEEL WALKWAY
FISHWAY ENTRANCE
CONCRETE VERTICAL SLOT FISHWAY
ENTRANCE GATE
EXISTING BUILDINGS
VIEWING WINDOW
VIEWING ROOM
PENSTOCK
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WEBER HYDROELECTRIC PROJECT
FISH PASSAGE
VERTICAL SLOT FISHWAY ALTERNATIVE
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WEBER HYDROELECTRIC PROJECT
FISH PASSAGE

TRADITIONAL VERTICAL SLOT FISHWAY ALTERNATIVE

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FISH PASSAGE

NATURAL CHANNEL FISHWAY ALTERNATIVE

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-	RL	LDS	658-020	04-26-16	SK-4

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APPENDIX C

CONCEPTUAL DESIGN DRAWINGS FOR THE PREFERRED ALTERNATIVE

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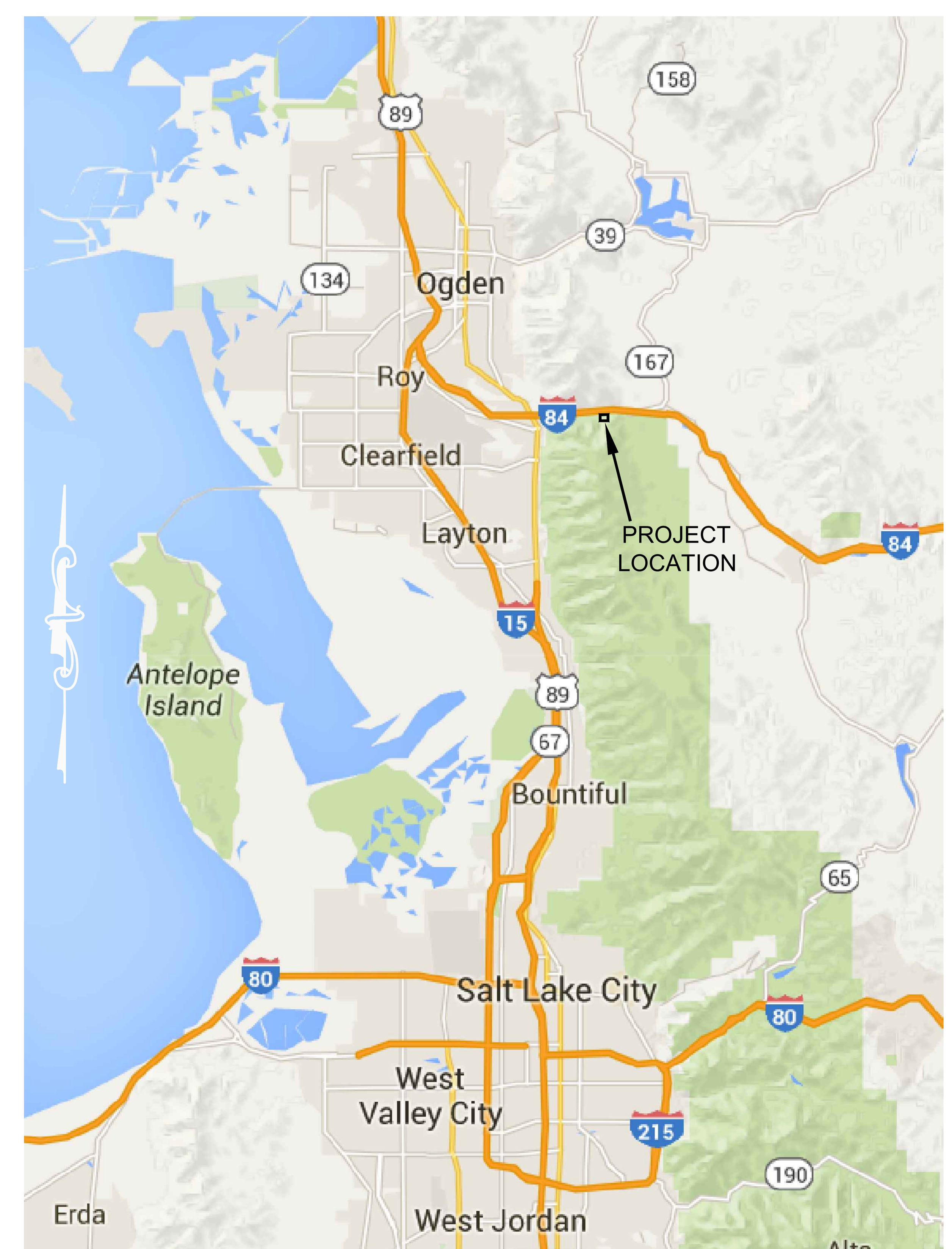
WEBER HYDROELECTRIC PROJECT
UPSTREAM FISH PASSAGE

DRAWING LIST				
SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS
1	COVER SHEET & DRAWING LIST	8-01-16	B	CONCEPTUAL DESIGN
2	EXISTING SITE PLAN	6-15-16	A	CONCEPTUAL DESIGN
3	PROPOSED SITE PLAN	8-01-16	B	CONCEPTUAL DESIGN
4	FISHWAY PLAN	8-01-16	B	CONCEPTUAL DESIGN
5	FISHWAY PROFILE & BAFFLE/POOL DETAIL	8-01-16	B	CONCEPTUAL DESIGN

CONCEPTUAL DESIGN
8-01-16

SITE MAP



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DATE 06-14-16	
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DR TLT / CH –	
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No.	DATE	REVISION	BY	CHK	APP
A	6-15-16	CONCEPTUAL DESIGN			
B	8-01-16	CONCEPTUAL DESIGN			

REFERENCE DRAWINGS | DRAWING No.

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APPROXIMATE EDGE OF WATER AT NORMAL POND
EXISTING GABION WALL
WEBER RIVER
APPROXIMATE EDGE OF WATER WITH HEADPOND DRAWN DOWN AND RIVER FLOW @ 120 CFS
EXISTING SPILLWAY TAINTER GATES
EXISTING LOW LEVEL OUTLET GATE
EXISTING POLE
EXISTING SECURITY FENCE
EXISTING EDGE OF PAVEMENT
EXISTING PARKING AREA
EXISTING INTAKE BUILDING
EXISTING RAILROAD TRACKS
EXISTING STEEL WALKWAY
ABANDONED FISHWAY CURRENTLY USED FOR MINIMUM FLOW DISCHARGE
EXISTING CONCRETE RETAINING WALL
EXISTING BUILDINGS
EXISTING PENSTOCK
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UPSTREAM FISH PASSAGE
EXISTING SITE PLAN
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Kleinschmidt
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FISH PASSAGE NOTES:

1. TARGET SPECIES: BONNEVILLE CUTTHROAT TROUT AND BLUEHEAD SUCKER.

2. STATION HYDRAULIC CAPACITY: 320–365 CFS.

3. MINIMUM BYPASS FLOW: 34–50 CFS.

4. PERIOD OF OPERATION OF FISHWAY: FISHWAY WILL BE IN OPERATION ANYTIME THE HEADPOND IS FULL. THE FISHWAY WILL NOT BE OPERATED DURING PERIODS WHEN THE HEADPOND IS DEWATERED. WHEN THE HEADPOND IS DEWATERED THE LOW LEVEL OUTLET GATE WILL BE OPENED TO ALLOW FISH PASSAGE.

5. RIVER FLOW OPERATING RANGE: WHEN THE HEADPOND IS FULL THE FISHWAY WILL REMAIN IN OPERATION FOR RIVER FLOWS OF 34 CFS TO APPROXIMATELY 2,500 CFS.

6. HEADPOND OPERATING RANGE: NORMAL WATER SURFACE ELEVATION IN THE HEADPOND IS EL. 4798.2'. TYPICAL HEADPOND LEVEL FLUCTUATION IS IN THE RANGE OF 1–3 INCHES, BUT MAY FLUCTUATE AS HIGH AS 7 INCHES.

7. TAILWATER OPERATING RANGE: NORMAL WATER SURFACE ELEVATION IN THE TAILWATER IMMEDIATELY DOWNSTREAM OF THE SPILLWAY GATES IS EL. 4785.9. ADDITIONAL INFORMATION IS BEING GATHERED TO CONFIRM THE FULL RANGE OF TAILWATER ELEVATIONS ACROSS THE RIVER FLOW OPERATING RANGE.

8. ATTRACTION FLOW: THE ATTRACTION FLOW FOR THE FISHWAY WILL BE EQUAL TO THE REQUIRED MINIMUM FLOW (34–50 CFS). 20 CFS WILL BE PASSED THROUGH THE FISHWAY AND THE REMAINING ATTRACTION FLOW WILL BE PASSED THROUGH THE EXISTING MINIMUM FLOW SLUICEWAY.

9. THE FISHWAY WILL BE DESIGNED TO HAVE A WATER SURFACE ELEVATION DROP OF 9" PER POOL.

10. THE FISHWAY WILL BE DESIGNED SUCH THAT THE POOLS HAVE AN ENERGY DISSIPATION FACTOR (EDF) LESS THAN 4.0.

NOTES:
1. ALL ELEVATIONS IN NAVD 1988 DATUM.

WEBER HYDROELECTRIC PROJECT
UPSTREAM FISH PASSAGE
PROPOSED SITE PLAN

SAP# –	
PL#	
DATE 06-14-16	
ENG JEW	DES –
DR TLT	CH –
APPROVAL	

PACIFICORP A PACIFICORP COMPANY — Kleinschmidt — HYDRO

SCALE: AS SHOWN | SHEET 3 | 0658020 | REV. B

PLOT SCALE: 1 = 1

No.	DATE	REVISION	BY	CHK	APP
A	6-15-16	CONCEPTUAL DESIGN			
B	8-01-16	CONCEPTUAL DESIGN			

No.	DATE	REVISION	BY	CHK	APP

DRAWING No.	REFERENCE DRAWINGS

DRAWING No.	REFERENCE DRAWINGS

BORDER REVISED 09/05/07 K.R.G.

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EXISTING PAVED PARKING AREA
4803
RAISABLE FISH TRAP DETAILS TO BE DETERMINED IN CONSULTATION WITH THE FISHERIES RESOURCE AGENCIES.
FISH TRAP SHALL:
1. BE A PERMANENT STEEL FRAMED STRUCTURE
2.
CONCRETE VERTICAL SLOT FISHWAY (9" DROP PER POOL), SEE PROFILE SHEET 5
SEE BAFFLE DETAIL SHEET 5
EXISTING SECURITY FENCE
NEW CONCRETE RETAINING WALL
NEW PAVED AREA
NEW SECURITY FENCE
VERTICAL SLOT
BAFFLE
x EL. 4803.0'
17'-0"
TURNING POOL
W.S. EL. 4790.70'
SLOPE DN
W.S. EL. 4791.45'
W.S. EL. 4792.20'
W.S. EL. 4792.95'
W.S. EL. 4793.70'
W.S. EL. 4794.45'
W.S. EL. 4795.20'
W.S. EL. 4795.95'
W.S. EL. 4796.70'
W.S. EL. 4797.45'
W.S. EL. 4798.20'
FLOW
10'-0"
POOL 8
POOL 9
POOL 10
POOL 11
POOL 12
POOL 13
POOL 14
POOL 15
POOL 16
POOL 17
5'-0"
x EL. 4803.0'
POOL 7
W.S. EL. 4789.95'
W.S. EL. 4789.20'
W.S. EL. 4788.45'
W.S. EL. 4787.70'
W.S. EL. 4786.95'
W.S. EL. 4786.20'
POOL 6
POOL 5
POOL 4
POOL 3
POOL 2
POOL 1
STEPS
x EL. 4801.0'
WALKWAY GRATING
NEW GABION RETAINING WALL
HANDRAIL AROUND GRATING OPENING AT FISH TRAP
FISHWAY EXIT W/ STOPLOG SLOT & GRIZZLY RACKS INV. EL. 4794.45'
x EL. 4795.5'
x EL. 4791.0'
8'-0"
8'-6"
FISHWAY ENTRANCE INVERT EL. 4782.45'
3'-0"
13'-9"
117'-0"
NORMAL TAILWATER EL. 4785.9'
NEW DOWNWARD OPENING ENTRANCE GATE
EXISTING MINIMUM FLOW DISCHARGE, LOCATION TO REMAIN IN SERVICE
EXISTING MINIMUM FLOW GATE WILL REMAIN IN SERVICE TO ACCOMMODATE VARIATIONS IN THE REQUIRED MINIMUM FLOW
EXISTING BATHYMETRY
NORMAL HEADPOND EL. 4798.2'
WEBER RIVER
PLAN
1"=5'
5 0 5 10
SCALE IN FEET
NOTE:
GRATING AND GUARDRAIL DETAILS OVER FULL LENGTH OF FISHWAY TO BE DETERMINED DURING FINAL DESIGN.
EXISTING GRATING PLATFORM EL. 4801.0'
EXISTING SPILLWAY TAINTER GATES
NOT FOR CONSTRUCTION
NOTES:
1. ALL ELEVATIONS IN NAVD 1988 DATUM.
SAP# -
DATE 06-14-16
ENG JEW DES -
DR TLT CH -
APPROVAL
WEBER HYDROELECTRIC PROJECT
UPSTREAM FISH PASSAGE
FISHWAY PLAN
PACIFICORP
Kleinschmidt
HYDRO
SCALE: AS SHOWN SHEET 4
0658020
REV. B
REFERENCE DRAWINGS
DRAWING No.
REVISION
No. DATE REVISION BY CHK APP
A 6-15-16 CONCEPTUAL DESIGN
B 8-01-16 CONCEPTUAL DESIGN
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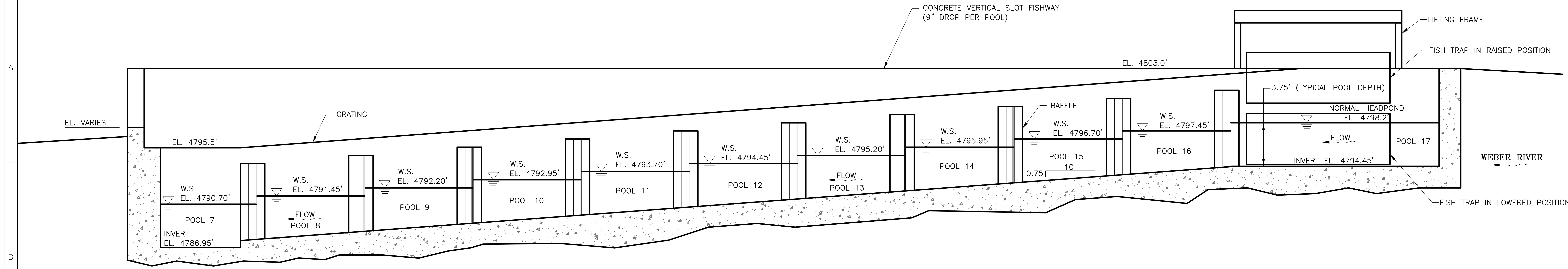
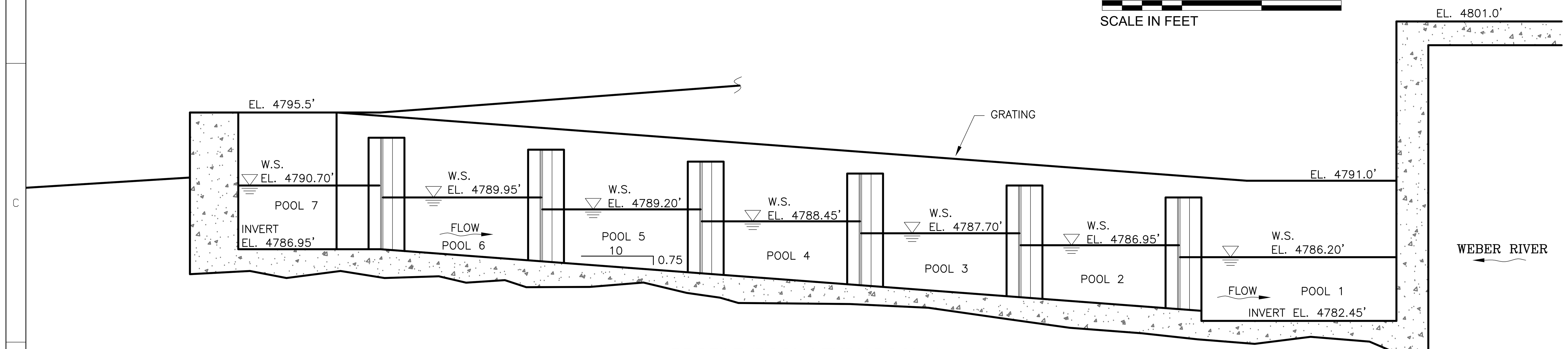
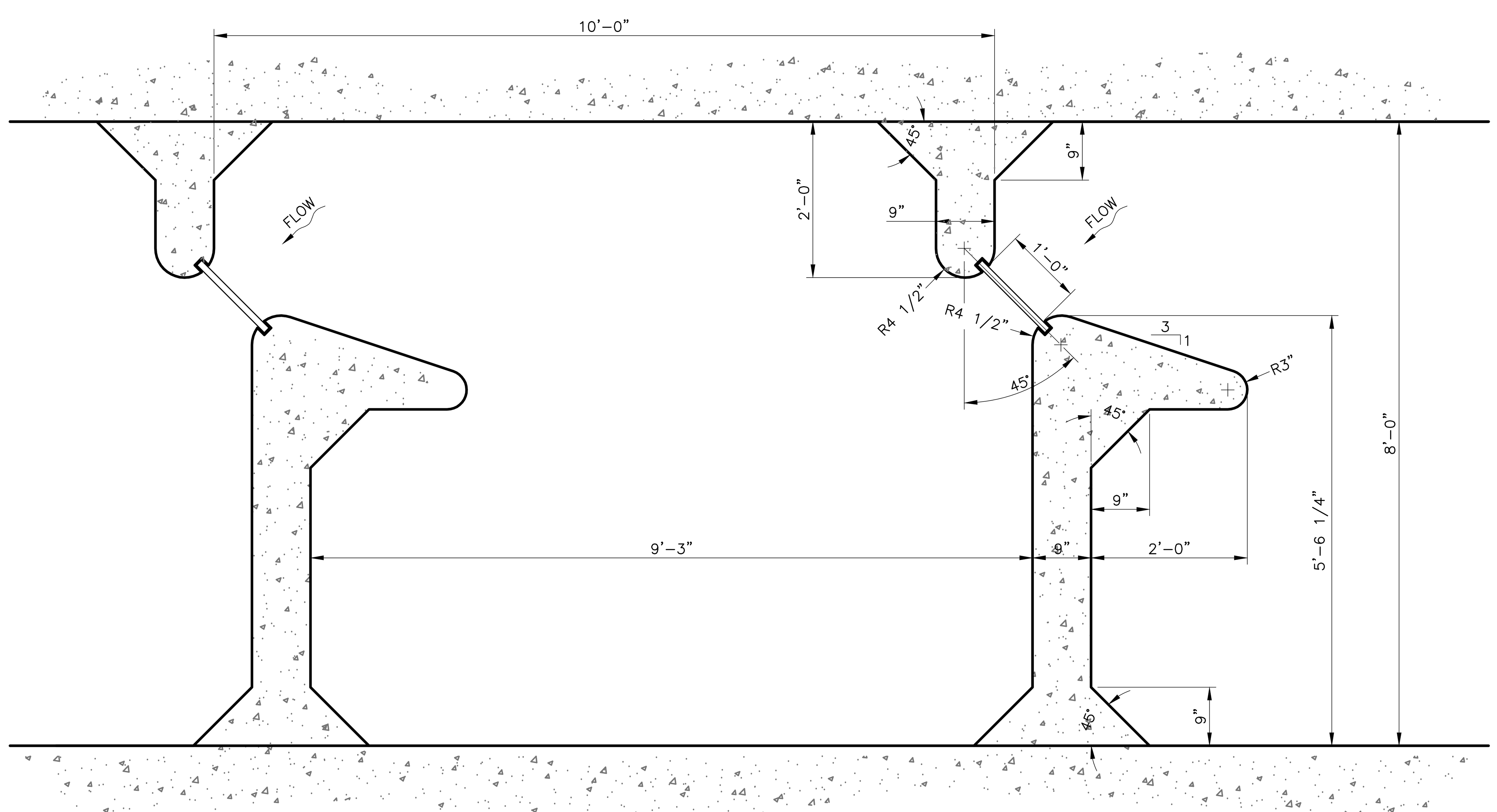


PROFILE (POOL 7 THRU POOL 17)
1"=5'

5 0 5 10
SCALE IN FEET



PROFILE (POOL 1 THRU POOL 7)
1"=5'



TYPICAL BAFFLE/POOL DETAIL
3/4"=1'-0"

NOT FOR CONSTRUCTION

SAP# -	
PL#	
DATE 06-14-16	
ENG JEW	DES -
DR TLT	CH -
APPROVAL	

WEBER HYDROELECTRIC PROJECT
UPSTREAM FISH PASSAGE
FISHWAY PROFILE &
BAFFLE/POOL DETAIL

PACIFICORP A PACIFICORP COMPANY Kleinschmidt HYDRO

SCALE: AS SHOWN | SHEET 5 | 0658020 | REV. B

PLOT SCALE: 1 = 1

No.	DATE	REVISION
A	6-15-16	CONCEPTUAL DESIGN
B	8-01-16	CONCEPTUAL DESIGN

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APPENDIX B

Recorded Lengths and Numbers of Each Size Class of Trout Used in the Turbine Mortality Field Study

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Table B-1. Recorded Lengths and Numbers of Each Size Class of Trout Used in the Turbine Mortality Field Study		
3-inch Size Group Length (mm)	6-inch Size Group Length (mm)	12-inch Size Group Length (mm)
78	170	260
109	185	310
95	185	210
95	160	270
97	180	200
110	165	290
105	178	270
100	165	290
115	170	270
115	182	300
105	150	310
109	170	290
105	185	260
110	162	270
95	185	275
78	175	275
98	155	305
93	180	320
110	175	230
92	155	285
88	170	300
90	195	265
115	160	285
102	160	278
80	175	310
95	180	285
78	185	260
100	165	300
105	180	205
100	160	210
95	145	300

Table B-1. Recorded Lengths and Numbers of Each Size Class of Trout Used in the Turbine Mortality Field Study		
3-inch Size Group Length (mm)	**6-inch Size Group Length (mm)**	**12-inch Size Group Length (mm)**
95	168	300
105	150	295
97	160	275
87	152	200
84	172	265
96	160	292
98	165	255
100	175	258
85	170	300
109	148	315
100	163	270
98	193	385
101	190	310
113	176	292
85	179	288
90	191	277
94	155	290
107	185	250
115	185	285
101	145	285
113	175	300
105	160	275
103	165	265
94	168	273
114	153	310
89	155	305
109	155	285
105	196	288
119	155	300
103	164	315
110	148	330

Table B-1. Recorded Lengths and Numbers of Each Size Class of Trout Used in the Turbine Mortality Field Study		
3-inch Size Group Length (mm)	6-inch Size Group Length (mm)	12-inch Size Group Length (mm)
92	171	300
93	160	290
112	160	255
100	145	290
100	180	295
116	155	310
90	135	275
120	155	255
96	185	300
98	180	290
94	160	295
107	165	288
100	150	294
105	184	295
110	160	310
100	154	303
95	155	280
106	185	250
92	150	285
100	160	398
105	175	280
100	175	305
112	185	300
88	155	305
90	199	285
96	158	310
105	170	285
100	150	335
95	155	310
85	100	295
105	125	288

Table B-1. Recorded Lengths and Numbers of Each Size Class of Trout Used in the Turbine Mortality Field Study		
3-inch Size Group Length (mm)	**6-inch Size Group Length (mm)**	**12-inch Size Group Length (mm)**
90	165	275
110	150	243
96	165	290
99	120	304
95	165	265
97	175	270
110		225
100		285
103		
85		
96		
102		
Average length: 99.8 mm	Average length: 165.8 mm	Average length: 284.5 mm

APPENDIX C

Photographs

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Photograph 1. Location where the underwater monitoring system camera was initially installed.

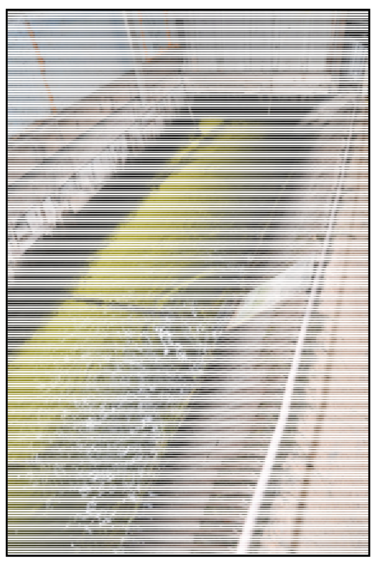
Photograph 2. Relocation of the camera between intake rack and penstock gates.

Photograph 3. Testing the underwater monitoring system with dead fish. RedFISH staff placing fish in close proximity of the camera.

Photograph 4. An adult Bonneville cutthroat trout from the Weber River (photo by Western Native Trout Initiative, Sage Lion Media)

Photograph 5. Weber powerhouse diversion with old fishway visible at rear retaining wall (photo taken on August 9, 2016). River flow was approximately 336 cfs at USGS 10136500, located at Gateway, UT.

Photograph 6. An adult bluehead sucker from the Weber River (Photo by UDWR).



Photograph 7. Project intake trash rack. Bar spacing is 1.25 to 1.5 inches.

Photograph 8. Project impoundment area.

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Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Fisheries Technical Report

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
Comments on the Draft Technical Report (Review period Feb. 9 – Mar. 13, 2017)			
None			
Comments on the Preliminary Draft Technical Report Review period (Dec. 22, 2016 – Feb. 1, 2017)			
KL/UDWQ	N/A	DWQ has no comments and approves the Draft Fisheries Technical Report.	N/A
PT/UDWR	N/A	The Utah Division of Wildlife Resources has reviewed the Draft Fisheries Technical Report Weber Hydroelectric Project Relicensing FERC NO. 1744. We feel that the document outlines and adequately reports on the project findings outlined in the Fisheries Study Plan. We feel this plan is ready to be filed with FERC and opened for public comment.	N/A
PT/UDWR		Study One: Upstream Fish Passage Conceptual Design Study. - We have been extremely pleased with the results from Study One: Upstream Fish Passage Conceptual Design Study. The Fisheries Work Group has functioned well and with PacifiCorp and Kleinschmidt, a fishway design was developed that will allow the two target fish, bluehead sucker and Bonneville cutthroat trout, adequate opportunities for upstream movement past the Weber Facility.	N/A
PT/UDWR		Study Two: Fish Migration Downstream of the Project. We also have been pleased with the progress of this project outlined in the Fisheries Study Plan. - Study Two Phase I: Turbine Mortality Field Study was a success with more fish recaptured than what most believed would be. Even with fewer smaller fish being recovered, we feel that we observed a fairly accurate representation of what would happen to the three target trout sizes used in the study. - Study Two Phase II: Turbine Entrainment Visual Assessment. The thought behind this portion of Study Two was sound, but sometimes information is more difficult to collect in the field. That was the case with this study, but we feel confident that the Fisheries Work Group moved forward in a positive manner with recommending the literature review (Phase III). - Study Two Phase III: Turbine Entrainment and Survival Literature Analysis. The authors have done a thorough job researching and reporting on fish entrainment specifics at hydroelectric plants across the West and ultimately how that information translates to entrainment risk with the target fishes at the Weber Facility. We agree that there are many aspects to the	N/A

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
		Weber Facility that would minimize entrainment risk to the target fishes, especially since the population densities of these two fish are relatively low at present in the Weber River. Pursuing some form of screening at the Weber Facility does not make sense at present. As fish passage projects, like the one outlined at the Weber Facility, and other habitat improvements are made for the two target fishes, we believe that population densities for these two fish will improve in the Weber River. At that time, we will need to determine how detrimental fish entrainment is for these fishes and prioritize screening projects where the highest entrainment rates occur. In the future, if it is determined that the Weber Facility happens to be a high risk for bluehead sucker and Bonneville cutthroat trout entrainment, we will work cooperatively to address the problem at that time.	
PT/UDWR	Page 7, bottom of page	Change endemic to native. Endemic implies that these fish only occur in the Weber River and nowhere else. Same comment for use of the word endemic throughout the document (e.g., pages 10, etc.)	Change made per the commenter's suggestion.
PT/UDWR	Page 8, first sentence under methods	Finish parenthesis around UDWR [e.g., change UDWR) to (UDWR)]	Change made per the commenter's suggestion.
PT/UDWR	Page 14	The average size of fluvial BCT in the Weber is not 300 mm. I don't believe we have attempted to get an average size for the fluvial BCT in the Weber because the lower size range is not static. Generally we consider a BCT in the Weber to be fluvial if they are 300 mm TL or larger.	Thank you for the information. The document will be edited to reflect: This species can achieve considerable size in the Weber River. Biologists working on the area consider BCTs in the Weber to exhibit a fluvial life history when they exceed 300 mm in total length.

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
PB/TU	N/A	Thank you for the opportunity to review and comment on this Draft Technical Report. Paul Thompson has submitted comments, and in an effort to improve efficiency I reviewed his comments and they are consistent with the comments that Trout Unlimited Staff have on this draft plan. I appreciate the collaborative effort put forth by PacifiCorp and the members of the Fisheries Working Group effort to produce this report. Trout Unlimited Staff recommends moving this report forward for public review with the recommended changes in Paul Thompson's email. Thank you.	N/A
GW/USFWS		I have no comments on the fisheries technical report at this time	N/A
FR/SS	Page 3	**"The Weber hydroelectric facility includes the following components: (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);"** In the documents prepared by PacifiCorp, I cannot locate any discussion of the history of the "non-operative fish passage structure". Obviously, when this was constructed, it was designed with care and a sincere desire to protect fish populations on the Weber. Can information be provided regarding the design of this "fish passage structure", the reasons for its failure, and the legal history regarding its construction? Conversely, there is a question raised later in this document that some fish might actually be able to use it under certain operational conditions.	No information regarding the legal history of the historic fishway is available. The fishway is clearly marked on the original plans (circa 1910), likely before any criteria were available to ensure it was planned/built 'correctly,' but other details appear to be lost to the passage of time. PacifiCorp understands the intent was appropriate, but was likely never functional for fish given its dimensions and water volume unless possibly at certain high flows. Fish passing the structure are likely using the low level outlet, per timing and subsequent discussion with the FWG.

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Page 17, Table 2	**Population Estimates with 95% Confidence Intervals of Bonneville Cutthroat Trout** It appears that there is a difference in the population estimates for Bonneville Cutthroat Trout in the 3 river segments. Is this in fact the case? If so, is there an explanation for the differences? This Table only includes data for Bonneville Cutthroat Trout. When the sampling was done, was data also collected for whitefish and brown trout?	The work cited in Budy et al. 2014 reported population estimates that were indeed different between sections. It should be noted that the river sections were sampled at different times of the year which could affect population size estimates. In addition, the authors state that sampling effort varied between the study sections which could also affect estimates. Budy, et al. 2014 did make some estimates of brown trout population sizes in sections 2 and 4 that PacifiCorp did not report since the focus of this fisheries report centered on BCT and bluehead suckers.

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Page 18	**Discussion of movement of Bonneville Cutthroat Trout** The documentation that in fact Bonneville Cutthroat Trout somehow are able to move past the diversion dam is interesting and perhaps a critical element in understanding the survival of this population. However, your explanation is hard to understand. If I understand the forebay operations correctly, the low-flow gate on the south side would only be a possible route past this dam, if the forebay were drawn down in a low flow situation. If the power plant is operational and the forebay is full, this would not be a possible path into the upper river. Consequently, combining the observation of trout movement past the diversion dam with information on the operational state of the power plant is important. The observation states that these fish moved past the diversion dam during spawning period seems to indicate that this movement occurred in the spring when the forebay would have been full meaning that the south side route would not have been available.	Your observations are correct, although there was a time period of over a year when the plant was offline and the low level was open—PacifiCorp believes that is the most likely time that fish have been able to move past the diversion structure. A camera was placed to get video footage of fish attempting to move past the spill gates, and an attempt was made to put a pit tag antenna in the low-level opening. However researchers could not get it functional during the critical time period. Neither method yielded positive information regarding fish movement. PacifiCorp believes that the most likely physically possible and logical movement for fish to pass upstream of the Weber diversion dam is through the low level gate when it is open.

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Page 39	**Average monthly flow at Gateway & Weber Hydroelectric Project FERC No. 1744 Pre-Application Document May 2015, page 33 - Table 3.2-1 Average monthly flow data for USGS gaging station - No. 10136500** The flows on the Weber seem to be lower in recent years. One factor that might be partially responsible is the construction of Jordanelle Reservoir. Has this in fact affected flows on the Weber River? Due to the construction of Jordanelle and water agreements, it is probable that increased diversions to the Provo from the Weber have decreased flow conditions on the Weber. The 1990 Settlement Agreement on Olmsted between PacifiCorp, the Bureau of Reclamation, and the Central Utah Water Project led to decreased PacifiCorp power generation on the Provo. Is there ongoing compensating revenue coming to PacifiCorp as part of this settlement? For lost revenue on either River system?	All of the diversions on the Weber River (including the trans-basin Provo diversion) have affected Weber River flows, including Echo, Jordanelle, Deer Creek, and related water storage projects in the Weber and Provo watersheds. PacifiCorp received compensation for the 1990 Central Utah Project condemnation of the Olmstead Project, but that is not 'on-going.' Lost generation on the Weber River resulted from both the 1965 and 1938 agreements with US Bureau of Reclamation. The 1938 agreement does not result in compensation revenue, but in replacement power from US Bureau of Reclamation's Deer Creek project. PacifiCorp does receive financial compensation per the 1965 agreement.

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Overall	From the meetings and this document, it appears that PacifiCorp intends to reconstruct a fishway as a main mitigation measure for this project. The Weber Hydroelectric Project seems to represent only a small portion of PacifiCorp's power production. Does FERC and the company have guidelines regarding the amount of funds they consider appropriate to dedicate to mitigation expenses related to this Project or as part of re-licensing in general?	The FERC relicensing process promotes a balance between the use of a public resource for the benefit of society (clean renewable power) with impacts of that use on environmental, social and cultural resources. Through the Weber River relicensing, fish passage has been identified as a significant impact that should be addressed. While FERC has no guidance on level of mitigation required, they will consider economic investment in establishing the term of a new license. Accordingly and given this significant investment to construct a new fishway, PacifiCorp will be requesting a new license period of 50 years, the maximum period that FERC may grant in a new license. This period will allow the project to responsibly recover its investment.

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Fisheries Technical Report

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Page 8	This page discusses investments made in the Project since the 1990 license. Were any investments made in mitigation during the past license period?	Yes. The project operated in an annual license mode from ~1970-1990 (due to an attempted project takeover by a municipal utility operator), so the 1990 license was the first since the 1940s. The 1990 license included minimum flows (and resultant lost generation), construction of the recreation site, ADA-accessibility improvements, and enhancements to recreational access, among others.
FR/SS	Page 20	“Below the Weber diversion dam, the current license mandates a continuous minimum stream flow of 34 cfs or inflow, whichever is less, from October 1- March 31 annually; and, a continuous minimum flow of 34-50 cfs (range dependent on the annual runoff forecast), or inflow, whichever is less, from April 1- September 30 annually.” Will these same flow requirements continue with this license?	Yes—that PM&E measure will be formally proposed in the Draft License Application and has already been informally agreed to by stakeholders as appropriate mitigation.
FR/SS		**Location of the New Fishway** I assume that the new fishway would be placed in the location of old fishway destroying the old fishway. Understanding its function seems important before it is destroyed.	The historic fishway is actually planned to be an integral part of the new structure, to move the larger portion of the attractant flow through the structure. It is not planned for demolition.

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Fisheries Technical Report

Commenter (initials/ agency)	Section Title/ Paragraph	Comment	Resolution
FR/SS	Page 19	**Bluehead Sucker - Biology and Life History: Bluehead Sucker** The studies cited to understand needs of Bluehead Suckers seem to indicate that the fish do not show the type of movement that is found with Bonneville Cutthroats. Is there opinion regarding the needs of this species in the project area?	Bluehead suckers do not have the same jumping abilities as BCT and also have lower burst swimming speeds in comparison; they also may move for spawning later in the year as they require warmer water temperatures. However, based on input from the FWG, PacifiCorp believes that implementing fish passage at the dam and which is designed to accommodate both species (specifically the full slot design), will meet the needs of bluehead sucker in the Project Area.

FINAL
RECREATION TECHNICAL REPORT

WEBER HYDROELECTRIC PROJECT RELICENSING
FERC PROJECT NO. 1744

Prepared for

PacifiCorp—Hydro Resources
1407 West North Temple
Salt Lake City, UT 84116

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June 30, 2017

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CONTENTS

APPENDICES

TABLES

FIGURES

1.0 INTRODUCTION

PacifiCorp owns and operates 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, Utah. The current FERC license will expire on May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. The Project has a generation capacity of 3.85 megawatts and is located partially on federal lands managed by the USDA-Forest Service (USFS), and partially on lands owned by the Union Pacific Railroad Company (UPR). PacifiCorp filed a Notice of Intent to File Application for New License and a Pre-Application Document to initiate FERC's Alternative Licensing Process for the Project on May 29, 2015.

This document is a recreation resource technical report to meet FERC licensing requirements and address study requests from American Whitewater (AW), Trout Unlimited (TU), and the Utah Division of Wildlife Resources (UDWR). The study includes the following four components: 1) an inventory of existing recreation facilities and opportunities in the Project vicinity, 2) a recreation use and demand study, 3) a phased whitewater boating feasibility study, and 4) a recreation needs assessment. Note that the *Whitewater Technical Report* is summarized in the body of this report and included in full text as Appendix C.

According to the approved study plan, the study has two principal objectives:

- Characterize existing recreation opportunities and use levels (including those for whitewater boating) in the Project vicinity. Existing recreation facilities and opportunities (recreation resource supply) in the Project vicinity will be identified and mapped. Use of recreation facilities in and near the Project Study Area (recreation resource demand) including the existing day-use Weber recreation site will be summarized based on use data, if available, or estimates.

- Identify both existing and future recreation needs (including those for whitewater boating) related to the Project over the term of the new license. Existing needs will be identified based on current use data and agency consultation. An estimate of future demand for recreation opportunities at the Project will be made.

2.0 NEXUS TO PROJECT

The Project has potential direct and indirect effects on recreation resources and use within and adjacent to the Project Area, including the affected reach of the river downstream from the dam. These effects include providing public access to natural open space areas within and surrounding the Project for a variety of recreation activities, and access to and use of the river, forebay and tailrace for recreation purposes as well as effects on river flows. PacifiCorp has developed and operates the existing Weber day-use recreation site. User-defined trails from the recreation site to the old highway to the west (crossing under I-84) allow unrecorded use of USFS and private lands during all seasons, most commonly for anglers. The forebay access road is used in all seasons to access the river both upstream and downstream of the recreation site, again, most commonly for angling. The recreation site is used for picnicking, most commonly in late spring and summer, as the low sun angle (due to the narrow canyon walls) creates extended and relatively cold and windy winter-like conditions that tend to discourage all but the most cold-hardy users.

Study results have helped to inform PacifiCorp, USFS, AW, TU, and other stakeholders by synthesizing the information collected during the recreation studies and defining existing and future recreation needs that can reasonably be addressed and that are being considered for implementation during a new license term.

3.0 PROJECT AREA

For the purposes of this document and the preceding Study Plans, 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 which contains all Project features (encompassing the FERC Project Boundary as defined above), and which extends out for the purposes of characterization and analysis from the farthest edge of the Project Boundary, and 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.

4.0 STUDY AREA

The Study Area includes the Project Area as described above and shown on Figure 1 along the Weber River from the diversion dam to the powerhouse, including lands owned by the USFS or Union Pacific Railroad, as described in the Pre-Application Document. Note that the Study Area as defined includes the riverbank across from the powerhouse for review of a potential boater take-out site (this area is within the existing FERC Project Boundary and is covered by PacifiCorp's USFS Special Use Permit for the Project, but is also located at the terminus of the access road leading to the Davis & Weber Counties Canal Company's (DWCCC) intake gates and related infrastructure).

5.0 BACKGROUND INFORMATION

The Project Area is located within Weber Canyon and is surrounded by USFS and UPR lands. The Uinta-Wasatch-Cache National Forest is adjacent to the highly populated and urbanized Wasatch Front, which stretches from Brigham City, Utah, south to Nephi and includes the state capital of Salt Lake City. The mouth of Weber Canyon is approximately 8 miles from the Ogden City center and 30 miles north of Salt Lake City. The western, or down canyon, edge of the Project Area is approximately 9 miles from the Ogden City center. Recreation is the dominant land use on surrounding USFS land and includes activities such as camping, hiking, fishing, picnicking, biking, snowmobiling, and cross-country and downhill skiing.

Weber Canyon itself offers opportunities for fishing in the Weber River and limited (due to the lack of safe and legal access) hiking along the canyon slopes. Approximately 1,500 feet east of the Project's diversion dam, on eastbound Interstate 84, the Utah Department of Transportation (UDOT) maintains a rest stop. The rest stop has restrooms, water, picnic tables, Americans with Disabilities Act (ADA) river access for handicapped persons, viewpoints, and irrigated landscaping. UDOT maintains another rest stop approximately 2 miles east of the Project Area.

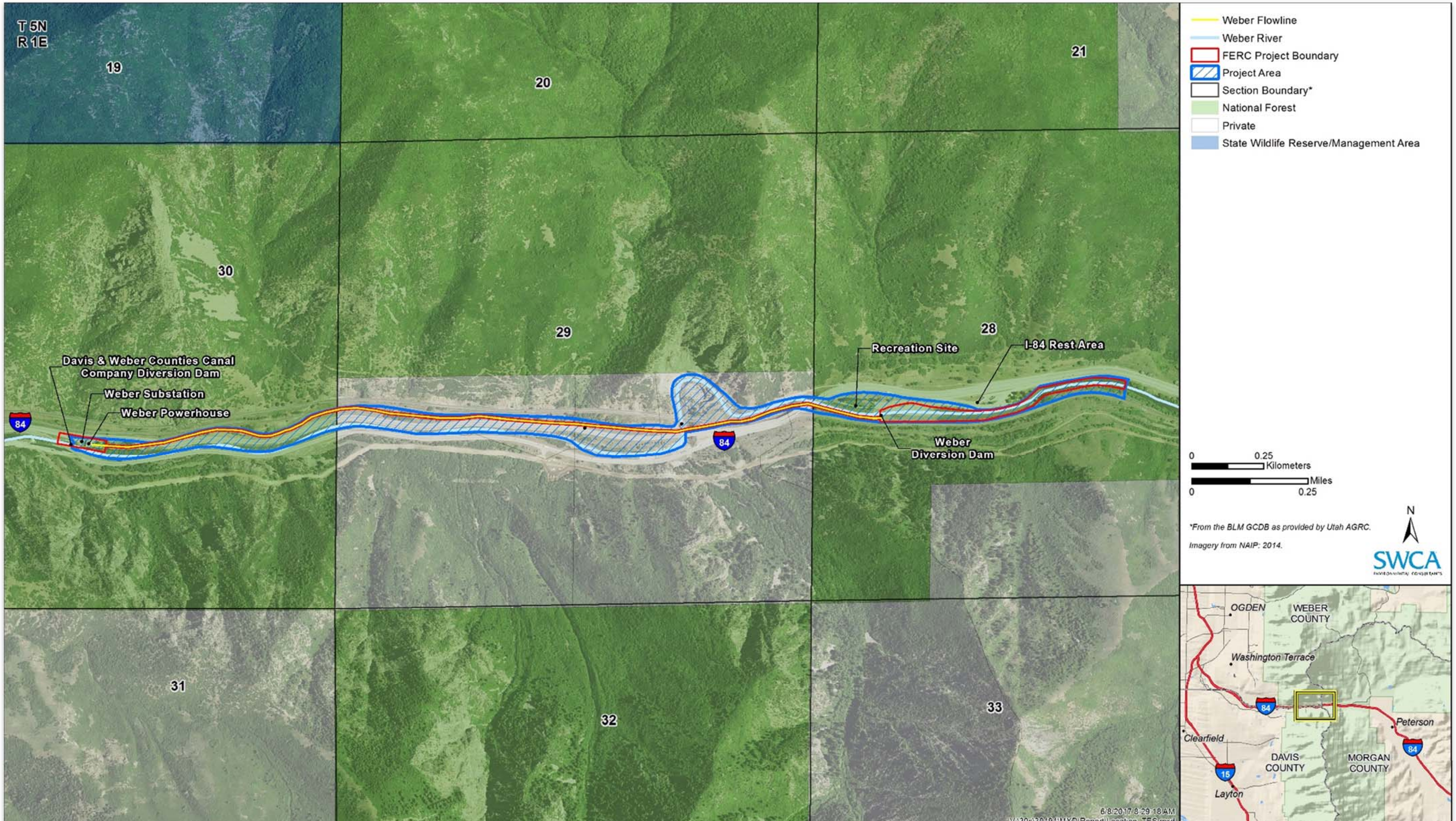

Figure 1. Weber Hydro Relicensing Project Location.

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The existing Weber recreation site is located on USFS land but is operated by PacifiCorp in the Project Area, immediately downstream from the Weber diversion dam. It includes a small parking area, five picnic tables, a lawn, fishing access to the river downstream of the dam, fishing access to the forebay with a platform that meets ADA requirements, and a portable toilet that is available on a seasonal basis.

Based on the National Park Service's vehicle occupancy multiplier (2.4 during off-season and 2.7 during peak season) and vehicle count data from a counter located for a year at the entry to the Weber diversion dam and recreation site, PacifiCorp estimated that approximately 19,454 people visited the recreation site during 2014, with 13,687 visitors during the off season and 5,767 visitors during the peak season (the Friday before Memorial Day through Labor Day). Because these numbers are based on car count data only, no information exists regarding specific uses of the area by the visitors noted above during 2014.

Extensive angling use occurs in the bypass reach (i.e., the reach of the river between the dam and the powerhouse where flows are reduced when the Project is diverting water for power generation). UDWR completed a creel survey in the Weber River from the mouth of Weber Canyon upstream to the confluence with Lost Creek. An estimated 66,606 angler trips to this UDWR-assessed reach were made during 2013 (Nadolski and Penne, 2013). While the creel survey did not quantify the number of anglers specifically using the PacifiCorp bypass reach, it would be safe to assume that many of the estimated 19,454 visitors to the recreation site in 2014 were anglers, as public access to much of the remaining reach is limited.

While not designated as a Scenic Highway, Interstate 84 is popular for scenic driving, and at least one recreational loop drive crosses the Project Area. This recreational loop drive is popular for Ogden residents and involves taking Interstate 84 through Weber Canyon, past the Project Area's east end, turning north on Trappers Loop Road for 8 miles to Pineview Reservoir, and then returning to Ogden through Ogden Canyon via State Highway 39 along the Ogden River.

Although the Weber River overall offers one of the closest whitewater paddling opportunities for Wasatch Front boaters, whitewater boating opportunities within the Project Area are limited. The existing Class III-IV boatable section is relatively short and has limited safe and legal access options due to the constraints of Interstate 84 and a non-Project irrigation diversion dam located immediately downstream of the powerhouse. This reach is referred to herein as the Study Reach. While launching is straightforward from the recreation site put-in, taking out is problematic. The other limitation on whitewater boating in the Study Reach is sufficient flows. Especially during dry years (e.g., the last five, 2012 - 2016), which are forecasted to become more the norm in the Project Area, when the Project is operating, there is rarely enough flow in the bypass reach to boat without suspending generation. These constraints are discussed in detail below under the Whitewater Boating Use and Demand Analysis.

There are no commercial whitewater outfitters operating on this reach. None are expected to operate in the future because the narrow river channel is not suitable for rafts, the pattern of flows suitable for whitewater boating is unpredictable, and there are challenges with access.

Other recreation opportunities in the Project Area are limited by Interstate 84, the two active UPR lines, two pipelines, a fiber optic line, steep terrain, and limited safe and legal access. The potential for trails is limited due to safe access limitations and because users would have to traverse either the channelized river (and cross under the existing I-84 bridge) or steep canyon walls on either USFS or private UPR lands.

Detailed documentation of recreational use of the Project Area is limited, which necessitated this study. Findings are summarized below under Results.

6.0 METHODS

This section provides a description of the study methodologies, including data collection and analysis techniques, and a schedule including field season(s) and the duration.

The study methods included the following four subtasks:

- Recreation Supply Analysis, which inventories recreation facilities and use areas in the Project Area and their condition;
- Recreation Use and Demand Analysis, which identifies existing recreational demand in the Project Area and estimates future demand for various activities of interest;
- Whitewater Boating Feasibility Study, which evaluates whitewater boating use on the Weber River and possible enhancement measures for whitewater boating opportunities within the Project's bypassed reach;
- Recreation Needs Analysis, which synthesizes, compiles and analyzes the results of all of the above analyses into one synthesis study report. This analysis identifies existing and future recreation needs over the potential term of the new license (30 to 50 years).

The study looked at Project-specific recreation supply and capacity, demand, and current and future needs in the context of the local supply and projected demand to determine if the existing Project recreation facilities are fulfilling their intended purpose and meeting recreation needs at the Project. The results of this analysis have been used in the development of recreation resource enhancement measures.

7.0 RESULTS

7.1 Recreation Supply Analysis

This section describes the existing recreation amenities at the Weber recreation site, their condition, and maintenance requirements.

7.1.1 Existing Recreation Amenities

The existing recreation amenities at the site are listed in Table 1. Appendix A includes all of the photos referenced below and a map indicating the point from which each was taken.

Table 1. Recreation amenities at the Weber Hydroelectric Project site. Photos referenced are found in Appendix A.

Project No.	Recreation Amenity Name	Recreation Amenity Type	Amenity Status	Notes
P-1744	Weber Rec Site Day Use Area	Picnic Area	Constructed	Parking for approximately 12 vehicles (photo 3), four tables (photos 7, 10, 11, and 12), four grills (photos 7, 10, 11, and 12), trash can (photo 4), and paved path leading to one table and grill (photo 7).
P-1744	Weber Rec Site Day Use Area	Interpretive Display	Constructed	Information on Project management, rules, and fishing (photo 5).
P-1744	Weber Rec Site Day Use Area	Fishing Platform	Constructed	Fishing platform at forebay, with ADA access and one table (photos 1 and 2).
P-1744	Weber Rec Site Day Use Area	Paved Path	Constructed	Paved path down the side of the grass area (photo 6 and 9).
P-1744	Weber Rec Site Day Use Area	Informal Use Area	Constructed	Open grass area (photo 8 and 13).
P-1744	Weber Rec Site Day Use Area	Active Recreation Area	Constructed	Sandbox play area (photo 16).

7.1.2 Amenity Condition and Maintenance

The Weber recreation site day-use area is generally in good condition, but there are some items that need attention:

- The protective shields around the trees, to prevent damage by beavers, are often damaged or missing.
- The picnic tables are in good condition but the BBQ grills are missing from two of the posts. Maintenance personnel indicate that the grills are stolen from time to time, despite their being locked to the poles.
- The information display panel includes required FERC Part 8 regulations and fisheries information but is generally lacking in interpretive information about the site, although it does contain some information about Bonneville cutthroat trout and bluehead sucker, the two species of concern that are known to occur in the Project Area. It is in need of fresh paint.
- The fishing platform is in good condition with only the railing needing fresh paint.
- The paved trail is cracked and buckled due to tree roots and is overhung by branches in places.
- The chain link fence on the south side of the paved trail has numerous patches from visitors cutting holes in the fence, presumably for fishing access downstream of the dam. Portions of the barbed wire along the top of this fence are damaged or missing.
- The grass is well cared for and in good condition.

- The sandbox area has become overgrown with vegetation and the fence surrounding the sandbox area is damaged.

The grass appeared to be well maintained and adequately cared for. The dumpster was never seen to be filled to capacity. The seasonal toilet appeared to receive sufficient maintenance to accommodate actual use levels throughout the study. Small pieces of scattered trash could be found in varying concentrations throughout the recreation site as well as along the river, both upstream and downstream of the dam, along the river corridor, and beneath the overpass.

During winter months, snow removal becomes an additional component of maintenance. This task is also conducted as needed.

In terms of Americans with Disabilities Act (ADA) compliance, the fishing platform is in compliance but the trail up to the picnic table nearest the parking lot is above the acceptable grade and is cracked and buckled by tree roots. The paved path on the south side of the recreation area is also not ADA compliant due to the aforementioned condition of the asphalt.

The recreation site is an out-of-the-way spot with ready freeway access. As a result, various illicit activities have been reported anecdotally, generally occurring at night. A Sheriff's Deputy attending to a minor incident at the recreation site during the study confirmed this speculation. PacifiCorp has considered installing a gate at the entrance to the diversion dam and recreation site that could be closed and locked at night.

Current maintenance conducted by Weber plant personnel at the recreation site entails grass mowing and edging, lawn watering, sprinkler maintenance and repair, tree branch removal, trash cleanup, and repair of vandalism. These tasks are conducted on an as-needed basis, as determined by the Weber personnel. A dumpster and seasonal toilet are also provided and maintained through contracts with outside companies.

7.1.3 Points of Public Access and Trails

The primary point of public access is through the recreation site picnic area along the paved trail. Beyond this paved trail, a primitive trail leads visitors further downstream (and outside the Project Boundary) where additional access is limited due to the positioning of the freeway. Several unsanctioned pull-off locations exist along the freeway that serve as access points as well.

7.1.4 Other Recreation Facilities in the Vicinity

The primary recreation facility in the vicinity is the State-managed rest stop located approximately 0.25 miles up the canyon. While this site is managed by the Utah Department of Transportation (UDOT), a privately contracted company maintains it. The area primarily provides a place for motorists to stop and rest, but people frequently use the area to picnic and fish. The USFS has no developed recreation sites in the vicinity.

The UDOT-managed rest stop absorbs a large amount of traffic. The impacts of this site and its close proximity to the Weber recreation site are multifaceted. The privately contracted company does a very good job of maintaining UDOT's rest stop facilities. When compared to the recreation site, fishing along this portion of the forebay is better, picnic tables are located closer to the river, signage is clearer, and the area is generally more accessible.

The area of primary concern as it relates to dispersed recreational activities is an area adjacent to Horseshoe Bend, on the old highway right-of-way, where people have been target shooting for some time. While this area falls outside of the Weber Project boundary (and is located on land owned partially by UPR and partially by the USFS), the Weber recreation site is the primary point of access. Photos of this location are in Appendix A (Photos 25 – 27).

7.2 Recreation Use and Demand Analysis

USFS representatives contacted for this study said they do not have any information regarding visitor uses in the Project vicinity. Due to the steepness of the canyon, hunting is the most common form of dispersed recreation outside of the Project Area.

The Utah 2014 *State Comprehensive Outdoor Recreation Plan* report shows current uses, visitor perceptions, and future needs for the Wasatch Front area. This information shows that about half of the Wasatch Front population regards outdoor recreation as extremely important. Just over half of these people travel over 25 miles for recreation opportunities. Some information from the report is relevant to use of the Weber recreation site:

- Hiking/backpacking ranks as the most common recreational activity of Wasatch Front residents, with camping second, and fishing third.
- Walking for pleasure or exercise is the most common outdoor activity in the Wasatch Front area, with playground activities third, wildlife/bird watching fourth, and picnicking fifth.
- City parks are the most important recreational facilities while “Natural Areas” are second. Most residents are very satisfied with existing city parks.
- Additional parks and hiking trails are the top recreational facility needs in the Wasatch Front area. Additional walking trails rank fifth, and playground equipment ranks ninth.

7.2.1 Visitor Survey

General recreation visitor surveys were conducted over the course of seven periods, once a month from March through September 2016. Surveyors were at the site approximately 12 hours each day and offered the survey to every visitor they encountered. In total 51 visitors were encountered and 47 of those completed the survey. Two of the individuals who declined to take the survey indicated that they had previously taken it and did not wish to take another. Visitors were either handed surveys to fill out on their own while at the site, assisted with filling out the survey while at the site, or given a survey to take home and return by mail, depending on their preference.

A copy of the survey and tabulated results are included in Appendix B. Many of the individual results are not discussed in the body of the report; while they may be of interest, they were not specifically relevant to the objectives outlined in the study plan, although this report does summarize common and/or specifically relevant findings.

7.2.2 Recreation Use Metrics

UDOT was contacted for visitor use data at the State rest stop and none was available.

Based on data collected over the course of this study, primarily during the visitor-use survey described in the preceding section, we estimate recreation use at the Weber recreation site in Table 2. Although this use estimate is significantly different from the most recent annual vehicle count use estimate, the following paragraphs discuss the methodology behind the updated, better-quantified estimate.

Table 2. Recreation use metric estimates for the Weber recreation site.

Estimated Recreation Visits Per Year	3,754
Estimated Recreation Visitor-Days Per Year	605 – 1,248
Site Occupancy (maximum observed during study):	
Parking (approximately 12 stalls)	50%
Tables (five tables – four in grass area and one at the fishing platform)	20%

As defined in the study plan, a recreation visit is "a visit by one person to a recreation area for any portion of a single day." We have no method of precisely calculating this value since there is no attendant at the entrance of the recreation area who could keep track of this kind of data. In order to estimate recreation visits we used data from our survey. Specifically, we used the average number of people who visited the site on the days we were surveying. Our survey took place on weekdays as well as on weekends. As expected, weekends had higher average recreation visits at 12 per day. Weekdays averaged 9.6 recreation visits per day. There are 52 weeks in a year with one additional day outside of those 52 weeks. Depending on the year, that day may be either a weekend or weekday. Since for 5 out of 7 years that extra day will be a weekday, we added one additional weekday worth of recreation visits to our yearly total presented in Table 2.

This estimate of recreation visits per year is substantially lower than the figure for 2014 cited above under Background Information. This results from several factors. First, the NPS vehicle occupancy figures of 2.4 and 2.7 for off-peak and peak seasons, respectively, are not reflective of observed use at the recreation site. Based on our visitor-use survey, actual peak-season occupancy was 1.4 per vehicle. This is consistent with the prevalence of solitary recreational pursuits such as fishing, walking, and target shooting that dominate use of this recreation site.

Second, the vehicle counter data used in the 2014 survey included vehicles that drove into the recreation site and immediately turned around. Again, this is a function of this recreation site's unique location, at the same highway exit as the State rest area. Third, the traffic counter data included PacifiCorp employees visiting the Project facilities, not the recreation area. Based on these considerations, we are confident that the estimates derived from the visitor-use survey are more reliable.

We also used survey data to estimate recreation visitor-days. The study plan defines a recreation visitor-day as "12 hours of use by any combination of users to a recreation area." In order to estimate this value we used the survey answers to question 6: "How long did you or are you going to be recreating at the Weber recreation site today?" Possible answers in the survey were "short trip (under 3 hours)," "about half the day," and "the majority of the day." There was no pattern evident in the answers to this question based on whether the survey was conducted on a weekday or weekend, perhaps due to our small sample size (7 days of visitor surveys); therefore, we did not distinguish between weekends and weekdays in this calculation.

Seventy-nine percent of respondents selected the "short trip" option, with 15 percent selecting "about half the day" and 6 percent selecting "the majority of the day." Given the coarse nature of these categories, we present recreation visitor-days as a range. For the minimum estimate, we defined a short trip as 1 hour, half the day as 4 hours, and the majority of the day as 8 hours. For the maximum estimate, we defined a short trip to be 3 hours, half the day to be 6 hours, and the majority of the day to be 12 hours. Using the estimated recreation visits per year, the percentages of answers to question 6, and the two sets of values for question 6 answers, we estimated recreation visitor days as presented in Table 2.

Site occupancy is presented in Table 2 as maximum occupancy observed at recreation area facilities over the course of the surveys. Neither parking nor tables were ever observed to be approaching capacity with maximum parking occupancy at approximately 50 percent (based on a lot capacity of 12 vehicles) and maximum table occupancy at 20 percent (one of five occupied).

7.2.3 Trail Camera

A heat- and motion-triggered camera (Reconyx HC600) was installed in a position to view the primitive trail extending from just past the sandbox area toward the highway overpass on March 11, 2016. The camera operated continuously through September 13, 2016. There was a period from May 28, 2016 to June 28, 2016 when the camera became obscured by growing vegetation and no data was collected. After that, the camera was moved to a more elevated position where vegetation was no longer an issue. Unfortunately, based on the increasing trend of use from March through May and the generally declining trend of use from July through September, the missing period of June was likely the highest use period for the primitive trail. Thus the results may underestimate overall use, but the breakdown by type of recreation was not likely affected.

Individual trail users were only counted once per trip out and back on the trail, and each member of a party was counted individually. Occasionally users were seen going one direction on the trail and not the other, presumably due to use of a different route on the corresponding trip. These users were also counted once. Users were categorized into use types by their dress and any gear or equipment they carried. It was generally obvious what use-type to assign to a particular user, but in cases where it was unclear, walking was the default category. Table 3 summarizes the results of trail camera survey.

Clearly, fishing is the primary recreational use of the Project Area, based on use of the trail leaving the recreation site, with walking second. During June and July, fishing as a percentage gained relative to walking, perhaps as a result of summer heat. The third highest use, target shooting at the informal site adjacent to Horseshoe Bend on the old highway right-of-way, remained fairly consistent across the study period.

Table 3. Analysis of primitive trail users by use type. Based on data from remote camera.

Use Type	Percentage	n
March Individuals and Use Types (March 11-31)		
Fishing	44	31
Walking	42	29
Shooting	11	8
Photography	1	1
Prospecting	1	1
Totals	**100**	**70**
April Individuals and Use Types (April 1-31)		
Fishing	54	86
Walking	34	54
Shooting	11	17
Photography	1	2
Totals	**100**	**159**
May Individuals and Use Types (May 1-28)		
Fishing	54	100
Walking	31	57
Shooting	9	16
Photography	3	6
Kayaking	3	5
Totals	**100**	**184**
June Individuals and Use Types (June 28-30)		
Fishing	79	26
Walking	12	4
Shooting	9	3
Totals	**100**	**33**
July Individuals and Use Types (July 1-31)		
Fishing	73	200
Walking	12	53
Shooting	14	51
Photography	1	2
Totals	**100**	**189**
August Individuals and Use Types (August 1-31)		
Fishing	68	124
Walking	20	37
Shooting	12	22
Totals	**100**	**183**

Table 3. Analysis of primitive trail users by use type. Based on data from remote camera.

Use Type	Percentage	n
September Individuals and Use Types (September 1-13)		
Fishing	76	50
Walking	22	15
Shooting	2	1
Totals	**100**	**66**
Total Individuals and Use Types		
Fishing	61	617
Walking	25	249
Shooting	12	118
Photography	1	11
Kayaking	<1%	5
Prospecting	<1%	1
Totals	**100**	**1,012**

7.3 Whitewater Boating Feasibility Study

The relevant results of the associated *Whitewater Recreation Study Technical Report* are summarized below. The full report, with complete methods, results, and discussion, is attached as Appendix C. The objective of this study was to assess whitewater boating opportunities provided across a range of flow conditions based on the water available in the Study Reach downstream from the Weber diversion dam.

7.3.1 Whitewater Boating Hydrology Analysis

PacifiCorp maintains a non-consumptive water right of 365 cubic feet per second (cfs) from the Weber River for power generation. For purposes of this analysis, the average diversion for generation is assumed to be 300 cfs. During the most recent 10-year flow period (2005 – 2015), inflows of greater than 380 cfs to the Project (the total of approximate maximum generation flow and minimum instream flow), measured at the USGS Gateway gage, occurred approximately 31 percent of the time, or 113 days per year. These flows generally occurred from April through August, coinciding with irrigation season flows that are released upstream from Echo Reservoir. Inflows of greater than 700 cfs occurred approximately 11 percent of the time, or 40 days per year, almost exclusively in May and June. The Gateway gage is widely used by boaters and others to determine the flow in the Study Reach.

A minimum acceptable boating flow of 450 cfs through the Study Reach was calculated through the internet survey and focus group discussion (although a minority of focus group attendees reported boating the Horseshoe Bend section at lower flows), as indicated below in the Whitewater Boating Use and Demand Analysis. The calculated minimum acceptable flow of 450 cfs in the Study Area is shown as a red line on Figure 2 for reference.

The Project is frequently offline during the winter months, in all but the wettest years, due to storage reservoirs and interference contracts on the Weber River upstream of the Project. During the non-operational periods all flows at Gateway gage pass over the Weber diversion dam and into the Study Reach. In 2015 and 2016 when the Project was offline, data from the Gateway gage indicated no flows over 450 cfs, and thus no boating opportunities in the Study Reach, occurred in 2015 and 2016 (Table 3-1 in Appendix C).

The Project operated for 176 days in 2015 and 217 days in 2016 through September 30, 2016 (end of the period covered by this report; as of November 9, 2016, the Project was still operating at very low levels). During periods of Project operation, flows greater than 750 cfs are necessary at Gateway gage for a 450 cfs flow, and thus a whitewater opportunity, in the Study Reach without reduction of generation. Mean daily flow at Gateway gage during Project operations was greater than 750 cfs on a single day in 2015 and 2 days in 2016 (note that Figure 2 below shows flow measurements in the Project study reach rather than values from the Gateway gage. In order to get Gateway gage values, 300 cfs must be added to the values in Figure 2). Days with acceptable flows for whitewater boating generally occurred in April and May.

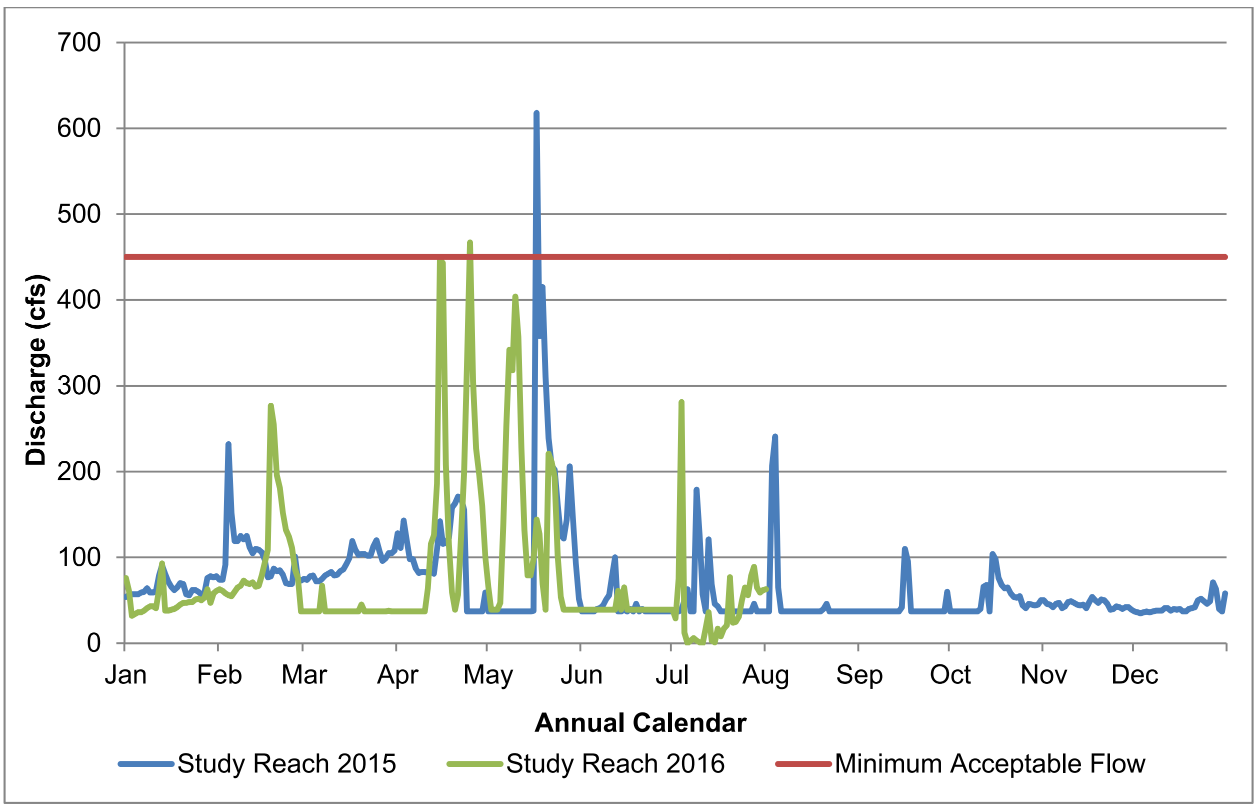

Figure 2. Mean Daily Flows in the Project Study Reach in 2015 and 2016

In short, flows sufficient to boat the Study Reach, from the accessible put-in at the recreation site to a safely accessible take-out downstream would continue to be rare (based on the most recent flow data) without interrupting generation.

7.3.2 Whitewater Boating Use and Demand Analysis

Internet Survey and Focus Group

An Internet survey was launched on March 24, 2016, and closed on July 4, 2016. A total of 62 individuals responded to the survey with nine incomplete surveys removed from the overall analysis due to incomplete survey responses. An additional eight surveys were included in the analysis of the background information but were excluded from the flow analysis due to a lack of responses for flow-related questions. A total of 45 responses were used in the flow analysis for this study. Survey respondents were encouraged to report the results of historic trips on the Study Reach as well as more recent trips. The earliest date for trips reported was November 26, 1976. The flows cited in trip reports ranged from 241 cfs to 4,300 cfs, as measured at the Gateway gage.

PacifiCorp hosted a whitewater focus group for the Project on May 3, 2016, from 7:00 to 10:00 p.m. in Ogden, Utah. A total of 30 invitations were delivered, and 15 individuals registered for the focus session, all of whom participated. Results of the Internet survey and focus group are summarized below.

Current Use

While this study identified 450 cfs as the minimum acceptable boater flow for the Study Reach as a whole, some use occurs at lower flows, mostly confined to the Horseshoe Bend rapid. This limited use is explained below under Flow Preferences.

Whitewater boating in the Study Reach typically occurs during the spring months, corresponding with the melting of the lower-elevation snowpack. In 2015, 22 reported trips from Internet survey participants occurred in the Study Reach from March through September with the majority of the trips occurring in May and June. In 2016, 11 trips were reported with the majority of trips occurring in April and a single trip listed for late June.

In general, whitewater boaters indicated they made fewer than five trips to the Study Reach during the previous 12 months (Figure 3-9 in Appendix C). In fact, 15 participants indicated they had not paddled the Study Reach in the previous 12 months, whereas 24 respondents indicated one to five trips in the previous 12 months. Two participants indicated making 6 to 10 trips or 11 to 20 trips, respectively, during the past 12 months. No participants reported making more than 20 trips during the past 12 months.

When asked the total number of trips they have made to the Study Reach for whitewater recreation over time, the largest number of Internet survey participants (n=17) indicated one to five trips total, followed by 12 participants indicating 11 – 20 total trips, and 11 participants indicating more than 20 total trips.

Weekends and weekdays after work hours (typically 5 p.m.) were preferred for trips to the study reach (Figure 3-12 in Appendix C).

Internet survey participants compared the study reach to local, state, and regional whitewater rivers using a five-point rating scale ranging from worse than average to among the very best. The whitewater resources used in the comparison included the Weber River play park, rivers within a one-hour drive, other rivers in Utah/Idaho/Wyoming, and other rivers in the United States. For each comparison, the majority of survey respondents rated the Project study reach worse than average relative to the other whitewater recreation resource comparisons (Figure 3-14 in Appendix C). Four survey respondents identified the study reach as among the very best within a one-hour drive. In general, the unfavorable rating of the Project study reach increased as the geographic radius of the comparison expanded (i.e., other rivers in Utah/Idaho/Wyoming and other rivers in the United States).

Challenge Level

The majority of Internet survey respondents rated the whitewater difficulty for this section of the Weber River as Class IV whitewater (Figure 3). Focus group participants provided more detailed ratings of the whitewater difficulty for the individual rapids across a range of flows. As expected, considerable discussion ensued among the participants regarding the difficulty of individual rapids at various flows. Individuals more familiar with the reach and with higher skill levels tended to rate the whitewater difficulty lower compared to individuals with less experience. In the end, the focus group participants agreed that the overall rating for the Study Reach is Class IV, reflecting the difficulty in Horseshoe Bend and Triple Drop rapids.

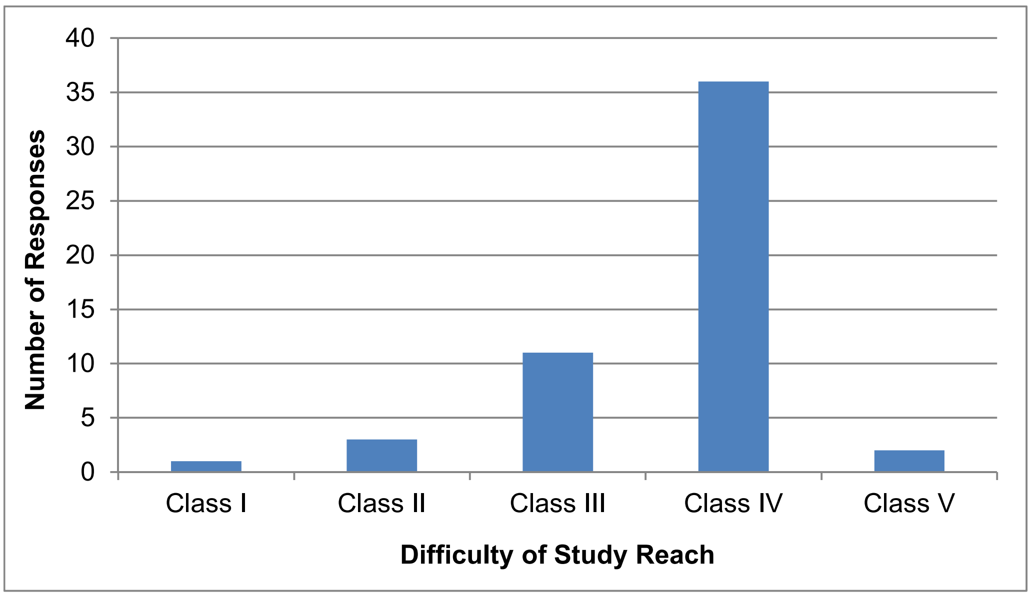

Figure 3. Study Reach Whitewater Difficulty Based on Internet Survey Responses

Flow Preferences

Focus group participants also provided information on flow preferences. Boaters indicated they rely on the Gateway gage located directly upstream of the Weber diversion dam for real-time flow information. The Gateway gage serves as a reference point since the boaters are not knowledgeable of PacifiCorp's diversion capacity. During the focus group discussion, boaters provided their flow preferences based on the Gateway gage flows. Those numbers have been adjusted (i.e., generation diversions subtracted as appropriate) to reflect flows in the Study Reach for comparison with flow recommendations provided by the Internet survey participants.

Section 4 of the Internet survey allowed participants to rate a range of flows from 200 to 1,000 cfs in the Study Reach. This comparative flow rating was used to develop flow preference curves (Figure 4). The minimum acceptable flow was just under 450 cfs. The optimum flow range was 600 to 1,000 cfs (Figure 4). Participants rated 900 cfs as the most acceptable flow between 200 and 1,000 cfs. Internet survey participants were largely in agreement that flows less than 400 cfs were unacceptable, but as flows increased above 400 cfs the acceptability ratings varied more broadly (Figure 3-16 in Appendix C).

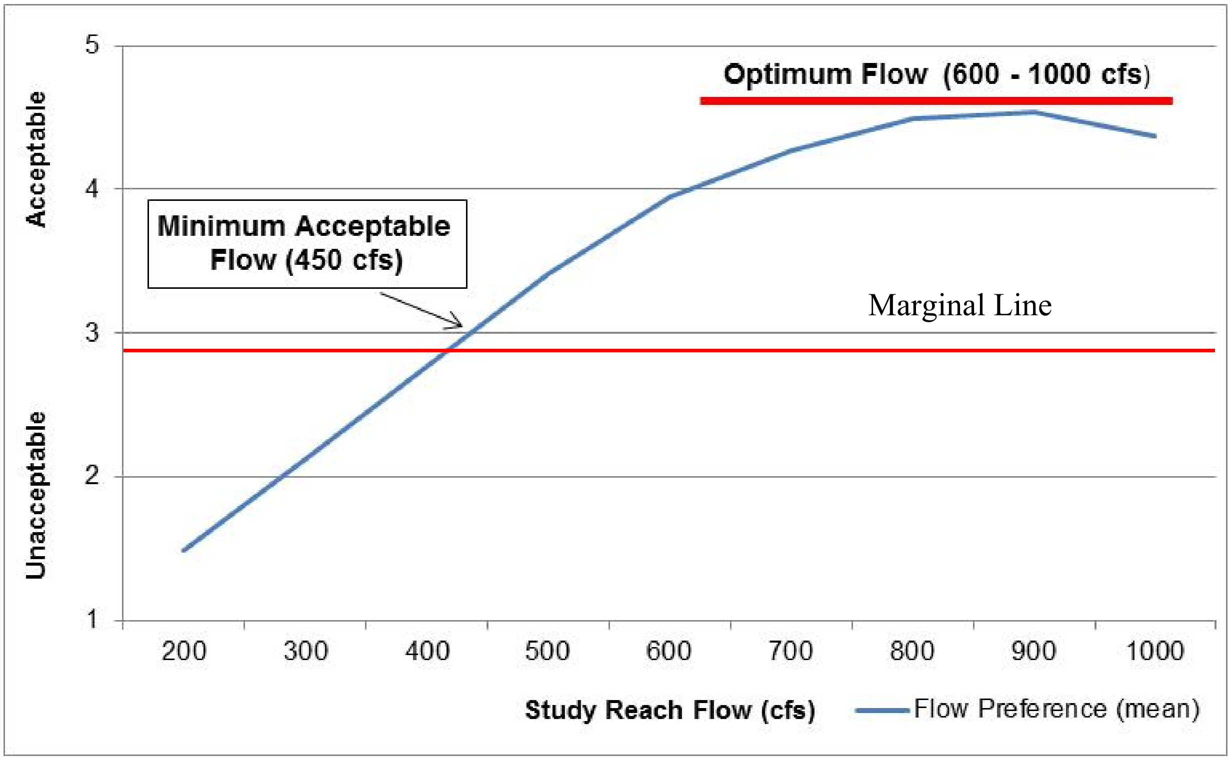

Figure 4. Flow Preference Curve Identifying Minimum Acceptable and Optimum Flow for Internet Survey Participants

Focus group participants commented that flow preferences have changed due to the changes in access to the Study Reach. Historically, when access was allowed from I-84 to the bottom of Horseshoe Bend, the minimum acceptable flow was as low as 140 cfs. Boaters would paddle the Horseshoe Bend rapid only, because 140 cfs was too low for Ledges 1, 2, and 3 at Triple Drop. Horseshoe Bend at 140 cfs offered a technical slalom boating opportunity. The current access restrictions require a higher minimum acceptable flow because more water is needed to navigate Triple Drop and the 1.2-mile Hell or Highwater section downstream. Focus group participants indicated the flow needed to navigate that section is 300 cfs, but the minimum acceptable flow is closer to 400 cfs for Ogden boaters and higher for boaters traveling longer distances.

Given the flow patterns summarized above under Whitewater Boating Hydrology Analysis, sufficient flows pose a substantial constraint to whitewater recreation in the Study Reach.

River Access

The majority of boaters put in a short distance downstream from the Weber diversion dam where the paved walking path terminates at the riverbank (Figure 3-18 in Appendix C). River access is not permitted immediately downstream of the dam for safety and liability reasons. Boaters are able to launch on a gravel bar approximately 200 meters downstream from the dam (Photo 3-11 in Appendix C). PacifiCorp employees have observed boaters launching in the Project forebay. One focus group participant said he had paddled over the dam in the past. The dam is not suitable for safe navigation (Photo 3-12 in Appendix C) and paddling over it is discouraged by PacifiCorp.

After boating the Horseshoe, aka Scrambled Eggs, section of the bypassed reach using the recreation site put-in, boaters must either carry their boats back upstream along the old highway bed and back to the put-in, or continue downstream and portage the non-Project diversion located immediately downstream of the powerhouse. This diversion is owned by the DWCCC, and it commonly takes most or all of the flow in the Weber River at that point, limiting options to continue downstream.

The boatable reach of the river is further constrained by being located between the two lanes of I-84, and the only downstream access route is the road to the DWCCC diversion dam, which is gated and locked downstream of the potential portage area.

The only other access to the boatable reach is via the old highway bed, and the access point has been gated and locked by UDOT to prevent recreationists from using a freeway pullout that is considered unsafe due to the lack of acceleration and deceleration lanes. Due to geomorphology constraints, there is no room for acceleration or deceleration lanes in the Project Area.

The majority of boaters take out on South Weber Drive, also known as the Mouth of the Canyon (Figure 3-19 in Appendix C). During the focus group, participants indicated this is the default location currently, but it's not preferred because it requires paddling the 1.2-mile Class II-III section, Hell or High Water, below Triple Drop, portaging around the DWCCC diversion dam and paddling another 0.75 mile Class II section that may be severely dewatered by irrigation flow diversions.

In summary, safe and legal access to the Study Reach is difficult and limits use of the Study Reach by whitewater boaters.

Whitewater Boating Needs Analysis

Project operations, particularly in the months of April and May, cause a decrease in the number of whitewater boating opportunities. The Project diverts 300 cfs to the Weber powerhouse when instream flows at Gateway gage range from 450 to 750 cfs resulting in flows less than the minimum acceptable in the Study Reach. Mean daily flows between 450 and 750 cfs at Gateway gage occurred 13 and 26 days respectively in 2015 and 2016, resulting in a total reduction of 39 days of boatable flows. Flows greater than 750 cfs at Gateway gage result in sufficient discharge in the Study Reach for whitewater boating. Mean daily flows at Gateway gage exceeded 750 cfs 1 day in 2015 and 2 days in 2016.

Potential access improvements could be implemented at the Project Area for river recreation users. The historic direct access used by boaters to Horseshoe Bend from I-84 is unlikely to be restored. Vehicles travel in the west bound lane of I-84 at speeds in excess of 75 miles per hour.

Direct access to Horseshoe Bend would require construction of an off and on-ramp to I-84. The site is physically constrained, eliminating the viability of this option. The current put-in location at the Weber recreation site is suitable for whitewater boaters to park vehicles and access the river. The current take-out location is not suitable. A more desirable take-out location upstream of the DWCCC diversion dam is needed so boaters do not need to portage the diversion dam and paddle undesirable low flow conditions to the take-out. A potential parking area is located on river left adjacent to the DWCCC diversion dam. Boaters can exit the river upstream of the DWCCC diversion dam and walk a short distance (approximately 200 yards) to their vehicle.

Typically, a whitewater boating needs analysis would include an assessment of the recreation opportunities provided by an unregulated river, and then compare those to what might be available in a post-Project regulated reach. As the Study Reach is heavily regulated, both by upstream diversions and Project operations, and access to the Study Reach is compromised by a highway that was constructed after the Project was installed, separating impacts to recreation (access, flows, Project operations) to the extent necessary to do a complete needs analysis is not practical. Additionally, due to the run-of-river design and lack of water storage at the Weber Hydroelectric Project, the Project cannot provide flows sufficient to augment whitewater boating opportunities without significantly compromising generation. However, the needs analysis concluded the following:

- Flow-dependent recreation opportunities occur infrequently on the Weber River (which is regulated by upstream water storage and diversion projects beyond PacifiCorp's control), including the Study Reach, during the spring season.
- These opportunities are hampered by a lack of safe and legal access and egress.
- These limited recreation opportunities are affected by Project operations.
- Opportunities exist to increase the annual frequency of whitewater boating opportunities in the Study Reach when flows at Gateway gage are between 450 and 750 cfs.
- Notification of planned Project maintenance resulting in increased flow in the Study Reach could be beneficial to the boating (and fishing) community.
- PacifiCorp could participate in agreements to improve access at the DWCCC diversion dam directly downstream of the Weber powerhouse.

7.4 Recreation Needs Analysis

7.4.1 Current Needs

Managing the Weber recreation site presents a trade-off between making improvements and retaining the less-developed character of the site. Survey respondents indicate that they recognize this trade-off as well. If the area is significantly upgraded, it is likely that use will increase, which is something visitors commonly want to avoid. It is important to ensure that the facilities at the recreation site are sufficient to provide for visitors' needs but also to preserve the lower use levels and sense of quiet that brings people to the site in the first place.

Survey and trail camera results indicate that fishing, the most common form of recreation at the recreation site, is what visitors are most concerned about and where additional investment may be most warranted. Fishermen most strongly suggest that they would like to see improved in-river fish habitat. At a Project site visit to kick off this study, the UDWR representative said that there might be interest in making additional investments in the area. This partnership should be explored, and any reasonable improvements to habitat that can be made in the Project reach should be assessed.

For example, survey results indicate that fishermen are in favor of improving the trail beneath the freeway. Respondents noted that rattlesnakes are commonly found beneath the freeway, and one photo from the trail camera shows a man carrying a large dead snake on the end of his trekking pole. This trail could be improved and made safer by moving some large boulders then filling in the holes with an aggregate to create a trail. Note however that the trail exists in and crosses UDOT's I-84 freeway bridge right-of-way (ROW). UDOT engineers may or may not allow any alteration to the bridge footings that the primitive user-created trail traverses.

Fishermen also indicate that they would like other improved access to the river. The current primary access point located at the west end of the picnic site could be improved through the use of boulders to create an easy-to-navigate, natural looking staircase down to the river.

Improved waste collection is an area for improvement as reflected by the survey group. Small pieces of trash can be found throughout the recreation site, but litter is particularly abundant along river shores and at the shooting site. Policing this issue would be challenging in terms of resources, but there may be a good solution through a combination of increased signing and an additional trash can located on the far end of the picnic site.

Walkers, the second largest user group according to the trail camera data, would benefit from these trail improvements.

Target shooters are a relatively well-represented group in trail camera photos. While target shooting is not provided or managed on PacifiCorp Project lands, the recreation site does currently provide some of the access to an area commonly used for target shooting (above Horseshoe Bend, on the old highway ROW). Survey respondents commonly identified the shooting area as a place in need of improvement and management. PacifiCorp has no mandate or authority to control the shooting area (which is located on land owned partially by UPR and partially by the USFS), but collaboration with local law enforcement might improve the situation.

One result of the survey and trail camera data was the relatively small number of kayakers. Only five individuals from this user group were captured on the trail camera (less than 1 percent of the total recorded, although the camera was offline for a month during the highest period of use from May 29 – June 28, 2016), and none were encountered on survey dates. However, the camera data should not be taken to mean that only five kayakers used the Study Reach during the study period since many kayakers do not use the primitive trail but instead put in just downstream of the recreation site, or from a pullout located between the two freeway lanes in the immediate vicinity of the Horseshoe Bend; either location would not be picked up by the trail camera. Further, the whitewater user survey data indicated that 11 boaters utilized the area in 2016 (the year the camera was recording). At any rate, the preceding discussion under Whitewater Boating Needs Assessment identifies two improvements that would enhance this form of recreation in the Project Area – notification of when Project maintenance or other conditions were anticipated that would result in boatable flows in the Study Reach, and potential arrangements to improve take-out access at the DWCCC diversion dam downstream from the Weber powerhouse. Most other improvements suggested by survey respondents would also benefit boaters.

Other survey results revealed important information about how this site is used:

- The site is used primarily by people who live nearby. Eighty-six percent of surveyed site users indicated that they reside in Weber, Davis, and Morgan counties.
- Ninety-seven percent of surveyed site users indicated that they would be using the site less than half the day.
- Seventy-six percent of surveyed site users indicated that they had used the site more than 10 times. This represents a substantial number of repeat visits.
- The vast majority (74 percent) of surveyed site users indicated that they had used the primitive trail. This highlights the importance of that trail on visitor's use of the site.
- The primitive trail option for "Needs Improvement" was selected twice as often as the next highest selection, restrooms (34 vs. 16 percent).

In terms of potential improvements to the recreation site itself, survey respondents and the recreation specialists carrying out the study made these suggestions:

- Improvements to the user-created trail (if allowed by UDOT) under the freeway could facilitate access for most recreational users, although this area is outside the Project Boundary.
- Replacement of the chain link fence restricting access downstream of the diversion dam was frequently mentioned, although the fence is required to provide operational safety to recreational river users immediately downstream of the Project spill gates. There are multiple locations where the fence has been patched after being cut by fishermen trying to gain access closer to the dam. Signage indicating the distance to downstream river access could be added to reduce fence cutting.
- The USFS representative expressed interest in getting involved and possibly providing resources and expertise to improve the signage at the recreation site. Providing relevant information would improve visitors' recreation experience. The relationship with the USFS would allow for improved interpretive signing, including additional topics related to fish and wildlife, as well as the mandated FERC Part 8 form which is currently posted.
- Improvements to the recreation site turn-off from the freeway off-ramp and the road from the turn-off to the picnic area were also suggested. The road is potholed and lacks any signing that would welcome a visitor. Collaboration with the USFS could possibly result in a good sign for this location.
- The parking area itself lacks painted lines. Visitors expressed an interest in delineated parking stalls. The provision of an ADA parking stall should go along with this.
- Survey results suggest that a year-round toilet be part of the plan to address current needs and increased use in the future. While half of the survey group rated the current restroom as "Adequate," several of them made comments about improving to a permanent toilet, including the husband of one woman using a wheelchair.
- Removal of the fence around the sandy area at the west end of the picnic area was suggested, as was improving river access at this location.

- The problem with the fishing platform is not its condition but its location. The forebay in front of it is shallow and users cannot access areas with the best fishing, although this is a common problem with providing fishing opportunities in areas that are easily accessible from the parking area for all ability users. The fishing platform itself is in good condition, but the handrail could use new paint.
- Recreation site trees are being protected from beavers with sheet metal sleeves, secured with electrical tape. A visitor is seen in one picture from the trail camera carrying one of these metal sleeves that had come free, and it poses a possible safety hazard. A more aesthetical looking, safer, and more secure alternative could be used.
- Improved access to river flow information would help both boaters and fishing enthusiasts plan trips to the bypassed reach.
- Comments from American Whitewater on the preliminary draft report suggested the need for a discussion exploring the potential for whitewater flows through suspension of generation.

7.4.2 Future Needs

In the short to medium term, i.e., the next 10 to 20 years, visitor expectations regarding the types of recreational experiences available in the Project Area are not expected to change substantially. The site characteristics that currently limit recreation options, discussed in the preceding sections, are generally not subject to change. Day use by solitary, local fishermen, walkers, and target shooters will remain the dominant activity, with whitewater boaters taking advantage of the Study Reach when flow conditions allow. State of Utah population estimates project statewide population growth of 44 percent over the next 20 years. Use of the Weber recreation site could be expected to increase proportionally. Under this projected scenario, the improvements suggested above – primarily repair and replacement of existing facilities – are likely to be sufficient to meet anticipated needs.

As previously noted in the Background Information section, the recreation site is sometimes used for illicit activities at night because it is easily accessible and outside the public eye. PacifiCorp has considered gating the entrance and locking it at night. This may become a more pressing need as the area population grows. However, the trail camera study indicated that fishermen enter and depart before sunrise and after sunset, so nighttime closure would adversely affect that form of recreation.

Beyond the 20-year horizon and into the new license period, it is difficult to project how recreational demands on the Project Area and the options available to address them might change. The site's physical characteristics will continue to impose hard limits on recreational potential, but new forms of recreation and associated technologies will undoubtedly emerge. Witness the rapid growth of mountain biking over the past decade, or the emerging popularity of flying drones. Population growth will likely continue to accelerate, putting more pressure on all recreation venues.

In the face of this uncertainty, the most pressing need may be for PacifiCorp to maintain effective working relationships with its partners in managing Project Area land and resources, the USFS, UDWR, and UDOT. Through collaboration, these entities can ensure that the Project and surrounding land and infrastructure accommodate and support changing trends in recreation as effectively as possible.

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APPENDIX A

SITE PHOTOS

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Recreation Supply Analysis
Photo Locations

▲ Photo Locations - Arrow Indicates Direction

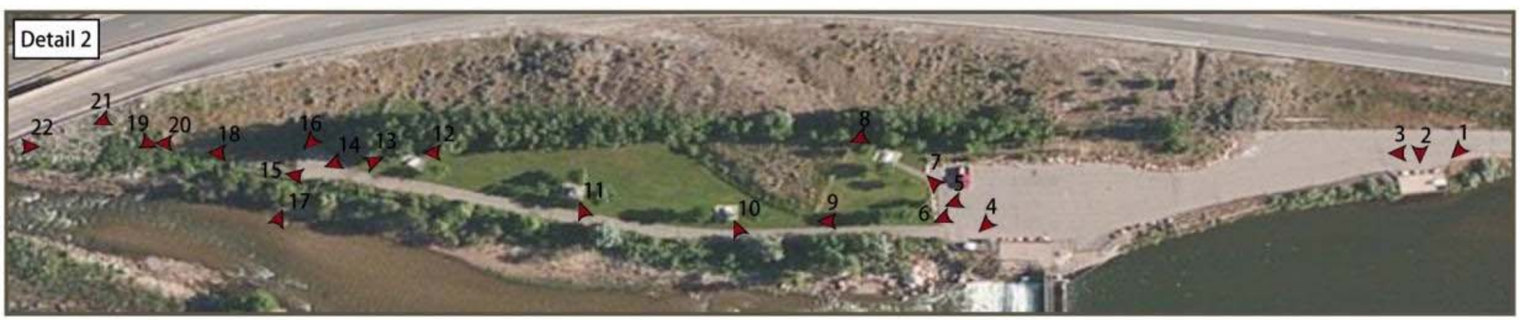

Photo Point 1

Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

Photo Point 7

Photo Point 8

Photo Point 9

Photo Point 10

Photo Point 11

Photo Point 12

Photo Point 13

Photo Point 14

Photo Point 15

Photo Point 16

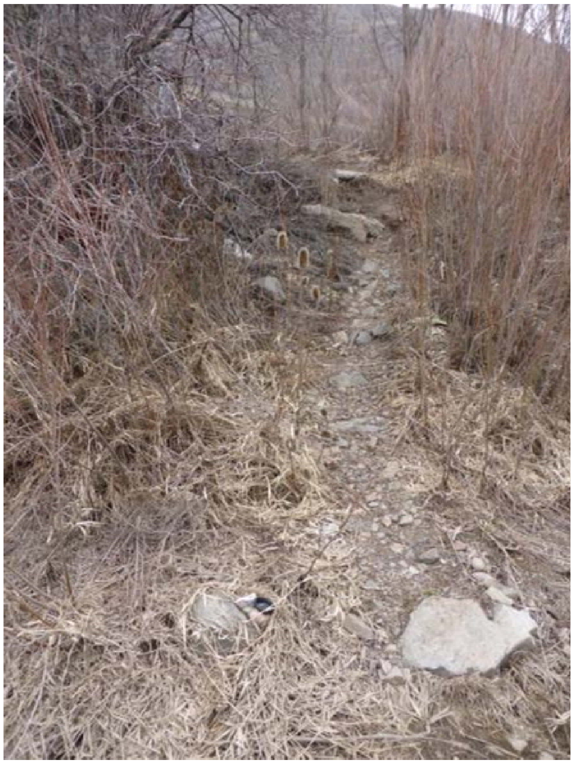

Photo Point 17

Photo Point 18

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APPENDIX B

VISITOR SURVEY QUESTIONNAIRE AND RESULTS

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Weber General Recreation
Visitor Use Survey

PacifiCorp Weber River Hydroelectric Project – Weber Canyon, Weber, Morgan, and Davis Counties, Utah

Introduction

PacifiCorp owns and operates the Weber Hydroelectric Project on the Weber River in Weber, Morgan, and Davis counties in Utah. This Project is operated under a license granted by the Federal Energy Regulatory Commission (FERC Project No. 1744). That license is nearing the end of its term and PacifiCorp has begun the process of renewing the Project's license. PacifiCorp would like to take this opportunity to evaluate the recreation uses associated with the Project.

PacifiCorp is requesting information from you to help in the evaluation of recreation opportunities associated with the Weber Hydroelectric Project, and on lands surrounding the Project. Please note that the Weber Recreation Site is unaffiliated with the nearby UDOT Rest Area; the recreation site is related solely to the Weber Hydroelectric Project. The information you provide will be used to describe the current recreation uses of the Project and determine the future recreation needs of the Project Area. Your participation in this survey is voluntary and the information you provide is strictly confidential. Your information will only be used for the purposes described here.

Thank you for your time and consideration.

To return survey by mail, please send to:

Cirrus Ecological Solutions
965 S 100 W #200
Logan, UT 84321

1. Would you be willing to take a few approximately 10 minutes to complete this survey?
   - ☐ Yes
   - ☐ No

   If no:
   Primary activity:
   Reason for refusal:

2. Is recreation your primary purpose for visiting this site today?
   - ☐ Yes
   - ☐ No

   If yes, what is your primary form of recreation at this site today?

   If no, what is the purpose of your visit here today?
   - ☐ Working or commuting to work
   - ☐ Stopping to use the restroom
   - ☐ Curious to see where this road goes
   - ☐ Other:

3. Including yourself, how many people are in your group today?

4. How many vehicles did your group use to visit the recreation site today?

5. Does anyone in your group have disabilities?
   - ☐ Yes
   - ☐ No

   If yes, are there sufficiently accessible facilities at this site for your activity?
   - ☐ Yes
   - ☐ No

   If no, please explain:

6. How long did you or are you going to be recreating at the Weber recreation site today?
   - ☐ Short trip (under three hours)
   - ☐ About half the day
   - ☐ The majority of the day

7. On average, how many times per year do you use this recreation site?

8. Approximately how many times have you used this recreation site in total?
   - ☐ 1
   - ☐ 2-5
   - ☐ 6-10
   - ☐ 10-20
   - ☐ 20+

9. How did you get information about or hear about this recreation site the first time you visited it?
   - ☐ Stumbled upon it
   - ☐ Word of mouth
   - ☐ Gear/tackle shop
   - ☐ Website If so, which website:
   - ☐ Other:

10. Please indicate: During which seasons have you participated in various activities at the recreation site?

Activity Type:	**Never**	**Spring**	**Summer**	**Fall**	**Winter**
Walking/Hiking					
Fishing from bank/wading above the dam					
Fishing from the platform above the dam					
Fishing from a float tube or similar craft above the dam					
Fishing from bank/wading downstream from the dam					
Whitewater boating					
Road cycling					
Driving for pleasure					
Viewing/photographing natural features					
Picnicking					
Relaxing/hanging out					
Nature study					
Escaping city/getting outdoors					
Swimming					
Bird watching					
Other:					

11. Did you use the primitive trail passing under the freeway from the recreation site to access the river during your visit?
    - ☐ Yes
    - ☐ No

    If yes, was the trail sufficient to meet your needs?
    - ☐ Yes
    - ☐ No

12. If you are using the river today, did you check the current river flow before your visit?
    - ☐ Yes
    - ☐ No

    If yes, where did you get your information regarding flows (USGS ‘Gateway’ gage is the one located approximately one mile upstream of the hydroelectric Project)?

13. Please indicate: How important were the following factors in selecting this site for recreation today?

Factor:	**Extremely Important**	**Very Important**	**Somewhat Important**	**Slightly Important**	**Not Important**
Proximity to home					
Variety of recreation opportunities					
No access fee required					
Lack of crowding					
Natural setting					
Access to river					
Access to whitewater boating areas					
Onsite restroom facilities					
Availability of picnic sites					
Pets permitted					
Clean/well maintained facilities					
Feeling of safety					
Handicapped access					
Other:					

14. If you are participating in whitewater boating during your visit, please indicate: Where did you put in and take out?

Location	Put In Location	Take Out Location
Weber Recreation Site (here)		
Pulled over on side of I-84 near the Horseshoe Bend		
Davis-Weber Irrigation Company dam (2 miles downstream from here)		
Other:		

15. Please indicate: What is your opinion of the condition of the facilities at the recreation site?

Site Feature	Condition				Suggestions for improvement
	Excellent	Adequate	Needs improvement	Not applicable	
Parking facilities					
Picnic facilities					
Restrooms					
Fishing platform					
Primitive trail passing under the freeway from the recreation site					
Paved walkway running downriver from recreation site					
Other					
Other					

16. What are the most important actions that could be taken to improve recreation at this site?
    - ☐ Additional picnic facilities
    - ☐ Improved trail passing under the freeway from the recreation site
    - ☐ Other improved fishing access to river
    - ☐ Improved boater access to river
    - ☐ Improve in-river fish habitat
    - ☐ Improved waste collection
    - ☐ Improved access to information about river flows
    - ☐ Other (Please explain):

17. Please provide any additional comments about recreation at this site you think are important:

18. What is your age?

19. What is your gender?
    - ☐ Male
    - ☐ Female
    - ☐ Other
    - ☐ Prefer not to respond

20. Which racial group do you most closely identify with?
    - ☐ American Indian/Alaska Native
    - ☐ Asian
    - ☐ Black/African American
    - ☐ Native Hawaiian or other Pacific Islander
    - ☐ White/Caucasian
    - ☐ Other: ____________________
    - ☐ Prefer not to respond

21. In what zip code do you reside?

Date:

Time:

Flow Rate:

Survey Response Analysis

Visitor Demographics:

Survey Question: What is your age?		
Age	**Percent**	**n**
<25	24	11
26-40	24	11
41-60	35	16
>61	17	8
Total	**100**	**46**

Survey Question: What is your gender?		
Gender	**Percent**	**n**
Male	96	45
Female	4	2
Other	0	0
Total	**100**	**47**

Survey Question: Which racial group do you most closely identify with?		
Racial Group	**Percent**	**n**
American Indian/Alaska Native		
Asian		
Black/African American		
Native Hawaiian or other Pacific Islander		
White/Caucasian	85	40
Latino	11	5
Other	2	1
Prefer not to respond	2	1
Total	**100**	**47**

Survey Question: In what zip code do you reside?			
Zip code	**Location/ Distance from Rec site**	**Percentage**	**n**
84040	**Layton, UT/7.4 mi.**	19%	9
84403	**Ogden, UT/22 mi.**	11%	5
84050	**Morgan, UT/19 mi.**	11%	5
84405	**Ogden, UT/9.2 mi.**	6%	3
84414	**Ogden, UT/24 mi.**	4%	2
84015	**Clearfield, UT/15 mi.**	4%	2
84041	**Layton, UT/12 mi.**	4%	2
84401	**Ogden, UT/15 mi.**	4%	2
84010	**Bountiful, UT/25 mi.**	4%	2
84075	**Syracuse, UT/19 mi.**	4%	2
84070	**Sandy, UT/44 mi.**	2%	1
84087	**Woods Cross, UT/26 mi.**	2%	1
84046	**Manila, UT/167 mi.**	2%	1
84101	**Salt Lake City, UT/31 mi.**	2%	1
83686	**Nampa, ID/331 mi.**	2%	1
85383	**Peoria, AZ/667 mi.**	2%	1
84092	**Sandy, UT/51 mi.**	2%	1
68930	**Montrose, CO/382 mi.**	2%	1
84301	**Bear River City, UT/46 mi.**	2%	1
	Total	**100%**	**47**

Visitor Characteristics:

Survey Question: Including yourself, how many people are in your group today?		
Number in Group	**Percent**	**n**
1	60%	28
2	30%	14
3	10%	5
Total	**100%**	**42**

Survey Question: What is your primary form of recreation at this site today?		
Use Type	**Percentage**	**n**
Fishing	75%	35
Walking	17%	8
Photography	2%	1
Picnicking	2%	1
Cycling	2%	1
Driving	2%	1
Total	**100%**	**47**

Survey Question: Does anyone in your group have disabilities?		
	Percentage	**n**
Yes	4%	2
No	96%	45
Total	**100%**	**47**
If yes, are there sufficiently accessible facilities at this site for your activity?		
	Percentage	**n**
Yes	50%	1
No	50%	1
Total	**100%**	**2**
Comments	Improve bathroom	

Survey Question: How long did you or are you going to be recreating at the Weber recreation site today?		
Duration	**Percentage**	**n**
Short Trip (<3 hours)	79%	37
About half the day	15%	7
The majority of the day	6%	3
Total	**100%**	**47**

Survey Question: On average, how many times per year do you use this recreation site?		
Number of Visits	**Percentage**	**n**
<5	32%	15
6-20	23%	11
20+	45%	21
Total	**100%**	**47**

Survey Question: Approximately how many times have you used this recreation site in total?		
Number of Visits	**Average**	**n**
1	9%	4
2-5	11%	5
6-10	4%	2
10-20	6%	3
20+	70%	33
Total	**100%**	**47**

Survey Question: How did you get information about or hear about this recreation site the first time you visited it?		
Method	**Percentage**	**n**
Stumbled upon it	52%	25
Word of mouth	46%	21
Gear/tackle shop		
Website	2%	1
Other		
Total	**100%**	**47**

Participation in Activities in the Study Area:

Survey Question: Please indicate: During which seasons have you participated in various activities at the recreation site?

	Season				
Activity Type	**Never**	**Spring**	**Sumer**	**Fall**	**Winter**
	Participation Percentage				
Walking/Hiking	53%	40%	43%	36%	13%
Fishing from bank/ wading above dam	50%	48%	43%	43%	22%
Fishing from the platform above the dam	83%	17%	15%	13%	9%
Fishing from a float tube or similar craft above the dam	83%	4%	9%	4%	2%
Fishing from the bank/ wading downstream of the dam	15%	76%	76%	68%	45%
Whitewater boating	89%	4%	9%	4%	2%
Road cycling	94%	2%	4%	2%	0%
Driving for pleasure	63%	35%	37%	35%	30%
Viewing/photographing natural features	55%	40%	40%	38%	32%
Picnicking	60%	26%	40%	30%	2%
Relaxing/hanging out	47%	48%	51%	43%	30%
Nature Study	81%	17%	19%	17%	13%
Escaping city/ getting outdoors	40%	57%	57%	55%	40%
Swimming	91%	0%	9%	2%	0%
Bird watching	72%	26%	28%	19%	17%
Other:					

Survey Question: Did you use the primitive trail passing under the freeway from the recreation site to access the river during your visit?		
Response	**Percentage**	**n**
Yes	74%	35
No	26%	12
Total	**100**	**47**
If yes, was the trail sufficient to meet your needs?		
Yes	64%	30
No	11%	5
N/A	**25%**	12
Total	**100%**	**47**

Survey Question: If you are using the river today, did you check the current river flow before your visit?		
Response	**Percentage**	**n**
Yes	15%	7
No	85%	40
Total	100%	47
If yes, where did you get your information regarding flows (USGS 'Gateway' gage is the one located approximately one mile upstream of the hydroelectric Project))?		
Responses: "Utah angler's report," "didn't find anything," "Utah stream flow," "Fishing report," "USGS Gateway gage."		

Importance of Factors:

Survey Question: Please indicate: How important were the following factors in selecting this site for recreation?	
Response	**Average rating of importance from 1 (low) to 5 (high)**
Proximity to home	4.15
Variety of recreation opportunities	3.06
No access fee required	4.45
Lack of crowding	4.21
Natural setting	4.08
Access to river	4.34
Access to whitewater boating areas	1.65
Onsite restroom facilities	2.93
Availability of picnic sites	2.6
Pets permitted	2.39
Clean/well maintained facilities	3.56
Feeling of safety	3.91
Handicapped access	2.77
Other	"Snow plowed roads," "Good fishing."

Survey Question: If you are participating in whitewater boating during your visit, please indicate: Where did you put in and take out?		
	Percentage	**n**
Location	**Put In Location**	**Take Out Location**
Weber Recreation Site (here)		
Pulled over on side of I-84 near the Horseshoe Bend		
Davis-Weber Irrigation Company dam (2 miles downstream from here)		
Other:		
N/A	100%	47
Total	**100%**	**47**

Opinion of Facilities:

Survey Question: Please indicate: What is your opinion of the condition of the facilities at the recreation site?

Site Feature	Excellent	Adequate	Needs Improvement	N/A
Parking Facilities	47%	45%	6%	2%
Picnic Facilities	47%	38%	13%	2%
Restrooms	26%	49%	16%	9%
Fishing platform	28%	21%	6%	45%
Primitive trail passing under the freeway from the recreation site	15%	34%	34%	17%
Other				

Survey Question: What are the most important actions that could be taken to improve recreation at this site?

Option	Percentage	n
Additional picnic facilities	15%	7
Improved trail passing under freeway from the recreation site	36%	17
Other improved fishing access to river	38%	18
Improved boater access to river	6%	3
Improve in-river fish habitat	53%	25
Improve waste collection	36%	17
Improve access to information about river flows	30%	14
Other		

Additional Information:

Survey Question: Please provide any additional comments about recreation at this site you think are important:

Responses
Clean up old water line on old road.

Survey Question: Please provide any additional comments about recreation at this site you think are important:
Responses
Leave as is.
Leave as is.
Improve the walking path under the freeway.
Create trail from S. Weber to Mountain Green.
More picnic tables, improve paved and primitive trail, provide access at dam.
Doing a good job.
Remove most fences.
More tables, access to dam.
Fix potholes.
Remove barbed wire.
Provide access at dam, remove trash at shooting range.
Artificial lures from dam to mouth of canyon, slot limits similar to Provo and Green Rivers.
Pave trail under highway, provide access to other side of river, encourage cleaning shells at shooting area.
Dredge river above dam, add rocks/gravel for better fishing off platform, plant more brown trout.
Clean or eliminate shooting area.
Preserve access.
Keep fence. Create access to other side of river.
Clean trash at shooting area, restrict access at dam.
Fishing platform in bad location. Maybe improve fishing habitat near the platform.
Add shooting info and designated area, lower flows below dam to improve fishing.
Keep as is.
More studies about the relationship between fish and flow rates.
Paint parking lines, improve pavement at turn-in, contain trash at shooting site, improve primitive trail, install parking at horseshoe bend, improve restroom.
Improve primitive trail, remove excessive vegetation in river, improve maintenance at forebay, increase water release.
Designated shooting area or maybe don’t allow shooting.
More restrooms.
Permanent restroom.
Improve primitive trail, don’t over-improve site, keep from getting crowded.
Less rocks to crawl over on primitive trail.

Survey Question: Please provide any additional comments about recreation at this site you think are important:
Responses
Please don’t change anything.
Permanent bathroom, remove weeds from water, better trail with more rocks.

APPENDIX C

WHITEWATER RECREATION STUDY TECHNICAL REPORT

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Appendix C - Weber River Hydroelectric Project

FERC No. 1744

Whitewater Recreation Study Technical Report

Prepared for:

PacifiCorp

Salt Lake City, UT

Prepared by:

ERM-West, Inc.

Bigfork, Montana

August 2016

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List of Acronyms and Abbreviations

CFS	Cubic feet per second
FERC	Federal Energy Regulatory Commission
MW	Megawatt
NRCS	National Resource Conservation Service
NWS	National Weather Service
Project	Weber River Hydroelectric Project, FERC No. 1744
UDOT	Utah Department of Transportation
USGS	U.S. Geological Survey

1.0 INTRODUCTION

PacifiCorp's Weber River Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 1744, is a 3.85 megawatt (MW) hydroelectric project located in northern Utah. It is approximately 30 miles northeast of Salt Lake City and 9 miles southeast of Ogden, Utah, near the mouth of Weber Canyon on the Weber River. The Project was developed in the early 1900s to supply electrical generation to the newly growing communities of the Wasatch Front. The Project's current FERC license will expire on May 31, 2020. This Recreation Study was conducted as part of the Project's relicensing process, with the goal to collect and organize information about recreation use and access in the study reach, with a focus on whitewater recreation use on the 1.9-mile reach of the Weber River between the Weber diversion dam and the powerhouse, where flows are altered by Project operations.

1.1. Study Objectives

The objective of the study is to assess whitewater boating opportunities provided across a range of flow conditions based on the water available in the Weber River downstream of the Weber Hydroelectric Project diversion dam and the river access available to recreationists.

1.2. Nexus to Project

The Project reduces stream flows in the 1.9-mile study reach. The Project is subject to minimum instream flows ranging from 34 to 50 cubic feet per second (cfs), depending on the season and water yields in the Weber River watershed.

1.3. Project Area

The study reach (Figure 1-1) was chosen because it is used by boaters for whitewater recreation. Boaters refer to a 0.3-mile section in the study reach as "Horseshoe Bend" and/or "Scrambled Eggs." The study reach extends from the Weber diversion dam near the Utah Department of Transportation (UDOT) Rest Area, to the Project powerhouse and directly upstream from the Davis & Weber Counties Canal Company's (DWCCC) headgates and canal intake.

2.0 METHODS

2.1 Whitewater Boating Hydrology Analysis

The nearest U.S. Geological Survey (USGS) gage (No. 10136500) to the study reach is located at Gateway, Utah, just upstream of the Weber Project diversion dam. The Gateway gage has data available for a period of record that covers 94 years. Data from the Gateway gage was used to calculate the hydrology for the study reach.

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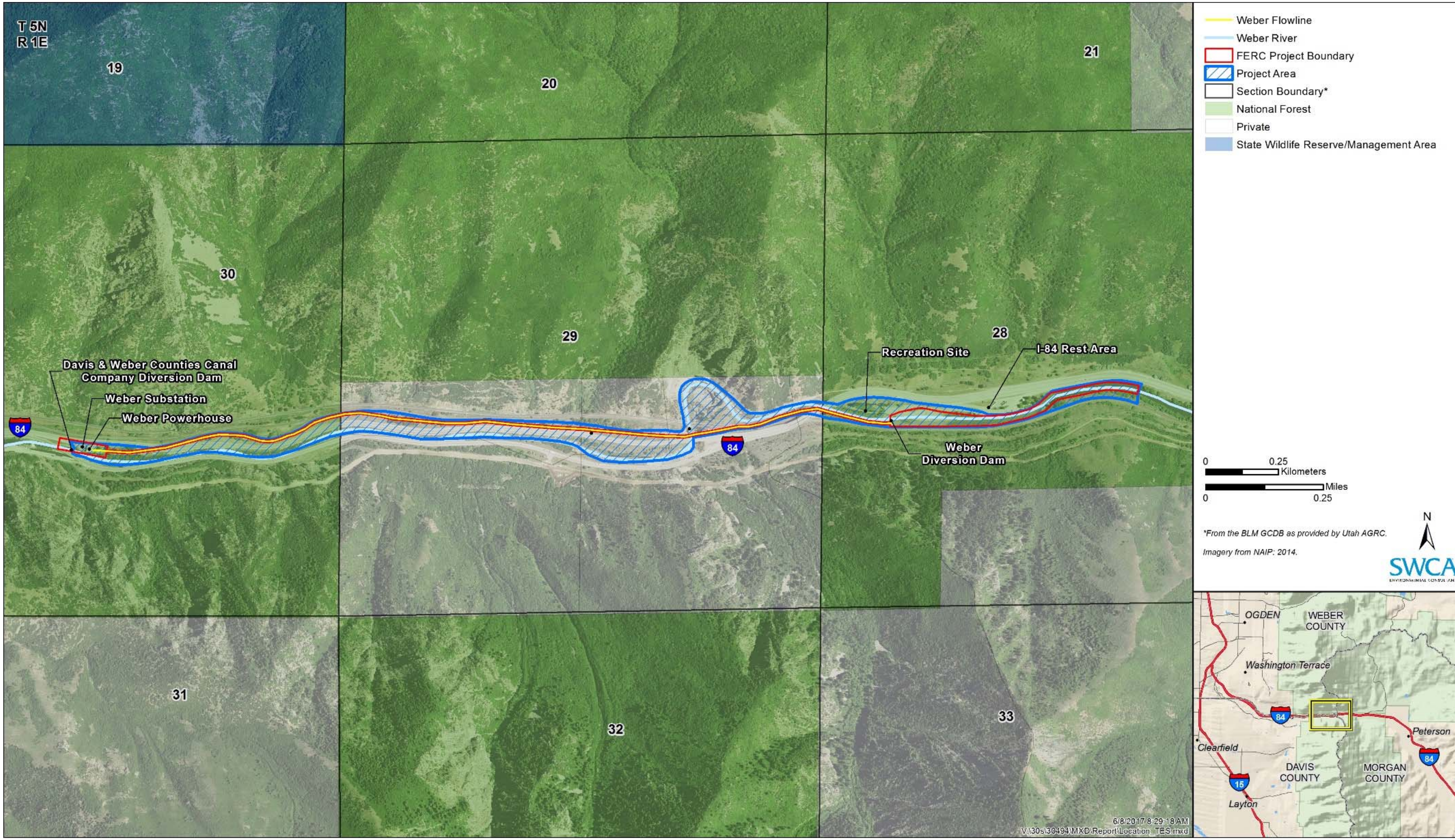

Figure 1-1: Weber River Hydroelectric Project Recreation Study Area

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Flows in the study reach downstream of the Weber diversion dam are typically approximately 300 cfs less than flows reported at the Gateway gage when the Project is operating at full capacity. The Project typically operates when flows are above approximately 100 cfs, but is not at full capacity until the river reaches approximately 350 cfs. Hydrology data for the study reach was calculated by PacifiCorp using power generation and the diversion gate flow data for the Project. For the calculations, it was assumed the entire discharge of the Weber River as measured at the Gateway gage was directed into the study reach through the two diversion gates during periods that the Project was offline. During periods of Project operation, the flow in the study reach was calculated using inflow data from the Gateway gage and data for the power flow from operation of the Project and bypass flows from operation of the diversion gates.

Example: 700 cfs @ Gateway – 300 cfs (Project) = 400 cfs bypass flow

Minimum instream flows are maintained in the study reach through the operation of the two diversion gates. Flows in excess of 350 cfs are passed over the diversion into the bypass. Minimum instream flow requirements for the Weber River and the study reach were established in the existing 1990 FERC license, "to protect and enhance the fish and wildlife resources of the Weber River." The current minimum flow requirement is for 34 to 50 cfs. The actual requirement is set annually dependent on the annual spring runoff forecast for the Weber River watershed (Table 2-1). The forecast is based on information from the National Resource Conservation Service (NRCS) and the National Weather Service (NWS), and it includes the following:

- A continuous flow of 34 cfs or all Weber River flow from October 1 – March 31, whichever is less; and
- A continuous flow of 34 to 50 cfs from April 1 to September 30, depending on the latest projected runoff forecast of the NRCS and NWS, or all Weber River flow, whichever is less.

Ramping rates are not specified in the Weber River instream flows. Because the Project is run of the river lacking ability to store increased water from upstream sources, flow in the bypass reach generally fluctuates proportionally with the river hydrograph.

Table 2-1: Minimum instream flow requirements based on runoff forecast

Runoff forecast (percent of normal runoff)	Required minimum flow (or inflow[1])
>=100 %	50 cfs
69-99 %	34.5 to 49.5 (50 cfs X % of normal)
<=68 %	34 cfs

1 inflow is defined as all Weber River flow

2.2 Whitewater Boating Needs Analysis

The whitewater opportunities in the study reach were evaluated using a three-phased approach outlined in Whittaker, Shelby, and Gangemi (2005). An initial desktop effort (Level 1) was performed to gather available information on the resource. A Level 2 field reconnaissance was performed to observe the resource first-hand and meet with whitewater boaters with previous experience and knowledge of the resource. The information gathered in the Level 1 and Level 2 efforts was analyzed to create more detailed summaries of whitewater use patterns and flow preferences in a Level 3 study effort. The Level 3 effort included deployment of an online survey questionnaire and a focus group session with whitewater boaters familiar with the study reach.

2.2.1 Level 1 Desktop Effort

The Level 1 desktop effort provided information on the whitewater opportunities in the study reach including length, access points, whitewater difficulty, rapid names, recommended navigation routes, flow range, flow information, and safety concerns (American Whitewater 2016).

2.2.2 Level 2 Field Reconnaissance

Identification and documentation of river access for whitewater recreation in the study reach occurred during the Level 2 field reconnaissance events on March 1, 2016, and May 3, 2016. Members of the Weber River Recreation Study Technical Group participated in the March 1, 2016 field reconnaissance. Site visit participants provided information on current and historic access to the river, current and historic use patterns in the study reach, and the range of flows typically boated. River access locations include areas that could be used for activities including parking as well as put-in and take-out locations for boats and equipment. Interviews with Project operators provided information on the timing of flows in the study reach, safety, and access issues.

2.3 Whitewater Boating Use and Demand Analysis

A whitewater survey questionnaire and focus group were administered to assess whitewater boating use and demand.

2.3.1 Level 3 Survey Questionnaire

The Weber River Whitewater Internet survey questionnaire design was based on accepted practices outlined in Whittaker et al. (1993) and Whittaker, Shelby, and Gangemi (2005). The survey included five sections: an introduction, background information about the participant, single-flow evaluations of the flow boated, comparisons with other flows, and recreation access preferences for the study reach. Information gathered from the Level 2 field reconnaissance was used to develop questions for the Internet survey. The draft Internet survey was presented to the Weber River Recreation Technical Group for review and comment. Comments were incorporated into the final survey. A copy of the Internet survey questionnaire is included in Whitewater Report Appendix A.

The survey was posted using Survey Monkey on March 24, 2016, and remained online 102 days through July 4, 2016. Participation was solicited electronically by advertising on PacifiCorp's Project website and forwarding the survey link to members of the boating community along the Wasatch front including individuals representing American Whitewater in the relicense proceeding.

Survey Monkey link: https://www.surveymonkey.com/r/XGKSCHD

PacifiCorp link: http://www.pacificorp.com/es/hydro/hl/weber.html#

2.3.2 Level 3 Focus Group

Survey participants were invited to participate in a focus group session after completing the Internet survey. Contact information was requested for participants interested in attending the upcoming focus group meetings. Individuals that expressed interest via the Internet survey received an email invitation in April 2016 with a reminder and information about the focus group session (Whitewater Report Appendix B). The invitation requested individuals interested in the focus group session register/RSVP for planning purposes.

The focus group session was facilitated by a river professional with direct experience conducting whitewater recreation studies. Background surveys were distributed to focus group participants to collect demographic, residence, and whitewater experience information that could be used for analysis of the data. The facilitator explained the focus group objectives and format to the participants. Next, facilitators reviewed the study reach, described the FERC relicensing process overview and Recreation Study, identified the Project infrastructure, and provided overviews of the watershed, flow regulation and the influence of additional projects on the seasonal hydrograph for the Weber River. The focus group discussion topics were organized into six categories: flow information, parking and river access (current and historic), rapid names and whitewater difficulty, flow preferences (minimum acceptable and optimum), whitewater use patterns, and comparisons with other local whitewater resources. Photographs collected during the Level 2 field reconnaissance along with maps of the study reach were used in the focus group session to generate discussion on specific rapids, whitewater difficulty as well as historic and current river access.

Notes from focus group participants are included in Whitewater Report Appendix C and included throughout the results.

2.3.3 Flow Preferences

The Internet survey prompted participants to rate eight flows in the study reach in 100 cfs increments from 200 cfs to 1,000 cfs using a 5-point acceptability rating scale. A whitewater flow preference curve (flow preference curve) was plotted for whitewater recreation in the study reach using the 5-point acceptability rating scale. Mean values from the Internet survey were plotted using the acceptability rating scale on the y-axis to develop flow preference curves. Mean flow values equal to 3 (marginal) on the flow preference curve were defined as minimum acceptable. Mean flow values greater than 3 were considered acceptable for the participants. For this study, and consistent with Whittaker et al. (1993), the optimum recreational flows include the range of flows beginning at the point in which the curve begins to flatten out and terminates at the point where there is a sharp decline in respondent acceptability ratings. The results of the flow preference curve and analysis for the study reach are described in Section 3.5.

Focus group participants were questioned on their flow preferences for the study reach in the May 3, 2016, focus group session. Participant responses were captured in meeting notes and synthesized in table format for minimum acceptable and optimum flows.

Focus group participants preferred discussing flows based on the Gateway gage rather than the flows present in the study reach because study reach flows must be calculated. For the data analysis in the results section, flow preferences from focus group participants have been calculated to the flows present in the study reach by subtracting out ~300 cfs. This allowed for comparison with the results from the Internet survey.

3.0 RESULTS

This section describes the whitewater recreation resource and access in the Project study reach using information and data gathered in the Level 1, 2, and 3 study efforts.

3.1 Whitewater Boating Hydrology Analysis

PacifiCorp analyzed the 94-year hydrologic record at the USGS Gateway gage in the Pre-Application Document as the Water Resources Final Study Plan. The analysis evaluated changes to the hydrology of the study reach over time due to the construction of new water storage and diversion projects upstream of the Project. These additional water storage and diversion projects have resulted in reductions to the mean daily flows in the study reach (Figure 3-1). The largest reduction occurred after the Echo Hydroelectric Project was completed in 1931.

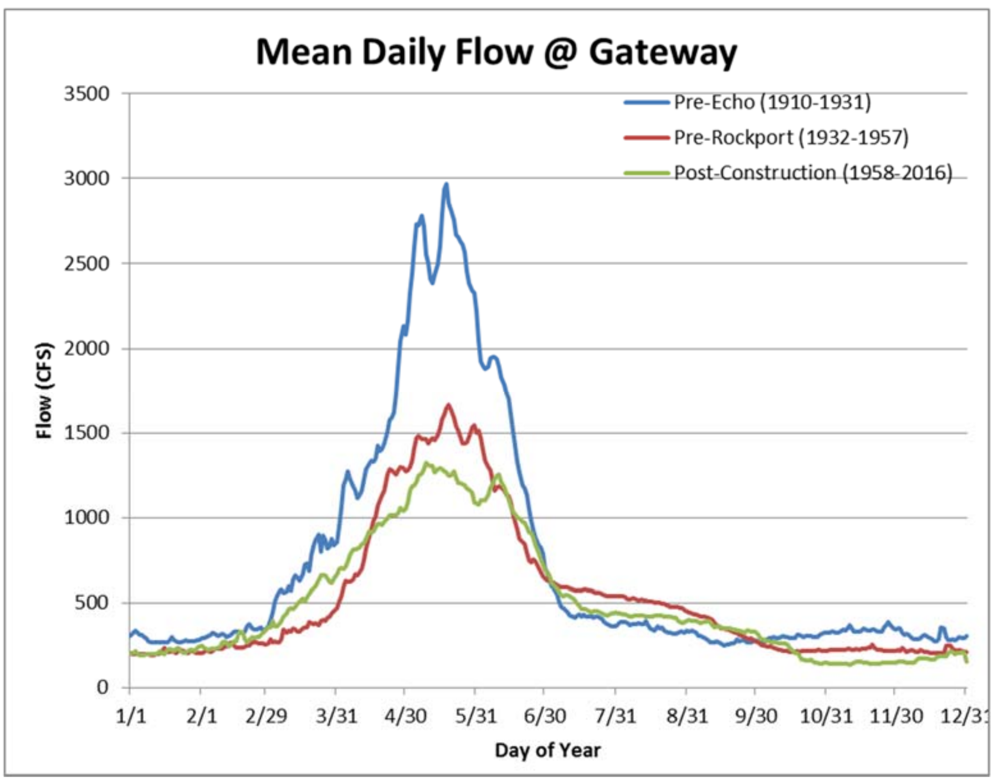

Figure 3-1: Mean Daily Flows at the Gateway gage No. 10136500 (PacifiCorp Final Study Plan Water Resources, 2016)

Due to low inflows, the Project is typically offline in the winter months. During the non-operational periods all flows at Gateway gage pass through the Weber diversion dam and into the study reach. In 2015 and 2016, data from the Gateway gage indicate that no boating opportunities occurred in 2015 and 2016 when the Project was offline (Table 3-1). Minimum acceptable flows in the study reach are discussed in Section 3.2.4. The calculated minimum acceptable boating flow of 450 cfs in the study reach (or 750 cfs on the Gateway gage during Project operations) is shown as a red line on Figure 3-2 for reference.

Table 3-1. Number of Days with Boating Opportunities 2015-2016 in Project Study Reach

Project operations	Number of days		Flow at Gateway Gage	Number of days	
	2015	2016 (thru Sept 30)		2015	2016 (thru Sept 30)
Project Offline	189	57	> 450 cfs	0	0
Project Operating	176	217	450 - 750 cfs	13	26
Project Operating			> 750 cfs	1	2

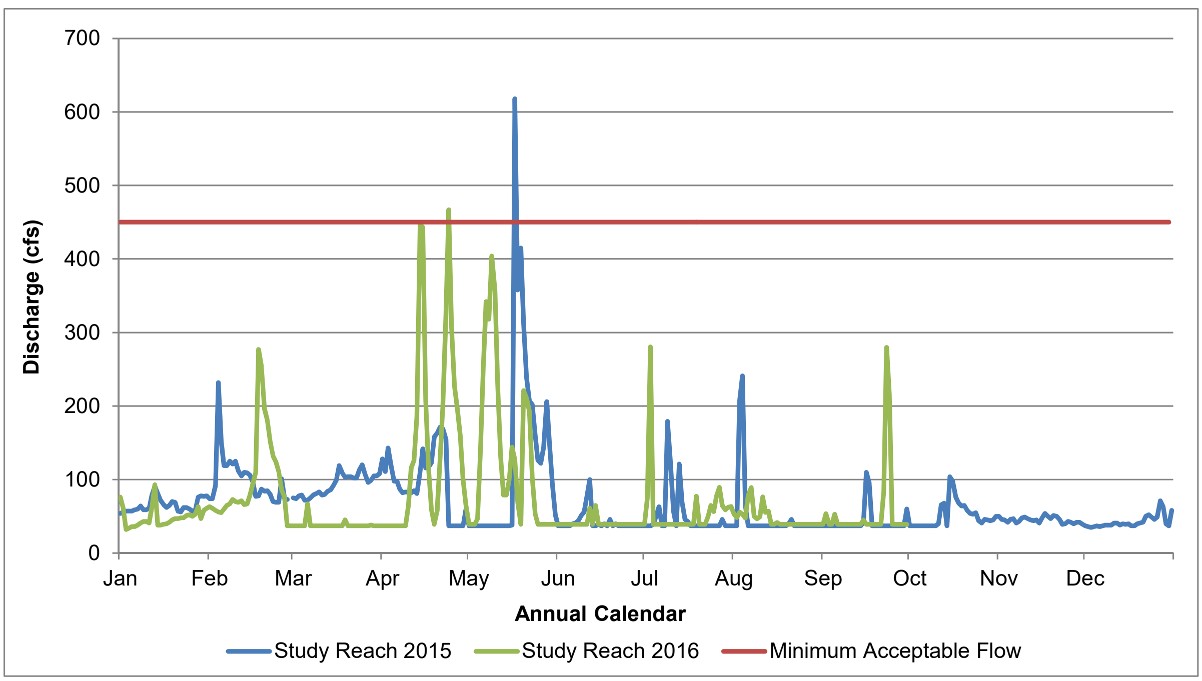

Figure 3-2: Mean Daily Flows in the Project Study Reach in 2015 and 2016

Operation of the Project in 2015 started in late March and continued until mid-October, when the forebay was drained and the radial gates were opened to the total flow of the river. The Project operated for a total of 176 days during 2015. The average flow in the study reach during operation of the Project was 61 cfs, with a minimum flow of 37 cfs, and a maximum of 618 cfs, which occurred on May 17, 2015. The minimum flow of 37 cfs in the study reach occurred during approximately 122 of the 176 days that the Project was operating.

In 2016, operation of the Project started in late February and continued until the end of September (end of the period covered by this report; as of November 9, 2016 the Project is still operating, although at very low generation levels). Between February 26, 2016 and September 30, 2016, the Project operated for a total of 217 days. The average flow in the study reach during operation of the Project in this period was 72 cfs, with minimum flows of 37 cfs (up to April 13, 2016) and 39 cfs (starting April 14, 2016), and a maximum of 467 cfs that occurred on April 24, 2016. Three hydrologic peaks of 400 cfs or greater occurred in the spring of 2016 (April 14-15, April 24, and May 9, 2016). The minimum flows in the study reach occurred during approximately 139 of the 217 days that the Project was operating.

During periods of Project operation, flows greater than 750 cfs are necessary at Gateway gage for a whitewater opportunity in the study reach. Mean daily flow at Gateway gage during operation of the Project was greater than 750 cfs on a single day in 2015 and 2 days in 2016.

Flows at Gateway gage between 450 and 750 cfs during Project operation result in a flow in the study reach less than the minimum acceptable flow for whitewater boating. The number of days when mean daily flows were between 450 and 750 cfs at Gateway gage during operation of the Project was 13 in 2015 and 26 in 2016. Over the total 94-year period of record, days with acceptable flows for whitewater boating generally occurred in April and May.

3.2 Whitewater Boating Use, Demand, and Needs Analysis

Information on whitewater use patterns, flow preferences and access was gathered through site visits, boater interviews, the Internet survey and a focus group session. The following section describes the results from these data collection efforts.

3.2.1 Internet Survey and Focus Group Participation

The Internet survey was launched on March 24, 2016, and closed on July 4, 2016. A total of 62 individuals responded to the internet survey with nine incomplete surveys removed from the overall analysis due to incomplete survey responses. An additional 8 surveys were included in the analysis of the background information, but were excluded from the flow analysis due to a lack of responses for flow-related questions. A total of 45 responses were used in the flow analysis for this study. Survey respondents were encouraged to report the results of historic trips on the Horseshoe Bend reach as well as more recent trips. The earliest date for trips reported was November 26, 1976. The range of flows listed for trip reports ranged from 241 cfs to 4,300 cfs, as measured at the Gateway gage.

PacifiCorp hosted a whitewater focus group for the Project on May 3, 2016, from 7:00 PM to 10:00 PM in Ogden, UT. A total of 30 invitations were delivered and 15 individuals registered for the focus session, all of whom participated. A complete list of focus group participants is provided in Appendix D.

Section 1 of the Internet survey gathered background information on the survey respondent. This information was used to characterize the pool of survey respondents using the Project study reach. Similarly, focus group participants were asked to complete the same background questions at the start of the focus group session. This allowed PacifiCorp to compare the pool of participants for the Internet survey group and focus group.

The participants in the Internet survey and the focus group had a similar age distribution (Figure 3-3). Participant age ranged from 20 to 69 years with the majority of the participants in the age category of 30 to 39 years for both groups. The next largest age category for the Internet survey was 20 to 29 years old, followed by 60 to 69 years (Figure 3-3). The age range for focus group participants was more evenly distributed compared to the Internet survey. Internet survey and focus group participants were predominately male (Figure 3-4). The whitewater skill level for focus group and Internet survey participants included individuals with intermediate, advanced, and expert skills (Figure 3-5). The majority of participants in both groups self-identified as having advanced whitewater skills. The number of years of whitewater paddling for the Internet survey group ranged from 4 to 40 years with an average of 16 years paddling. The focus group years of paddling ranged from 5 to 40 with an average of 19 years. Hardshell kayaks were the predominant watercraft used in the study reach by focus group and Internet survey participants although a small number of participants indicated use of raft, paddle raft, inflatable kayak, and open-canoe (Figure 3-6).

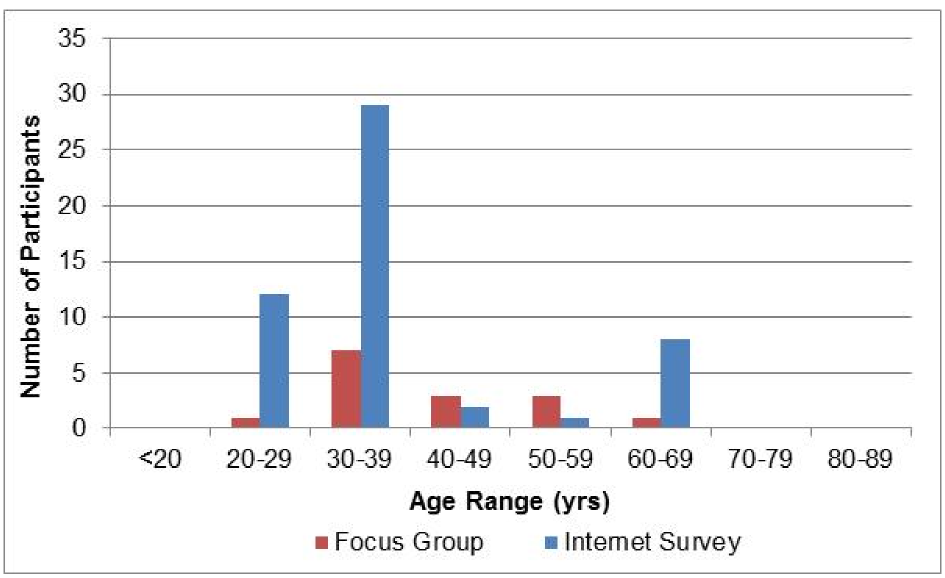

Figure 3-3: Age Distribution for Focus Group and Internet Survey Participants

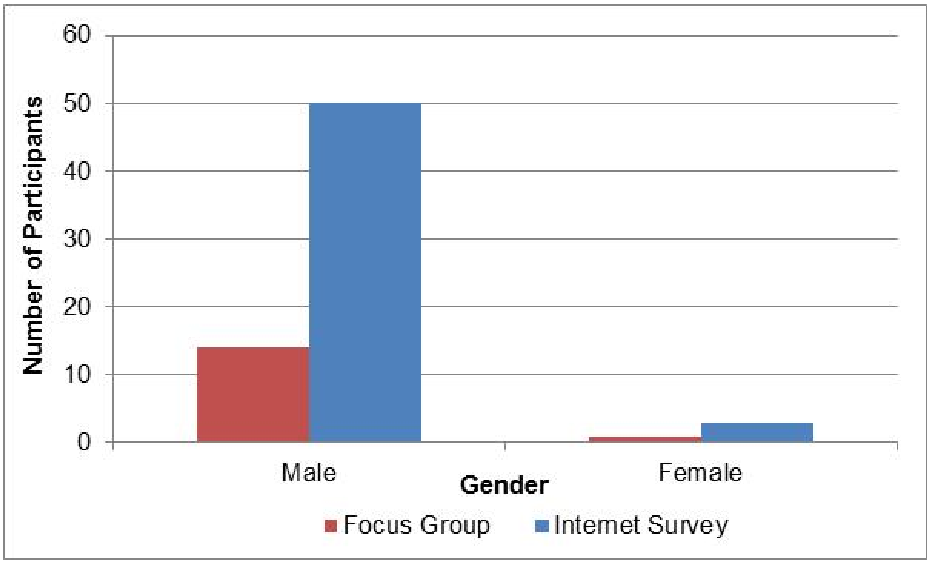

Figure 3-4: Gender of Focus Group and Internet Survey Participants

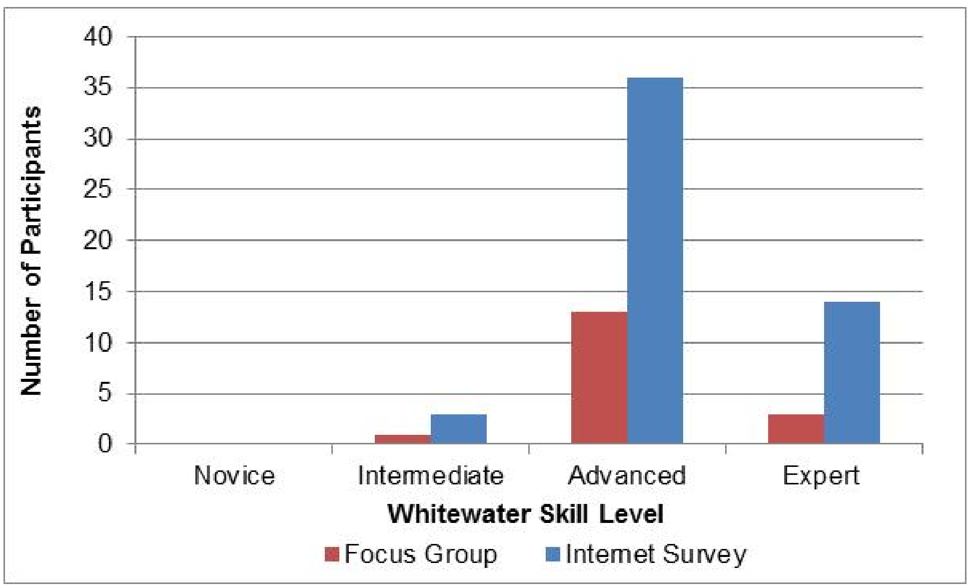

Figure 3-5: Whitewater Skill Level for Focus Group and Internet Survey Participants

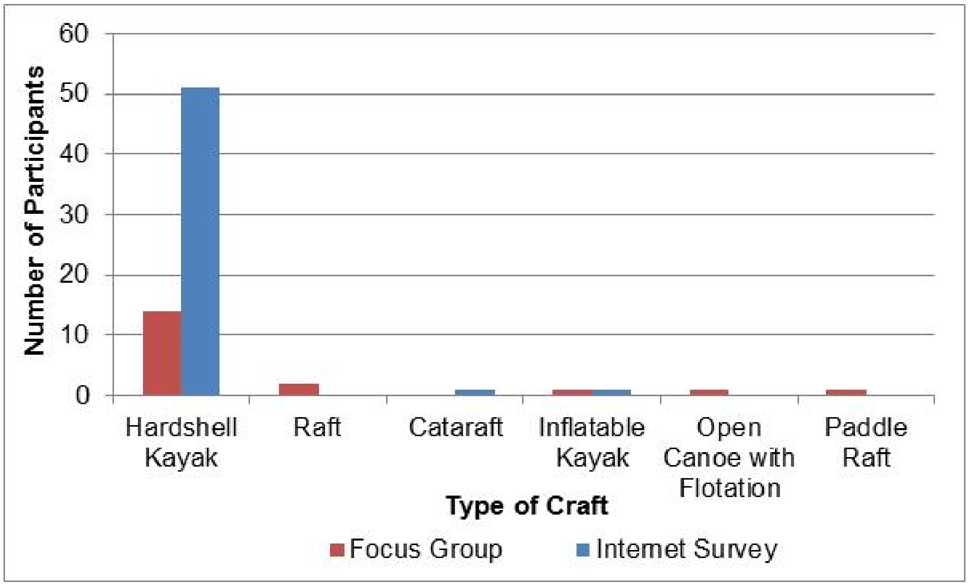

Figure 3-6: Type of Craft used by Focus Group and Internet Survey Participants in the Study Reach

3.2.2 Whitewater Rapids

The overall length of the study reach is approximately 1.9 miles. The whitewater boating community refers to the study reach as Horseshoe Bend and/or Scrambled Eggs, names which also specifically refer to a short (0.3 mile) section of continuous whitewater within the overall study reach that is the primary attraction (Figure 3-7). Within the study reach, the boating community has names for the more prominent rapids as well as the whitewater difficulty of the individual rapids (Table 3.2).

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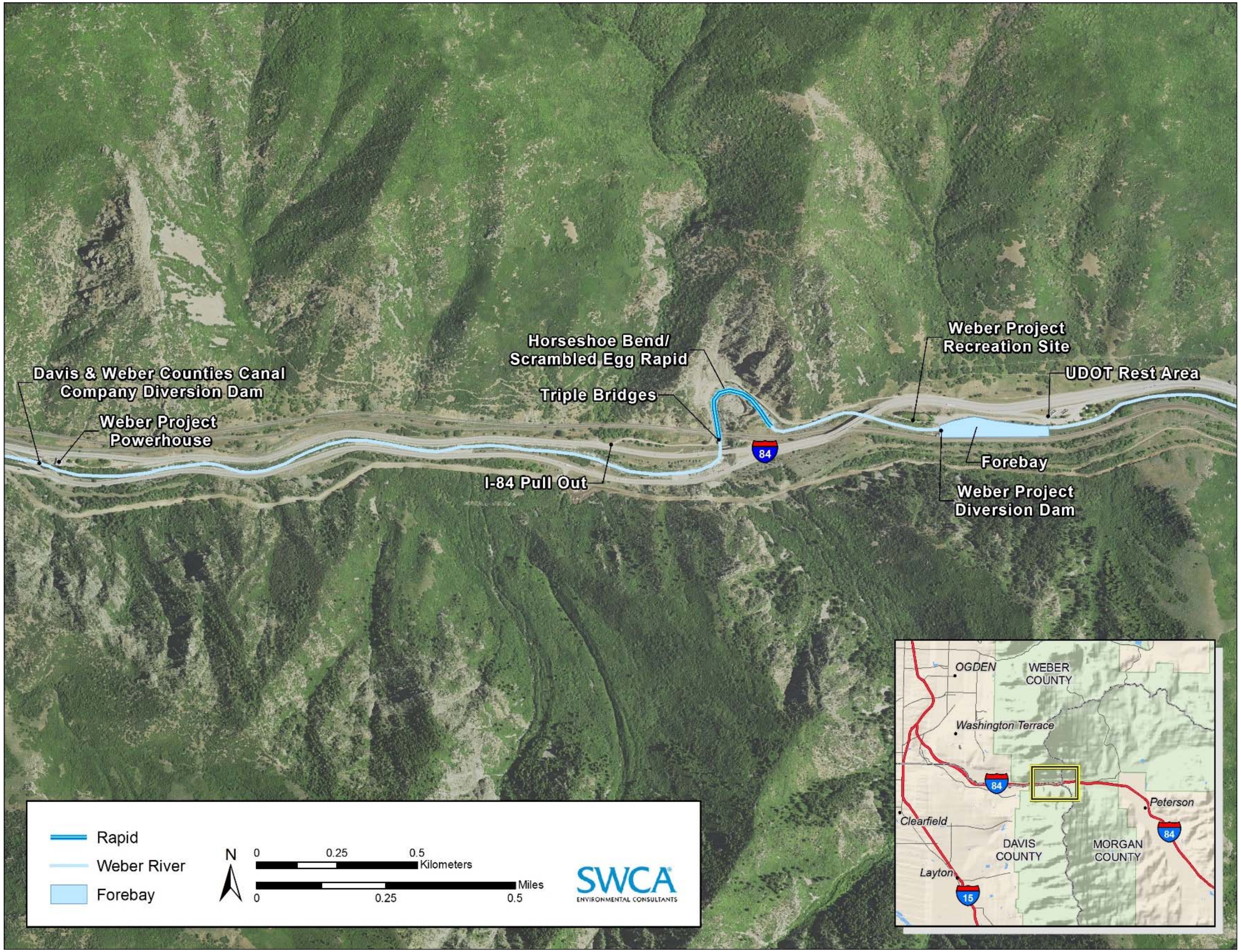

Figure 3-7: Location of Whitewater Rapids within the Project Study Reach

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Table 3-2: Whitewater Rapids in the Study Reach

Area	Project Study Reach	Length (miles)	Rapid Names	Focus Group Rating of WW Difficulty[1]
"Pipe" Area	Section of Weber River between Highway 84 Bridge to top of Horseshoe Bend rapid	0.25	Boogey Water	II
Horseshoe Bend (aka Scrambled Eggs)	Section of Weber River from the top of the bend to the railroad bridge	0.25	Upper Section	III (III+ >700 cfs)
			The Bend	IV (IV+ to V >2000 cfs)
			Bottom Section	III to IV
Triple Drop	Section of Weber River from the railroad bridge	0.1	Ledge 1	IV (III 200 cfs)
			Ledge 2	IV (III 200 cfs)
			Ledge 3	IV (III 200 cfs)
Hell or High Water	Section between Triple Drop and Weber Powerhouse	1.2	No Defined Rapids	III (IV- >1500 cfs)
Weber-Davis Irrigation Dam to Canyon Mouth[2]	Section between Irrigation Dam and South Weber Drive Take-out	0.75	No Defined Rapids	II (IV Portage)

[1] International Scale of Whitewater Difficulty

[2] Downstream and technically outside of Project study area

Horseshoe Bend itself is described as three sections: Upper Section (Photo 3-1), the Bend (Photo 3-2) and Bottom Section (Photo 3-3). Triple drop (Photo 3-4) consists of three ledge drops in quick succession: Ledge 1, Ledge 2 (Photo 3-5) and Ledge 3. Boaters refer to the 1.2-mile section below Triple Drop to the Weber Powerhouse as "Hell or High Water" (Photo 3-6) but do not have specific rapid names within that section of the river. Focus group participants commented that this section can have fun Class IV- play water at flows greater than 1,500 cfs. At flow levels less than 1,500 cfs, focus group participants commented that this section is less appealing. In fact, prior to the access restrictions on I-84, most boaters did not paddle below Triple Drop. Similarly, most boaters formerly avoided the 0.25 mile section upstream of Horseshoe Bend, electing instead to put-in at the start of the rapid.

Photo 3-1: Upper Section on Horseshoe Bend Rapid at ~40 cfs May 4, 2016

Photo 3-2: "The Bend" in Horseshoe Bend at ~2500 cfs

Photo 3-3: Lower Section on Horseshoe Bend Rapid at ~40 cfs May 03, 2016

Photo 3-4: Triple Drop Rapid at ~40 cfs May 03, 2016

Photo 3-5: "Ledge 2" in Triple Drop at 1,800 cfs

Photo 3-6: "Hell or Highwater" section at ~40 cfs May 03, 2016

The majority of Internet survey respondents rated the whitewater difficulty for the Project reach of the Weber River as Class IV whitewater (Figure 3-8). Focus group participants provided more detailed ratings of the whitewater difficulty for the individual rapids across a range of flows. As expected, considerable discussion ensued among the focus group participants regarding the whitewater difficulty for individual rapids at various flows. Individuals more familiar with the reach and with higher skill levels tended to rate the whitewater difficulty lower compared to individuals with less experience. In the end, the focus group participants agreed that the overall rating for the study reach is Class IV, reflecting the difficulty in Horseshoe Bend and Triple Drop rapids.

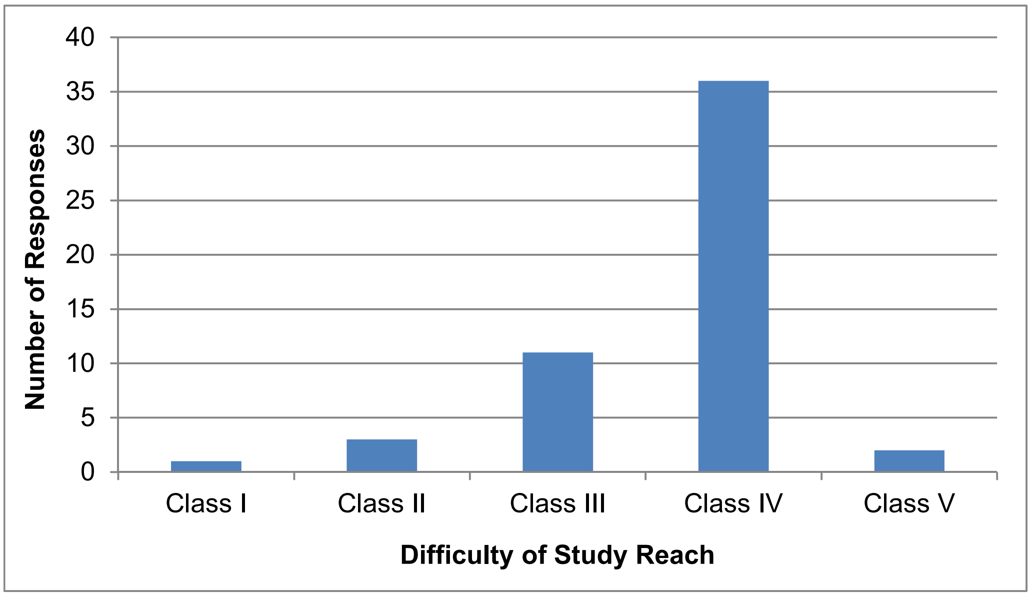

Figure 3-8: Study Reach Whitewater Difficulty Based on Internet Survey Responses

3.2.3 Whitewater Use Patterns

Whitewater boating in the study reach typically occurs during the spring months, corresponding with the melting of the lower elevation snowpack. Boaters take advantage of flows in the Horseshoe Bend section when discharge at the USGS Gateway gage exceeds the Weber diversion dam capacity. In 2015, trips from Internet survey participants occurred in the study reach from March through September with the majority of the trips occurring in May and June. In 2016, the majority of the trips reported occurred in April with a single trip reported for late June. There are no commercial outfitters operating on this reach; none are expected to operate in the future due to the narrow river channel not suitable for rafts, unpredictable pattern of flows suitable for whitewater and challenges with access.

In general, whitewater boaters indicated they made fewer than five trips to the study reach during the previous 12 months (Figure 3-9). In fact, 15 participants indicated they had not paddled the study reach in the previous 12 months, whereas 24 respondents indicated 1 – 5 trips in the previous 12 months. Two participants indicated making 6 – 10 trips or 11 – 20 trips respectively during the past 12 months. No participants reported making more than 20 trips during the past 12 months.

When asked the total number of trips they have made to the study reach for whitewater recreation, the largest number of Internet survey participants (n=17) indicated 1 – 5 trips total to the study reach, followed by 12 participants indicating 11 – 20 total trips, and 11 participants indicating more than 20 total trips.

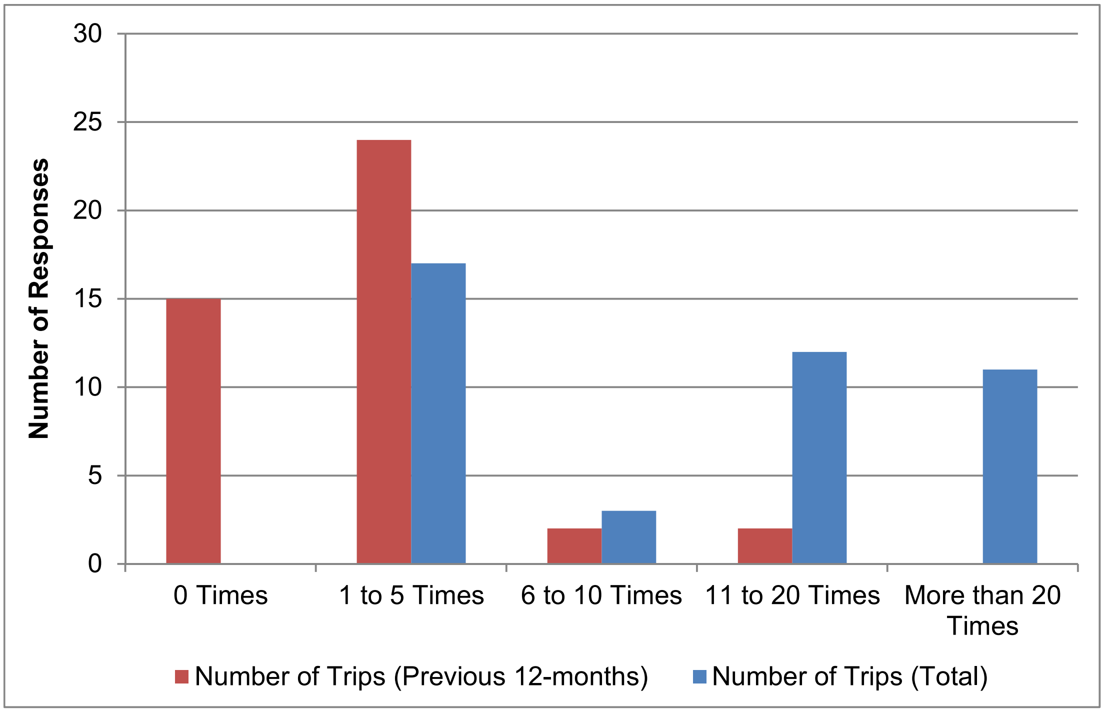

Figure 3-9: Number of Trips to the Study Reach by Internet Survey Participants

Internet survey participants indicate they spend 1 to 2 hours paddling during a typical trip to the study reach (Figure 3-10). Less than ten participants indicated 2 to 4 hours of paddling time and no responses were given to indicate a full day of paddling time. Approximately half of the survey respondents completed a single lap per trip to the study reach while the remainder of the respondents completed multiple laps. Of the 20 Internet survey participants that completed multiple runs, 11 completed two laps, 6 completed three laps, and 1 participant each completed four, five, and six laps (Figure 3-11). Focus group participants traveling longer distances commented they typically complete multiple laps in a single trip compared to boaters from the nearby community of Ogden. Weekends and weekdays after work hours (typically 5 PM) were preferred for trips to the study reach (Figure 3-12). Focus group participants indicated the timing of trips was largely dependent on the flow conditions and further commented that boaters need to be opportunistic in a dry state like Utah. In fact, some focus group participants indicated they would skip work to boat Horseshoe Bend during optimum flow conditions because it occurred infrequently. The number of trips per year is dependent on the availability of flows.

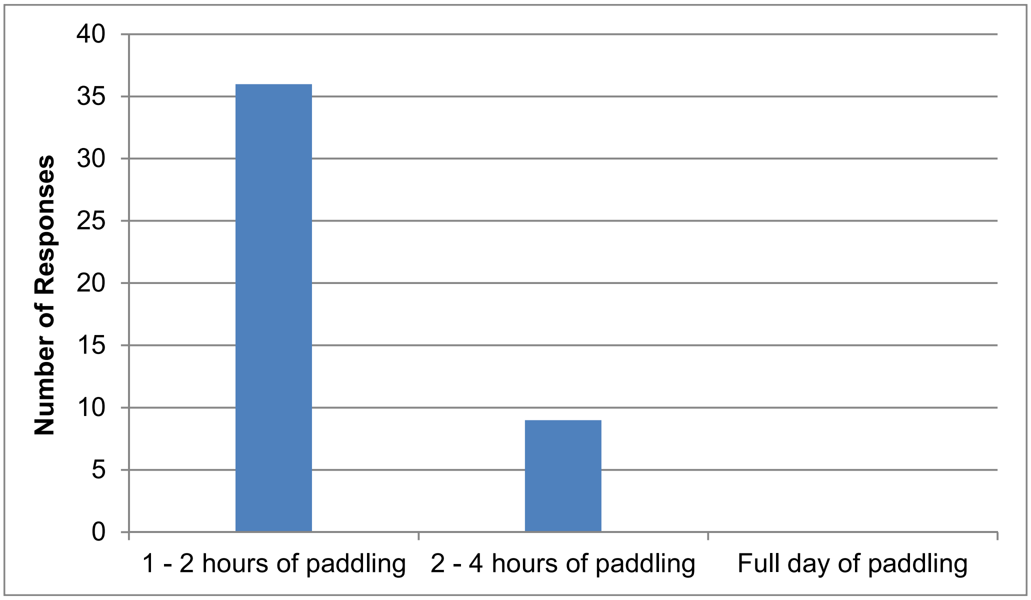

Figure 3-10: Amount of Time Spent Paddling during a Typical Trip through the Study Reach

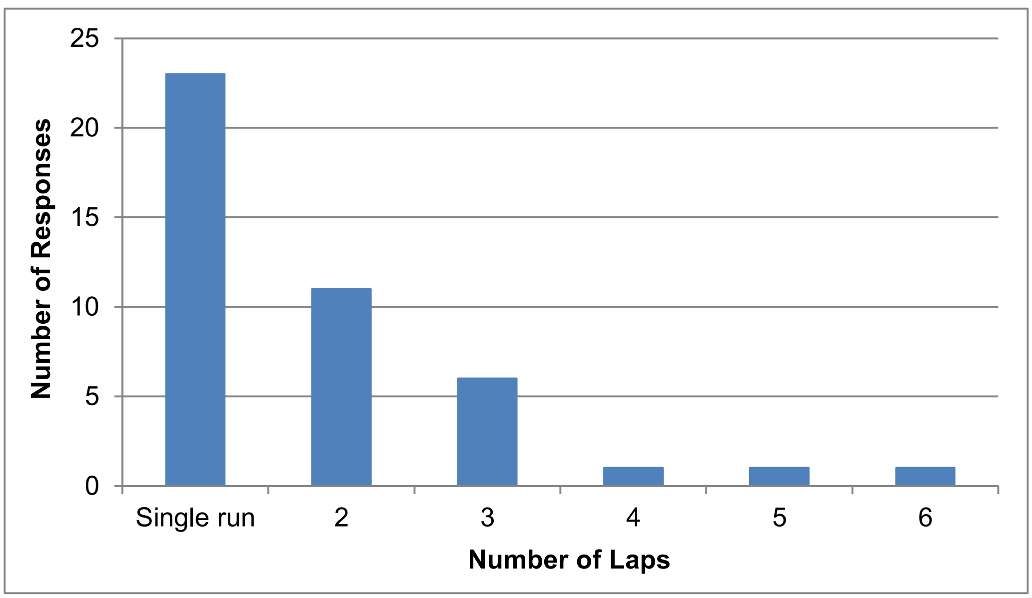

Figure 3-11: Number of Laps during the Reported Trip to the Study Reach

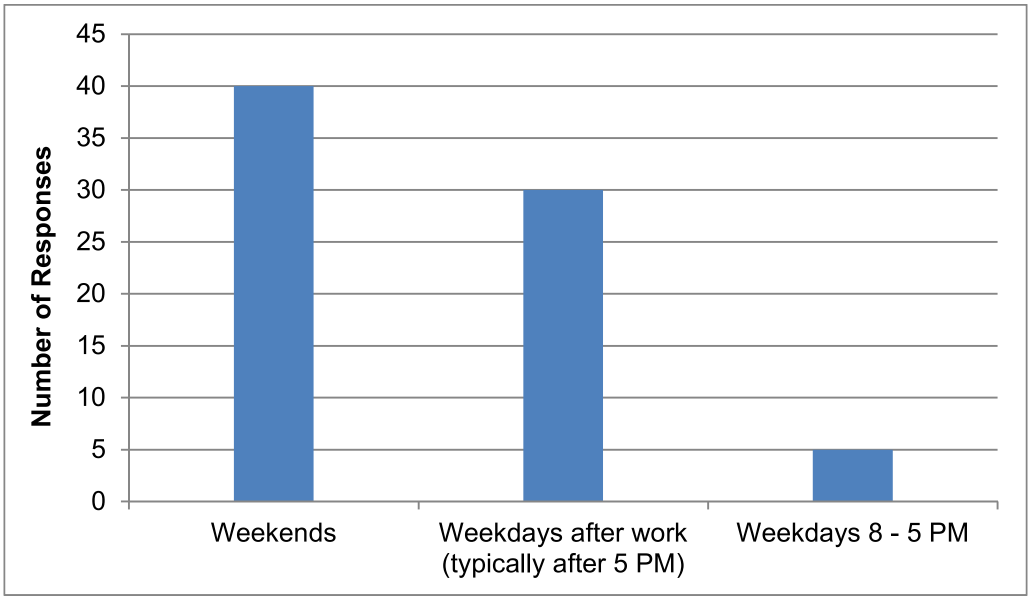

Figure 3-12: Timing of a Typical Whitewater Recreation Trip to the Study Reach

Internet survey participants were asked to rate the quality of the study reach for the following whitewater characteristics: technical boating, whitewater play, powerful hydraulics, and length. Overall, participants rated the study reach as moderately to totally acceptable for technical boating and powerful hydraulics (Figure 3-13). In contrast, this same group rated the reach as unacceptable to marginal for whitewater play and marginal for the length of the run.

Internet survey participants compared the study reach to local, state, and regional whitewater rivers using a five-point rating scale ranging from worse than average to among the very best. The whitewater resources used in the comparison included the Weber River play park, rivers within a one-hour drive, other rivers in Utah/Idaho/Wyoming, and other rivers in the United States. For each comparison, the majority of survey respondents rated the Project study reach worse than average relative to the other whitewater recreation resource comparisons (Figure 3-14). Four survey respondents identified the study reach as among the very best within a 1-hour drive. In general, the unfavorable rating of the Project study reach increased as the geographic radius of the comparison expanded (i.e., other rivers in Utah/Idaho/Wyoming and other rivers in the United States).

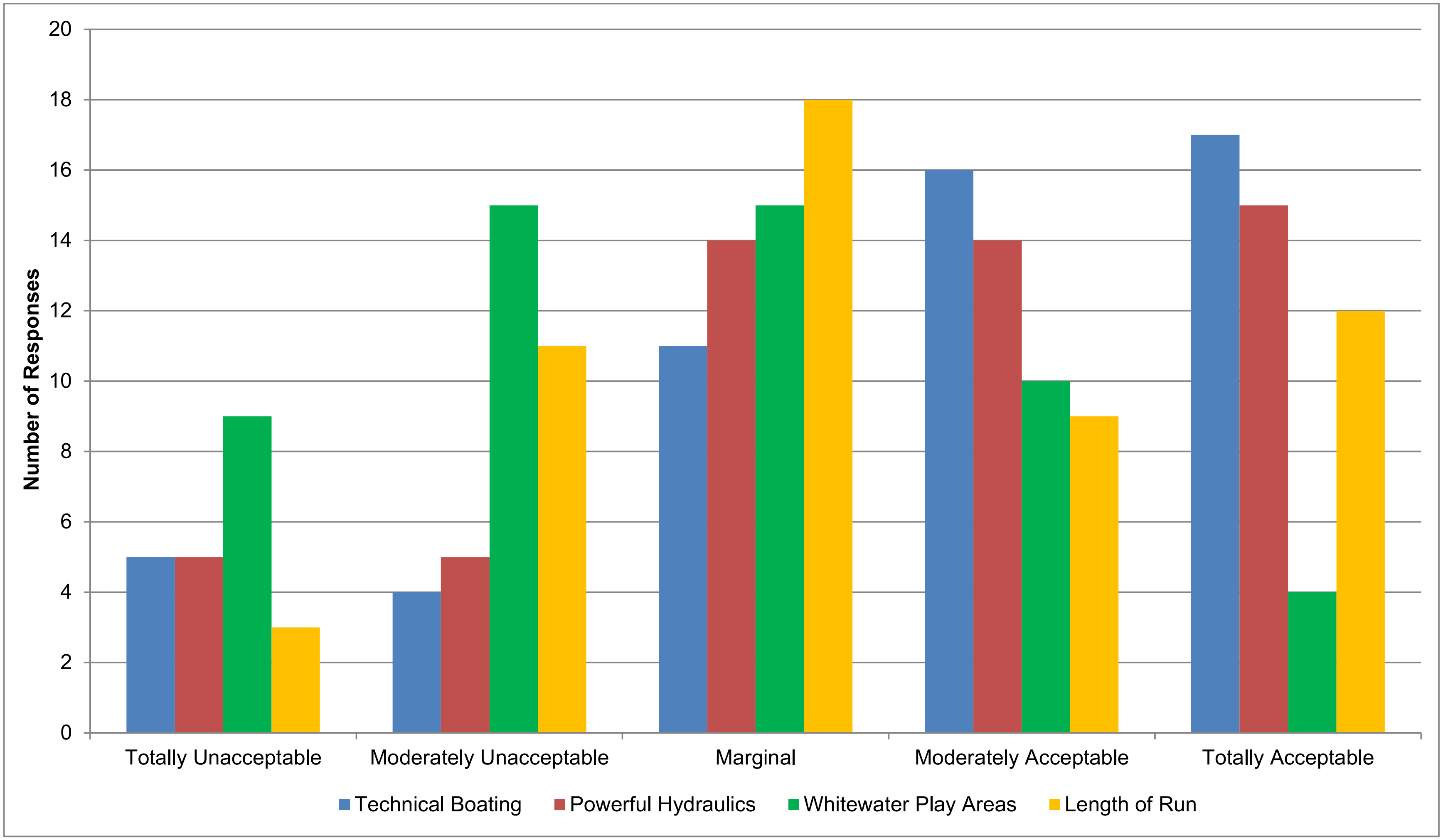

Figure 3-13: Internet Survey Acceptability Rating for Whitewater Features for the Study Reach

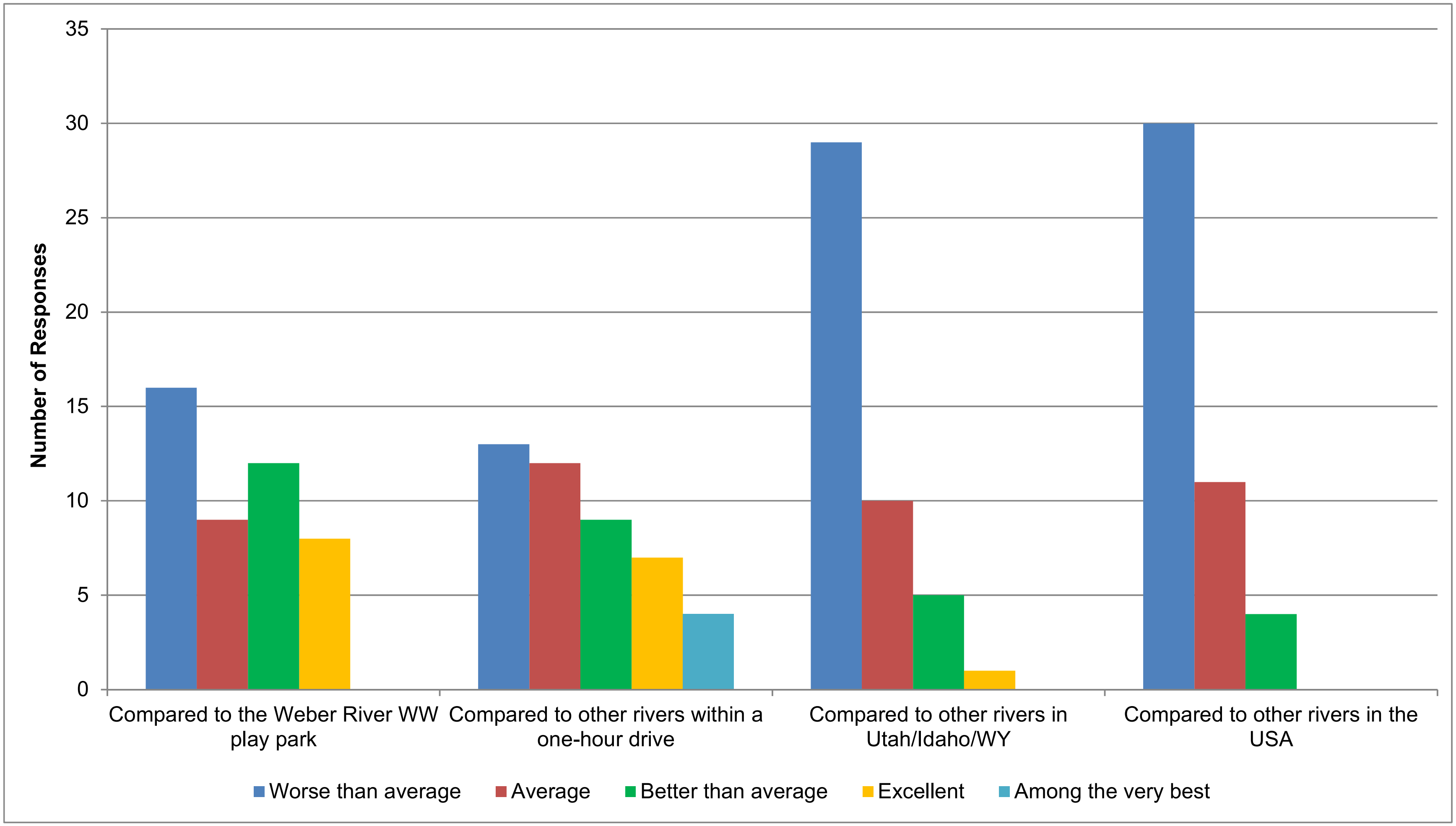

Figure 3-14: Internet Survey Comparison of the Study Reach with Local, Regional, and National Opportunities

3.2.4 Whitewater Flow Preferences

Focus group participants provided information on flow preferences during the May 3, 2016 session. Boaters indicated they rely on the USGS Gateway gage located directly upstream of the Weber diversion dam for real-time flow information. The Gateway gage serves as a reference point since the boaters were not knowledgeable of PacifiCorp's diversion capacity. During the focus group, boaters provided their flow preferences based on the Gateway gage flows. Those numbers have been adjusted to reflect flows in the study reach for comparison with flow recommendations provided by the Internet survey participants.

Section 4 in the Internet survey allowed participants to rate a range of flows from 200 to 1,000 cfs in the study reach. This comparative flow rating was used to develop flow preference curves for the Internet survey participants. The minimum acceptable flow was just under 450 cfs for the Internet survey participant mean responses. The optimum flow range was 600 to 1,000 cfs (Figure 3-15). Participants rated 900 cfs as the most acceptable flow between 200 and 1,000 cfs. The minimum acceptable flow identified in the flow preference curve is consistent with the written response average to Question 17 requesting participants identify their minimum acceptable flow (Table 3-3). Similarly, the optimum flow identified in the flow preference curve was consistent with the written responses average to Question 18 requesting participants identify their optimum flow. Internet survey participants were largely in agreement that flows less than 400 cfs were unacceptable, but as flows increased above 400 cfs the acceptability ratings varied more broadly (Figure 3-16).

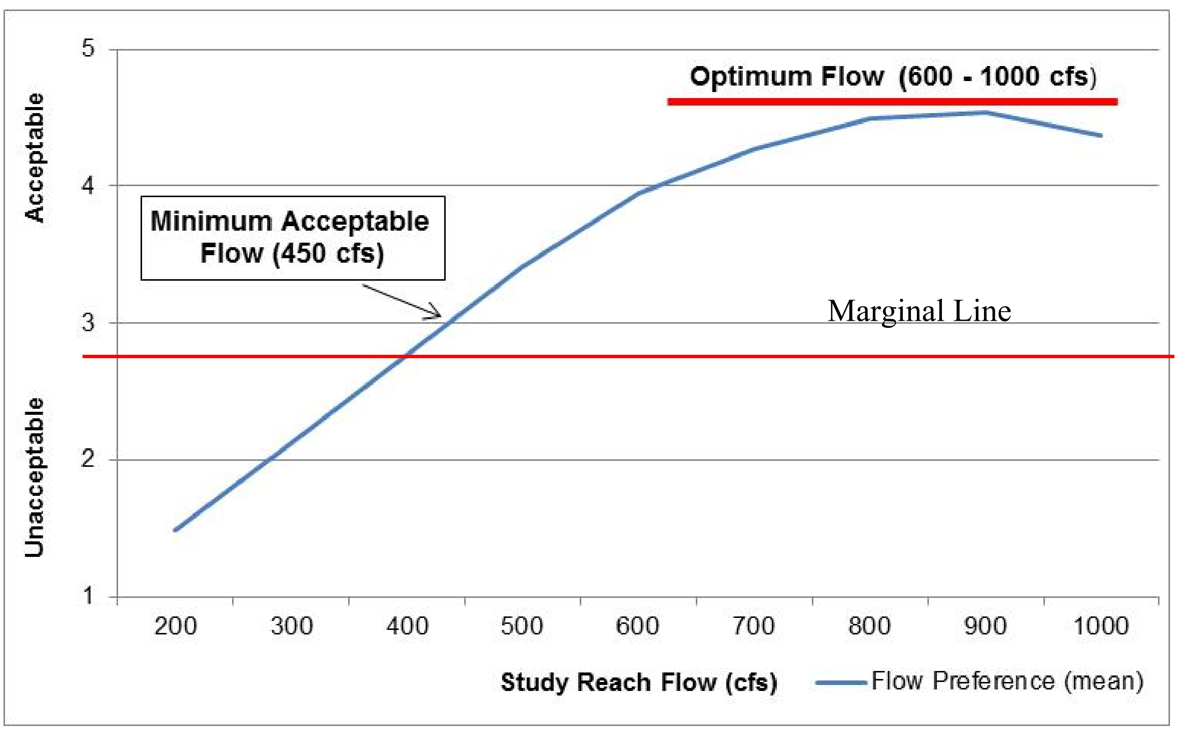

Figure 3-15: Flow Preference Curve Identifying Minimum Acceptable and Optimum Flow for Internet Survey Participants

Table 3-3: Mean Value for Minimum Acceptable and Optimum Flow Written in for the Internet Survey Participants

Minimum Acceptable Flow (cfs)	456
Optimum Flow (cfs)	950

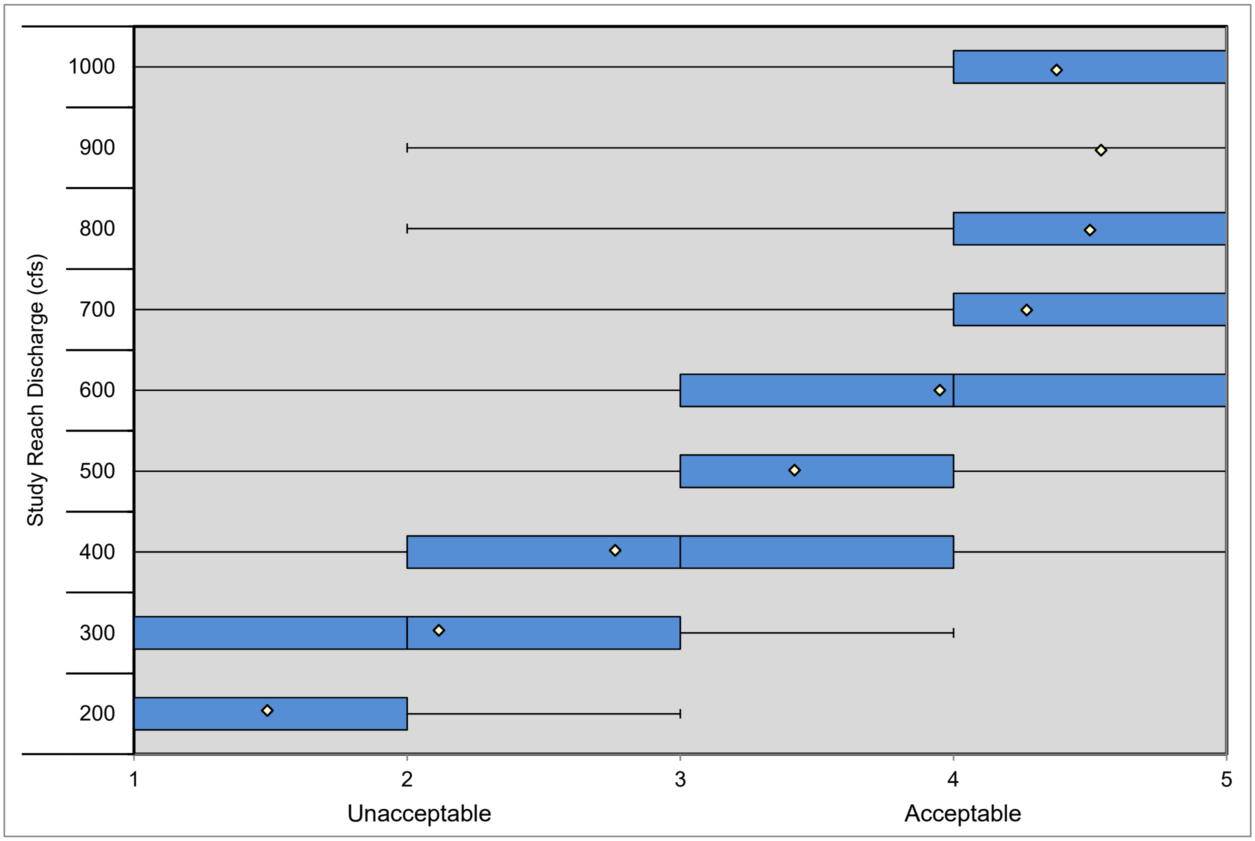

Figure 3-16: Box and Whisker Plot of Flow Comparison Ratings from Internet Survey Participants (◊ Mean Value)

Focus group participants indicated that flow preferences for the Horseshoe Bend reach are influenced by travel distance, competing boating opportunities, and access. Boaters with shorter travel distances (e.g., from Ogden), typically have a lower flow preference than boaters traveling longer distances from locations such as Salt Lake City. The minimum acceptable flow ranged from 300 to 700 cfs in the bypass with the latter flow identified by boaters with longer driving distance. Optimum flows ranged from 700 to 1,200 cfs, again with the latter flow preferred by individuals traveling from further away. In below-normal precipitation years, flow preference thresholds for minimum acceptable and optimum flows decrease reflecting the limited opportunities available, and more than one focus group participant commented that Utah boaters cannot be too picky. Conversely, when other whitewater opportunities are available in the area, boaters prefer higher flows in Horseshoe Bend.

In addition, focus group participants provided flow preferences for high challenge flow opportunities and a standard flow. High challenge flow recommendations ranged from 2,000 to 4,000 cfs. Participants indicated flows have been boated in this range historically (1984 and 2011) during above normal precipitation years when run-off exceeded storage capacity in the upstream reservoirs. These flows were paddled by a smaller pool of expert boaters capable of running continuous Class V rapids. The standard trip flow recommendations were identical to the optimum flow recommendations, 700 to 1,200 cfs.

Focus group participants commented that flow preferences have changed due to the changes in access to Horseshoe Bend. Historically, when access was allowed from I-84 to the bottom of Horseshoe Bend, the minimum acceptable flow was as low as 140 cfs. Boaters would paddle the Horseshoe Bend rapid only because 140 cfs was too low for Ledges 1, 2, and 3 at Triple Drop. Horseshoe Bend at 140 cfs offered a technical slalom boating opportunity. The current access restrictions require a higher minimum acceptable flow because more water is needed to navigate the 1.2-mile Hell or Highwater section downstream of Triple Drop. Focus group participants indicated the flow needed to navigate that section is 300 cfs, but the minimum acceptable flow is closer to 400 cfs for Ogden boaters and higher for boaters traveling longer distances.

3.2.5 River Recreation Access

Information on parking and public access to the study reach was obtained from the Internet survey and focus group. Internet survey participants were queried on the location for river access and parking for each trip to the study reach. Focus group participants provided information on current and historic river access and parking preferences.

Public parking adjacent to the study reach is currently available via the UDOT rest area (Photo 3-7) located immediately upstream from the Project, and the Weber Recreation Area maintained by PacifiCorp located at the diversion (Photo 3-8). Parking is also available approximately 1 mile downstream of the Project powerhouse on South Weber Drive (Photo 3-9). Internet survey responses indicate the UDOT and adjacent Weber Recreation Area were used the most for parking near the put-in, and South Weber Drive at the mouth of the canyon for the take-out (Figure 3-17). Focus group participant access was consistent with the patterns observed for the Internet survey. Some boaters indicate they use the UDOT rest area for parking instead of the Weber Recreation Site. Boaters shuttle a vehicle to the take-out at the mouth of the canyon on South Weber Drive.

There is no other legal public parking adjacent to the study reach between the Weber diversion dam and the Weber powerhouse. Parking on the shoulder of I-84 is prohibited. Vehicles parked on the shoulder of I-84 will be ticketed by the Utah highway patrol. Historically, boaters accessed the old highway from the westbound lane of I-84 directly downstream of the Horseshoe Bend section for parking. In recent times, UDOT gated access to the old highway from the westbound lane (Photo 3-10). Entrance to I-84 from the historic highway does not have a highway on-ramp.

Photo 3-7: UDOT Rest Area on I-84 Eastbound Lane

Photo 3-8: PacifiCorp Weber Recreation Site at Weber Diversion Dam on I-84 Eastbound Lane

Photo 3-9: Parking on South Weber Drive Adjacent to River Take-out

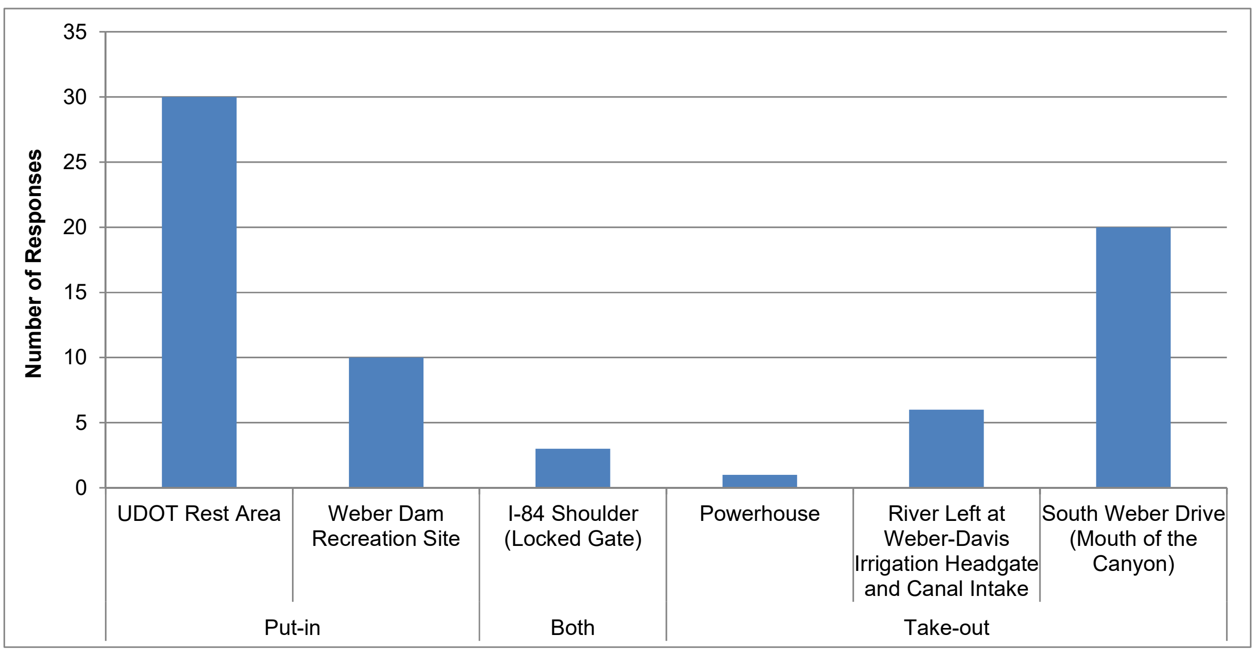

Figure 3-17: Parking Location Frequency for Internet Survey Respondents

Photo 3-10: Gate Obstructing Access to Old Highway from I-84 Westbound Lane

The majority of boaters put-in on the study reach a short distance downstream from the Weber diversion dam where the paved walking path terminates at the riverbank (Figure 3-18). River access is not permitted directly downstream of the Weber diversion dam for safety and liability reasons. Boaters are able to launch on a gravel bar approximately 200 meters downstream from the dam (Photo 3-11). PacifiCorp employees have observed boaters launching in the Project forebay. One focus group participant communicated they had paddled over the dam in the past. The dam is not suitable for safe navigation (Photo 3-12) and paddling over it is discouraged by PacifiCorp.

The majority of boaters take out on South Weber Drive, also known as the Mouth of the Canyon (Figure 3-19). During the focus group, participants indicated this is the default location currently, but it is not preferred because it requires paddling the 1.2 mile Class II-III section, Hell or High Water, below Triple Drop, portaging around the DWCCC diversion dam and paddling another 0.75 mile Class II section that may be severely dewatered by irrigation flow diversions.

Photo 3-11: River Launch Downstream of Weber Diversion Dam

Photo 3-12: Weber Diversion Dam

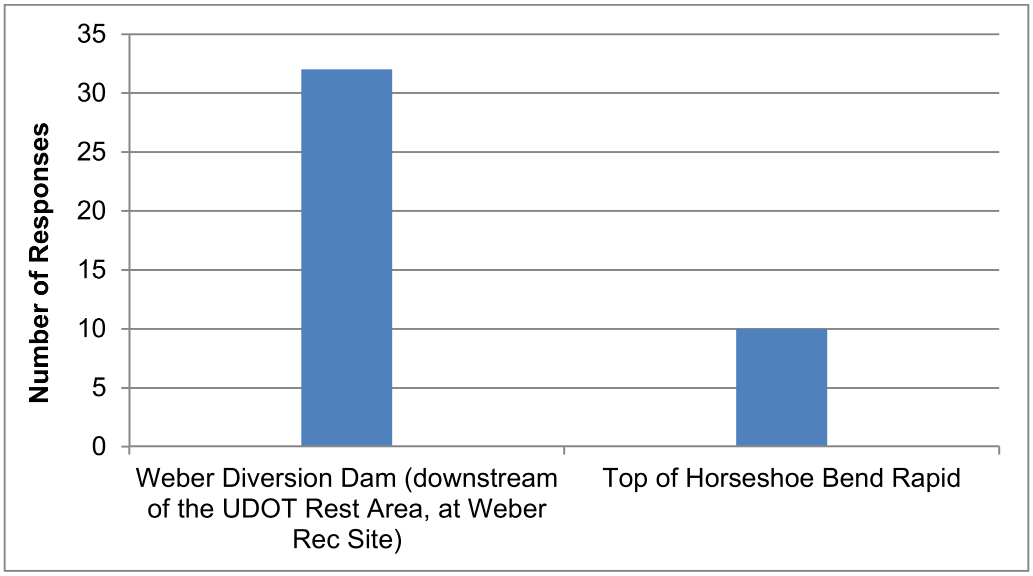

Figure 3-18: Put-in Location for Internet Survey Respondents

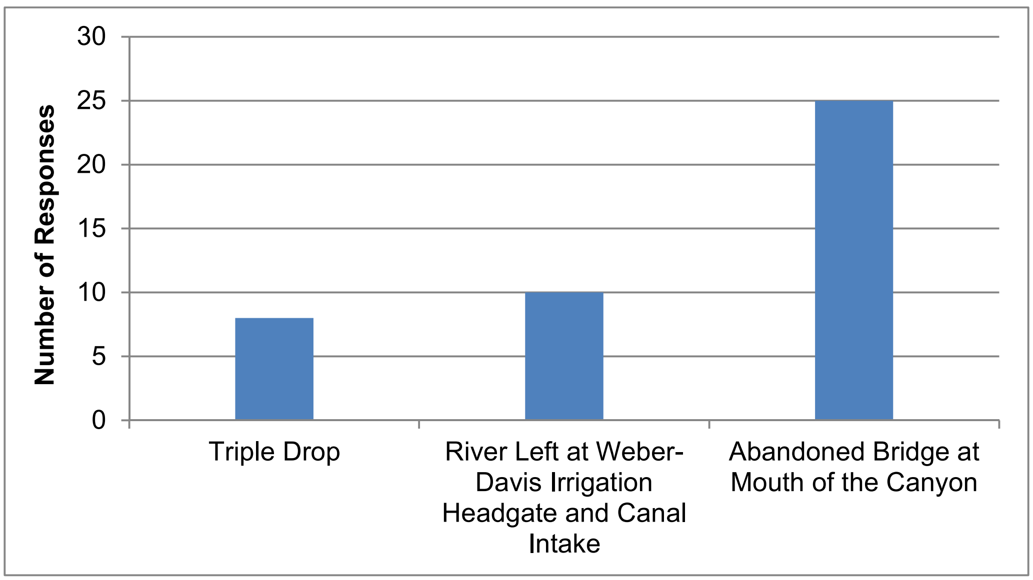

Figure 3-19: Take-out Location for Internet Survey Respondents

Focus group participants indicated that historically they accessed the study reach via the old highway from the westbound lane on I-84. This access point was more convenient because boaters could park in a single location to concentrate their paddling on the preferred Class IV Horseshoe Bend section and Triple Drop without the need to do a vehicle shuttle between the put-in and take-out. Boaters would typically park at the bottom of Horseshoe Bend and walk to the top with their boats. This allowed boaters to take-out at the bottom of Triple Drop and walk a short distance back to their vehicle. The proximity of parking adjacent to Horseshoe Bend was conducive to boaters completing several laps in a 2 hour period.

UDOT eliminated this preferred access location by installing a locked gate restricting access to the old highway from the westbound lane of I-84. Utah Highway Patrol tickets vehicles parked on the I-84 shoulder, further eliminating walk-in access on the old highway. Focus group participants commented that this loss of access has, in part, caused a decrease in the frequency of use because of the shuttle now required combined with the increased length of the less desirable Class II water and portage around the DWCCC diversion dam.

The DWCCC diversion dam obstructs downstream navigation (Photo 3-13). Boaters typically portage on river right. Some boaters paddle through the diversion structure under certain flow conditions. The river right gate was identified as the preferred route to navigate due to the lack of retentive hydraulics and presence of rebar in the river left diversion gate. For periods of time when the diversion gates are closed, river right was identified as the better option to portage around. When operating, the irrigation canal can divert substantial amounts of water, greatly reducing instream flows downstream of the DWCCC diversion dam and potentially impairing suitability for navigation.

A potential take-out location exists directly upstream of the DWCCC diversion dam on river left with vehicle parking. Access to this location via South Weber Drive is currently restricted by a locked gate (Photo 3-14).

Photo 3-13: DWCCC Diversion Dam Obstructing Downstream Navigation

Photo 3-14: Gate Restricting Access to DWCCC Diversion Dam Take-out

4.0 DISCUSSION

The whitewater study focused on the 1.9-mile section of the Weber River between PacifiCorp's Weber diversion dam and powerhouse. Boaters are attracted to an approximate 0.3 mile section within this 1.9 mile reach, which they call Horseshoe Bend. The Horseshoe Bend section provides Class IV whitewater paddling opportunities. Boaters have been paddling this reach since at least the mid-1970s. Historically, boaters were able to access the Horseshoe Bend section directly, allowing them to concentrate their paddling on the higher gradient and more difficult 0.3-mile section of the study reach. In essence, Horseshoe Bend presented a "Park and Play" whitewater opportunity. However, in the past decade, UDOT restricted direct highway access to Horseshoe Bend. Boaters must now access Horseshoe Bend in a more traditional river running fashion, including an upstream put-in and a downstream take-out. The put-in and take-out locations require a vehicle shuttle. Currently, boaters can park near the diversion and paddle or walk down to the Horseshoe Bend section. The most common take-out location currently is South Weber Drive downstream of the DWCCC diversion dam and approximately 0.75 mile downstream of the PacifiCorp powerhouse.

Internet survey participants identified 450 cfs as the minimum acceptable flow and an optimum flow range from 600 – 1000 cfs. The minimum acceptable flow for focus group participants ranged from 300 to 700 cfs while the range for optimum flows was 700 to 1200 cfs. Boaters reference the USGS Gateway gage for real-time flow information. Flows at the Gateway gage are approximately 300 cfs greater than flows in the Project study reach March through October.

Flow preferences referenced in this report represent those available in the Project study reach minus Project diversions.

Project operations, particularly in the months of April and May, cause a decrease in the number of whitewater boating opportunities. The Project diverts 300 cfs to the Weber powerhouse when instream flows at Gateway gage range from 450 to 750 cfs resulting in flows less than the minimum acceptable in the Project study reach. Mean daily flows between 450 and 750 cfs at Gateway gage occurred 13 and 26 days respectively in 2015 and 2016. Flows greater than 750 cfs at Gateway gage result in sufficient discharge in the Project study reach for whitewater boating, while the Project is operating. Mean daily flows at Gateway gage exceeded 750 cfs 1 day in 2015 and 2 days in 2016. Focus group participants indicated that flow preferences for the Horseshoe Bend reach are influenced by travel distance, competing boating opportunities, and access. Individuals with a tolerance for lower minimum acceptable flows tended to live in closer proximity to Horseshoe Bend. Boaters traveling longer distances tended to prefer a higher range of flows. Focus group participants indicated that in years with below-normal precipitation, flow preferences decreased due to the limited opportunities locally and regionally. Focus group participants also indicated that the threshold for minimum acceptable and optimum flows is now higher due to the changes in access that require boaters to paddle more of the study reach than the preferred whitewater rapids at Horseshoe Bend. The 1.2-mile section below Triple Drop rapid and the 0.75-mile section downstream of the DWCCC diversion dam require higher minimum acceptable and optimum flows than Horseshoe Bend. Focus group participants commented that the Horseshoe Bend rapid offers a technical boating opportunity at flows as low as 140 cfs. The current access situation has made it more difficult for boaters to take advantage of these technical boating opportunities due to the requirements to paddle the other sections of the river to reach the take-out location.

During the focus group session, boaters commented that the frequency of use has decreased following UDOT's access restrictions to Horseshoe Bend. According to focus group participants, the current access restrictions require boaters to paddle the full 1.9-mile length of the study reach plus the section of river downstream of the DWCCC diversion dam. The sections of the study reach directly upstream and downstream contain Class II-III whitewater difficulty compared to Class IV for Horseshoe Bend and Triple Drop rapids. These easier sections require more water to for a quality whitewater recreation experience compared to Horseshoe Bend. The flows needed to run these sections occur with less frequency than the lower flows needed for the Horseshoe Bend section.

Boating the Horseshoe Bend reach now requires two vehicles to shuttle between the put-in and take-out, compared to historical access that allowed boaters to park adjacent to the bottom of the Horseshoe Bend rapid in the middle of the study reach. The need to shuttle vehicles requires advance planning and coordination of schedules with one or more boaters to use the resource. This additional shuttling requirement has caused some focus group participants to lose interest in Horseshoe Bend.

In order to reach the take-out location, boaters typically portage the DWCCC diversion dam. Under certain conditions when the diversion gates are open, paddlers can run the right hand chute. When the DWCCC diversion dam is diverting water flows will be reduced substantially downstream compared to the Horseshoe Bend section. This requires boaters to navigate the 0.75

miles to the take-out with flows typically below the minimum acceptable. The combination of the portage and potential for low flow paddling conditions in this section between the DWCCC diversion dam and the take-out has led to a decrease in use according to some focus group participants.

Potential access improvements could be implemented at the Project study reach for river recreation users. The historic direct access used by boaters to Horseshoe Bend from I-84 is unlikely to be restored, due to UDOT safety restrictions. Vehicles travel in the west bound lane of I-84 at speeds in excess of 75 miles per hour. Direct access to Horseshoe Bend would require construction of an off and on-ramp to I-84. The site is physically constrained, eliminating the viability of this option. The current put-in location at the Weber Recreation Site is suitable for whitewater boaters to park vehicles and access the river. The current take-out location is not suitable. A more desirable take-out location upstream of the DWCCC diversion dam is needed so boaters do not need to portage the diversion dam and paddle undesirable low flow conditions to the take-out. A potential parking area is located on river left adjacent to the DWCCC diversion dam. Boaters could exit the river upstream of the DWCCC diversion dam and walk a short distance (approximately 200 yards) to their vehicle.

Typically, a recreation needs analysis would include an assessment of the recreation opportunities provided by an unregulated river, and then compare those to what might be available in a post-Project regulated reach. As the study reach is heavily regulated, both by upstream diversions and Project operations, and access to the study area is compromised by the highway that was constructed after the Project was installed, separating impacts to recreation (access, flows, Project operations) to the extent necessary to do a complete needs analysis is not practical. Additionally, due to the run-of-river design and lack of water storage at the Weber Hydroelectric Project, the Project cannot provide flows sufficient to augment recreation opportunities without significantly compromising generation. However, the needs analysis concluded the following:

- Flow-dependent recreation opportunities occur on the Weber River (which is regulated by upstream water storage and diversion projects beyond PacifiCorp's control), including the study reach, infrequently during the spring season;
- These opportunities are hampered by a lack of safe and legal access and egress;
- These limited recreation opportunities are affected by Project operations;
- Opportunities exist to increase the annual frequency of whitewater boating opportunities in the Project study reach when flows at Gateway gage are between 450 and 750 cfs;
- Notification of planned of Project maintenance resulting in increased flow in the study reach could be beneficial to the boating community;
- PacifiCorp could participate in access agreements to improve access at the DWCCC diversion dam directly downstream of the Weber powerhouse.

5.0 REFERENCES

American Whitewater. 2016. *National River Database*. Accessed: February 2016. Retrieved from: https://www.americanwhitewater.org/content/Wiki/help:rivers:database/

Whittaker, D., B. Shelby, and J.T. Gangemi. 2005. *Flows and Recreation: A Guide to Studies for River Professionals*. Washington, DC: Hydropower Reform Coalition.

Whittaker, D., B. Shelby, W. Jackson, and R. Beschta. 1993. *Instream Flows for Recreation: A Handbook on Concepts and Research Methods*. Anchorage, AK: U.S. Department of Interior, National Park Service.

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WW-APPENDIX A

Whitewater Recreation and Access Internet Survey

1. Introduction

Weber River Whitewater Boating Survey

Please read this before completing the survey.

This survey is part of PacifiCorp's Weber Hydroelectric Project (Project) relicensing study to collect and organize information about whitewater recreation use on the reach of the Weber River affected by the Project (Project Study Reach). Your participation in the survey will help to provide an understanding of the whitewater recreation opportunities on this reach of the river.

The extent of the study area is: the Weber River from the Weber Hydroelectric Diversion Dam near the UDOT Rest Area, to the takeout location approximately 1.9 miles downstream adjacent to the Weber Project powerhouse and across from the Davis-Weber Irrigation Company's headgates and canal intake (Figure 1).

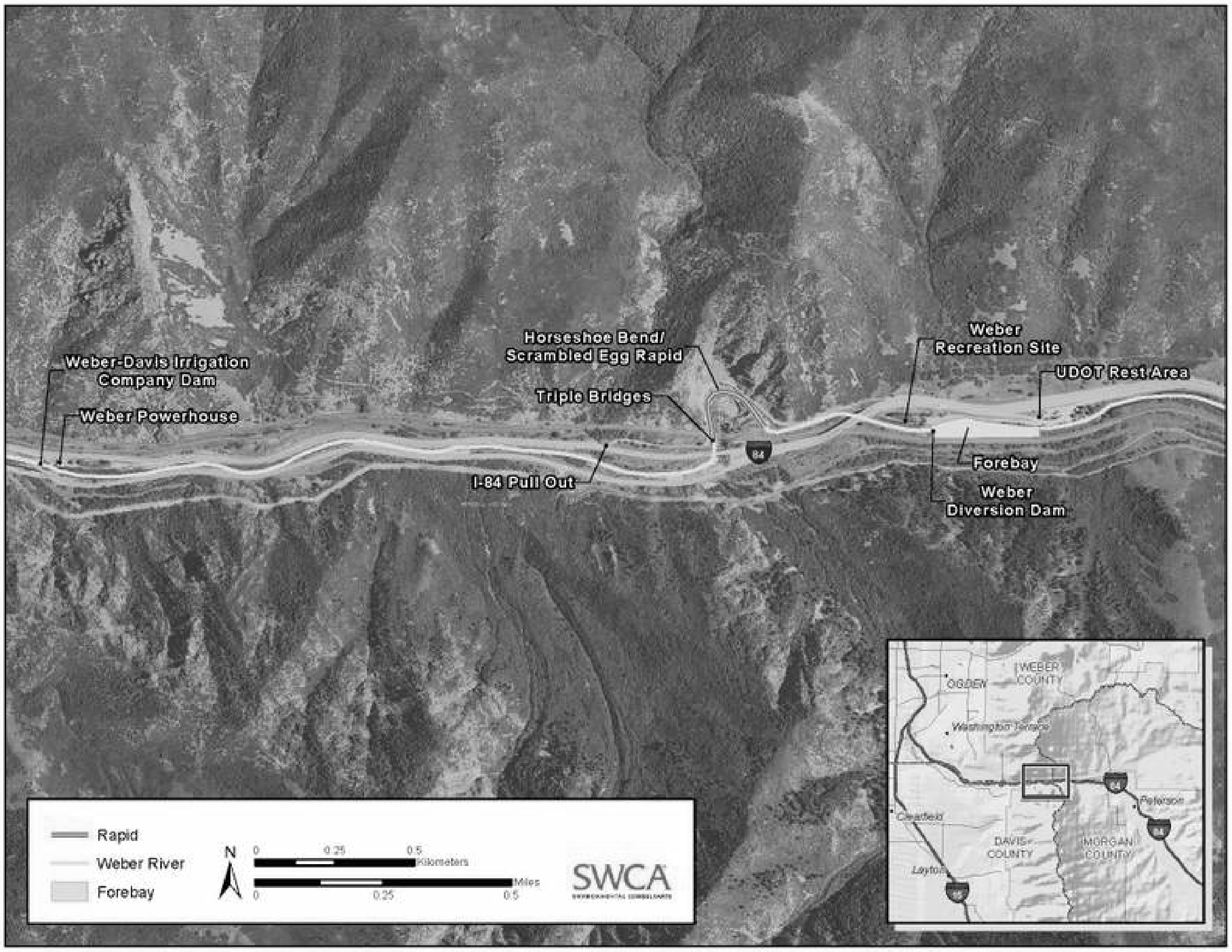
This study focuses on boating opportunities provided across a range of flow conditions based on the water available in the Weber River downstream of the Project diversion. The United States Geological Service (USGS) Gateway gage is widely used by boaters and others to determine the flow in the Project Study Reach. Flows in the Project Study Reach downstream of the Project diversion are typically 300 cfs less than flows reported at the Gateway gage, when the Project is online. The Project typically operates when flows are above approximately 100 cfs, but is not at full capacity until ~350 cfs.

In this survey you will rate the flows you boat in the Project Study Reach. Please complete this online survey for each date you boat (or have boated) this reach on the Weber River. Trips from past years can be entered as well provided you know the date and time of trip and can report on your experience under those flow conditions. Information from repeat paddlers provides valuable comparative information that helps to better understand the boatable flow range. Before completing the survey, please verify online the exact instream flows for the day you were boating (USGS Gateway Gage No. 10136500).

Your participation in this survey is important to the study's success. As you complete the survey, base your responses on your direct experience with this reach of the Weber River rather than guidebooks, group opinions or historic flow preferences. Also, encourage fellow boaters to participate in this study. The more responses we receive the more useful our results will be. Thank you for taking the time to complete this short survey, your input is greatly appreciated. PacifiCorp will publish the results of this study in a technical report that will be filed with the Federal Energy Regulatory Commission and on our website at: http://www.pacificorp.com/es/hydro/hl/weber.html.

Click "Next" to begin the survey.

Figure 1: Weber River Recreation Study Area.



2. Background Information

* 1. Your First and Last Name (for data sorting purposes only):

* 2. What was the date and time of this trip on this reach of the Weber River? (Please complete a new survey for each day paddling. Trips from previous years can be reported as well where the date and time of the trip are known.)

Date: MM / DD / YYYY

* 3. Gender?

- Male
- Female

4. Age?

Age (yrs):

5. In general, how many days a year do you spend whitewater boating?

- 1
- 2-5
- 6-10
- 11-20
- 21-30
- 31-50
- >50

* 6. What type of watercraft did you use for this trip?

- ◯ Hardshell kayak
- ◯ Open deck canoe with floatation
- ◯ Inflatable kayak
- ◯ Cataraft
- ◯ Closed-deck canoe
- ◯ Raft

Other, Please list

[ ]

7. How many years have you been using this type of craft?

Years:

[ ]

8. How would you rate your skill level with this type of craft?

- ◯ Novice (comfortable running Class II)
- ◯ Intermediate (comfortable running Class III)
- ◯ Advanced (comfortable running Class IV)
- ◯ Expert (comfortable running Class V)

3. Rating This Flow

* 9. In general, how would you rate the whitewater difficulty on this reach at this flow?

- ◯ Class I
- ◯ Class II
- ◯ Class III
- ◯ Class IV
- ◯ Class V
- ◯ Class VI
- ◯ Not sure

10. Please estimate the number of hits, stops, boat drags and portages you had on this trip.

Number of times I **hit** rocks and other obstacles (but did not stop): ____________

Number of times I was **stopped** after hitting rocks or other obstacles (but did not have to get out of my boat to continue downstream): ____________

Number of times I had to get out to **drag** or pull my boat off rocks or other obstacles: ____________

Number of times I had to **portage** around unrunnable rapids, log jams, or other obstacles: ____________

* 11. Please evaluate the flow volume during this trip for your craft and skill level for each of the following characteristics. (choose one rating for each row)

	1. Totally unacceptable	2. Moderately unacceptable	3. Marginal	4. Moderately acceptable	5. Totally acceptable
Availability of technical boating	◯	◯	◯	◯	◯
Availability of powerful hydraulics	◯	◯	◯	◯	◯
Availability of whitewater play areas	◯	◯	◯	◯	◯
Safety	◯	◯	◯	◯	◯
Length of run	◯	◯	◯	◯	◯
Number of portages	◯	◯	◯	◯	◯
Overall rating	◯	◯	◯	◯	◯

* 12. Are you likely to return to boat this flow you just evaluated?

- Yes
- No

* 13. In general, would you prefer a flow that was lower, higher or about the same as the flow on this trip?

- Lower flow
- About the same flow
- Higher flow

4. Comparing Flows

* 14. What was the flow (cfs) at theUSGS Gateway Gage when you boated?

Gateway Gage
(USGS 10136500)
Flow (cfs):

* 15. Determining flow in the Project Study Reach (method only applicable at flows greater than 350 cfs): Subtract 300 cfs from the USGS Gateway Gage flow you provided in Question 14. Write that number in the space below. That is the approximate flow in the Project Study Reach below the Weber Hydro Dam.

Example: 700 cfs at Gateway Gage – 300 cfs = 400 cfs in the Project Study Reach

Project Study Reach Flow: USGS Gateway Gage Flow – 300 cfs =

* 16. For comparative purposes, please estimate the quality of the following flows in the Project Study Reach for your craft and skill level. In making your evaluations, consider all the flow dependent characteristics that contribute to a high quality trip (WW challenge, WW play, safety and length of run). If you do not feel comfortable evaluating a flow you have not seen, select Don't Know. Choose one rating for each flow.

	1. Totally unacceptable	2. Moderately unacceptable	3. Marginal	4. Moderately acceptable	5. Totally acceptable	Don't Know
200 cfs	○	○	○	○	○	○
300 cfs	○	○	○	○	○	○
400 cfs	○	○	○	○	○	○
500 cfs	○	○	○	○	○	○
600 cfs	○	○	○	○	○	○
700 cfs	○	○	○	○	○	○
800 cfs	○	○	○	○	○	○
900 cfs	○	○	○	○	○	○
1000 cfs	○	○	○	○	○	○

* 17. Using flows calculated for the Project Study Reach, what is the minimum acceptable flow for you on this run in cfs? The minimum acceptable is the lowest flow you would return to boat, not the minimum flow necessary to navigate.

cfs:

* 18. Using flows calculated for the Project Study Reach, what is the optimum flow for you on this run in cfs?

cfs:

19. Boating opportunities on the Project Study Reach of the Weber River are....? (choose one per row)

	1. Worse than average	2. Average	3. Better than average	4. Excellent	5. Among the very best
Compared to the Weber River WW play park:	◯	◯	◯	◯	◯
Compared to other rivers within a one-hour drive:	◯	◯	◯	◯	◯
Compared to other rivers in Utah/Idaho/WY:	◯	◯	◯	◯	◯
Compared to other rivers in the USA::	◯	◯	◯	◯	◯

* 20. How long is a typical boating trip for you on the Project Study Reach of the Weber River? (Do not include driving time to the river)

◯ 1 - 2 hours of paddling

◯ 2 - 4 hours of paddling

◯ Full day of paddling

* 21. Boating trips to the Project Study Reach of the Weber River typically occur during which of the following time periods for you?

☐ Weekdays 8 - 5 PM

☐ Weekdays after work (typically after 5 PM)

☐ Weekends

5. Access to the Weber River

* 22. Where did you put-in?

- ◯ Weber Diversion Dam (located just downstream of the UDOT Rest Area, at Weber Rec Site)
- ◯ Top of Scrambled Eggs Rapid (aka top of Horseshoe Bend)
- ◯ Other, please name

* 23. Where did you take-out from the river?

- ◯ Triple bridges at bottom of Scrambled Eggs Rapid
- ◯ Davis-Weber Irrigation Company’s headgates and canal intake on River Left across from Weber Powerhouse
- ◯ Abandoned bridge at mouth of the Canyon

* 24. Did you do a single run on this date or multiple laps on this trip?

- ◯ Single run
- ◯ Multiple laps (number of laps)

* 25. Where did you park your vehicle for this trip while boating? (check all that apply)

- ☐ UDOT Rest Area
- ☐ Weber Dam Recreation Site
- ☐ I-84 shoulder at locked gate
- ☐ Powerhouse
- ☐ South Weber Drive access road to Davis-Weber Irrigation Company’s headgates and canal intake on River Left
- ☐ Abandoned bridge on South Weber Drive at mouth of the Canyon
- ☐ Other (name)

* 26. How many boating trips have you made to the Project Study Reach of the Weber River?

- 0 times
- 1 to 5 times
- 6 to 10 times
- 11 to 20 times
- More than 20 times

* 27. How many boating trips have you made to the Project Study Reach of the Weber River in the last twelve months?

- 0 times
- 1 to 5 times
- 6 to 10 times
- 11 to 20 times
- More than 20 times

28. Do you have comments on access to the Weber River for whitewater boating.

29. Do you have other comments about whitewater boating on the Weber River or general comments about flows for paddlers?

30. Thank you for participating in the Weber River Hydroelectric Project Whitewater Flow Study. PacifiCorp will be hosting a focus group with the whitewater community in the spring. If you would like to participate in the focus group please provide your email and phone number so we can inform you of the time and location. Alternatively, you can contact Eve Davies at 801-220-2245 to indicate your interest in the focus group.

Email Address:

Phone Number (w/ area code)

WW-APPENDIX B

Focus Group Email Invitation

Focus Group Invitation

Weber River Whitewater Study

Thank you for participating in the Weber River Whitewater Boating Survey, and for indicating interest in participating in the upcoming focus group. Focus group participants will help provide important information on whitewater use patterns, flow preferences, access issues, and flow information for this reach of the Weber River, which will complement data gathered through the online survey.

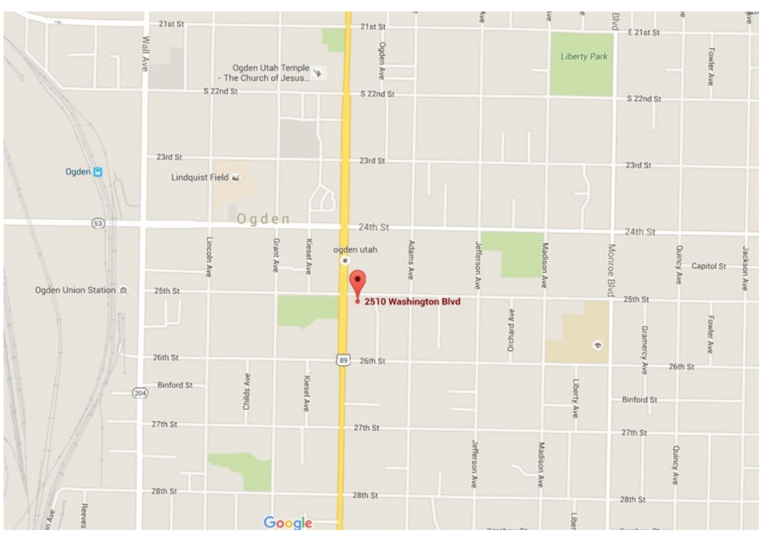
RSVP by Thursday, April 28: To participate in the Focus Group you must RSVP with Miriam Hugentobler (miriam.hugentobler@gmail.com) or (801) 652-8983 by Thursday, April 28. Include your name, email address, and phone number.

Space is limited for the Focus Group. Do not RSVP if you are uncertain on your attendance, otherwise you potentially prevent a fellow boater from getting on the list. We will re-confirm your ability to attend in advance using the contact information provided in your response; alternate attendees will be notified in the case of last-minute cancellations.

Focus group meeting details:

Date: Tuesday, May 03, 2016
Time: 7 – 9 PM (Approximately 1.5 to 2 hours depending on boater input and discussion.)

Location:
Ben Lomond Hotel, Browning Room
2510 S. Washington Blvd
Ogden, UT
(downtown Ogden at the corner of 25th Street and Washington)



This study is part of the Federal Energy Regulatory Commission's relicensing process for Weber River Hydroelectric Project. The study reach is the section of the Weber River from the Weber Hydroelectric Diversion Dam near the UDOT rest area to the takeout location approximately 1.9 miles downstream adjacent to the Weber Project powerhouse and across from the Davis-Weber Irrigation Company's headgates and canal intakes.

For further information, please contact Eve Davies at eve.davies@pacificorp.com or 801-220-2245.

WW-APPENDIX C

Focus Group Discussion Notes

WEBER RIVER RECREATION FOCUS GROUP

MAY 3, 2016, 7PM

John – introduction

Eve –

- Relicensing introduction – ALP=consensus required.
- Recreation study: Access changes in 2007 when highway was gated. FERC form 80 every 6 years. 20,000 visitors in 2014 (number of cars). Study will look at who recreators are, possible upgrades to user trail
    - Q: consider whether data are accurate due to whether the water year is adequate for paddling.
    - Eve: likely that WW use is a much smaller proportion than fishers. But, that's what this WW study is for.
    - Arnie: Access spot on 84-E right above the trestle bridge where the pipe goes over the river. They park between the highway and walk down to shoot in the cove. Not safe, pull off on left side of freeway.
    - E: there's enough concern by UDOT for accidents with pull outs on westbound pullout that they've asked highway patrol to ticket people.
    - Argument about the 20k visitor use number due to the 2.3 multiplier because fishers only come in 1 generally.
    - Bluehead sucker and Bonneville cutthroat trout (one of 2 fluvial populations) = ESA species on weber = fish passage is important in relicensing.
    - Tusher dam in Green river – took out a lowhead dam and created a boat passage/fish ladder
    - IBT water rights for BOR are attached to weber project water rights
    - Davis Weber is allowed to take entire river flow.
    - ISF 34-40 cfs
    - Comments asking about economics of the project, seeing no point to any modification

Focus Group

- Flow information – using gateway gage minus weber hydro flow
    - Gateway gage is reference, only other is visual, Bill posts on FB
    - Used to be a rock upstream of davis weber that was used as a stage height gage, but it has moved
    - Boaters weren't sure what the flow was, but knew it was lower than gateway gage
    -
- Access
    - Current parking locations
        - Park at PacifiCorp rec area, drop down to river at end of fence
    - Historic parking
        - Weren't concrete barriers at the top – could previously drive right to the top

        - Some parked right along the freeway and then walked behind the gate, then walked in with boats. Some never drove along the old highway. From here would just walk to top of horseshoe bend
        - Can run bend at much lower flow than the three drops – sometimes just do a couple laps of the bend
    - Downstream access
        - Pull out right of dam then walk around it
        - Grout on rocks on right is relatively new – when they rebuilt from the blowoff
            - Immediately after the work it was loose – it has gotten more stable.
        - Right hand gate is easier to run because its not retentive. Left has a retentive hydraulic and maybe rebar.
        - If you're taking out river right, easier to do with right gate closed.
        - When right gate is partially open, then can't run it plus can't portage on right. Left portage is long.(Usually can run the little bit of river downstream to the mouth even with minimal water – and when its running enough to paddle isn't necessarily during irrigation season.
        - At irrigation gate, sometimes can run just the stretch below the irrigation diversion in high water.
        - Typical takeout is near the abandoned bridge, park on south side
    - Parking
        - Sometimes do laps of horseshoe bend + ledges, particularly because it gets bony below
        - Many have only ever hiked back up to car, never set shuttle
    - Put in area has a high drug use problem
        - Usually cops wait at UDOT rest area then pull over drug users when they pull into PacifiCorp rec area
    - Rapid names
        - Highway bridge + boogey water = "pipe" area, class 2
        - Start of the bend, all runs together – no differentiation, just all called horseshoe bend from top to railroad bridge
            - Upper section class 3 to 3+ (bumps up at 700, at 1000 is huge)
            - Play spot = a boof at higher flows (600 cfs) – middle class 4
            - Bottom section is more of a rock garden area, class 3-4
        - Generally scout at the bridge (or "trestle"
        - Triple drop, called drop 1,2,3,
            - Class 3+ @ 200cfs
            - Class 4 @ 4-500
            - Most people say its always class 4.
            - This reach wouldn't be safe for class 2-3 boaters; not safe for swimming, walking, etc.
            - Generally when there's enough water in there to make it worth boating it's a class 4 run.
        - Walk from the bottom of the third drop back to the old highway or carry on downstream

    - Section between triple drop and weber powerhouse – hell or high water, surf waves in there at around 350-400 cfs, class 3
    - Irrigation dam to mouth – no name, class 2 with a class 4 portage and some pin potential
  - Flow
    - Flow in bypass reach only, but using gateway gage here.
    - Minimum:
      - depends on the year and/or if there is boating elsewhere
      - gage 1500 for people to travel from SLC or PC, Arnie would drive up for 550-600 in gage, others gage 600-700.
      - In Ogden, gage 525, but only running the bend (or 550 on gage)
      - Can do the bend with about 140 in the bend as a rock slalom. Would not go below triple drop without 300 in bypass. (gage 440-600).
    - Optimum
      - 1000 gage (usually Ogden is running then too, some prefer the Ogden)
      - 750-850, maybe get nervous over that flow
      - 1000-1500 for longer drives (longer drivers want more water)
      - Utah boaters cant be picky
    - High/Challenge flow
      - 2000 gage
      - 3000 gage
      - You tube w/slow motion – 2900 gage
      - Some crazy people run it 4000-4500 (2011)
      - 4000 gage 1984
    - Standard flow – what would you pick
      - 1000-1500 gage
      - 1200 gage
      - 1000 gage
  - Whitewater Use patterns
    - Weekdays after work, weekends
    - Since there are limited flows, usually not much choice
    - Opportunistic but don't take off work to run it.
    - Boating trip 1-2 hours, or just one hour.
    - Trips per year – whenever it flows. Not often
    - Laps: 2 or 3 on bend, whole thing not usually done in laps.
  - Comparison with local resources
    - Horseshoe is the most technical and best ride of other sections of the weber.
    - Mouth of Canyon to Riverdale could be worth running at high water (89 to Riverdale, downstream of diversion dam) class 3+ at really high water – big waves, easy access. Uinta bridge class 4, rest class 3. 3500 cfs. (tier below scrambled eggs if it was in)
    - Ogden River Narrows way better than Horseshoe bend.
      - 1.5-2 mile section – comparable to wild mile in big fork

            - At least 4 named drops
            - Class 3-4
            - Irrigation release. Used to have a recreational release and a race. Think the Ogden mayor cancelled it. All depends on level of Pineview reservoir.
    - Logan River
        - Staircase
            - About 1.5 hours from salt lake, 1 hour from Ogden
            - Section is really narrow, bony, ton of wood, lots of diversions, finicky
            - People will boat it but not really worth boating
            - Weber better than Logan. If both were optimal flows, would prefer weber.
        - Upper Logan good (12 miles) at high flows
    - Bear River - Black Canyon
        - More dependable than weber. May only ever choose weber over bear if weber happens to be a great level and are expecting there to be multiple additional opportunities for the bear
    - Cottonwood Creek – outflow of Joes valley? Very unusual to run. Very flashy.
    - Bear River Oneida – family section
    - Most similar to Weber is upper stretch of Malad. Consistent flows on Weber would greatly improve recreational boating on Wasatch
- Is there a way for PacifiCorp to notify people if w/d might not be happening
    - Eve working with FERC on how to report this – also important to fishers.
    - Could we get better, more accurate flow info that people could look up?
    -

WW-APPENDIX D

Focus Group Attendance

Weber Hydroelectric Project Relicensing Whitewater Boating Focus Group Browning Room, Ben Lomond Hotel Ogden, UT May 3, 2016			
Attending		**Name**	**Organization**
Focus Group	**Others**		
	x	Eve Davies	PacifiCorp
	x	John Gangemi	ERM
	x	Sandy Slater	ERM
	x	Neal Artz	Cirrus
	x	Matt Westover	Cirrus
	x	Nate Hawkes	Cirrus
	x	Miriam Hugentobler	Project Coordinator
x		Nathan Packham	
x		Alan McKean	
x		David Wolfgram	
x		Dawna Zukirmi	
x		Scott McKinstry	
x		Alan Clark	
x		Ryan Moore	
x		Gary Nichols	
x		Tanner Kadlec	
x		Bill Hunt	
x		Todd Clark	
x		Charlie Vincent	
x		Bryson White	
	x	Jennifer Pemberton	Reporter
13	8	**TOTAL - 21**	

WW-APPENDIX E

Focus Group Announcement

Weber River Whitewater Study—Focus Group May 3rd, Ogden, UT

PacifiCorp is hosting a whitewater focus group for the Weber River Hydroelectric Project (Project), FERC No. 1744. Focus group participants will help provide an understanding of the whitewater boating opportunities and use patterns on the reach of the Weber River downstream of the Project diversion (Project Study Reach). ERM (Environmental Resources Management) will be conducting the focus group. Your input is needed on whitewater boating opportunities, use patterns, flow preferences, and access in the Project Study Reach.

Please RSVP indicating your commitment to attend so we can reserve a seat for you. Space is limited.

Date: May 3, 2016
Time: 7:00 PM to 9:00 PM
Town: Ogden, UT

Please RSVP to Miriam.hugentobler@gmail.com or (801) 652-8983 to reserve your seat at the focus group session and to receive the location information.

The session will start promptly at 7pm; please arrive a few minutes early so we can start on time. The focus group session will begin with an overview of the Weber Hydroelectric Project and the whitewater reach on the Weber as well as instructions for your input during the focus group. It is imperative all participants receive the instructions. Late comers will not receive this instruction and disrupt the focus group session for other participants.

Thank you,
Eve Davies
PacifiCorp

WW-APPENDIX F

Focus Group Background Survey

BACKGROUND INFORMATION

Weber River Hydroelectric Project, FERC No. 1744

1. Name (used for data sorting purposes only): ____

2. What is the zip code of your permanent residence? __________________________________

3. Did you participate in the 2016 Weber River Whitewater Boating Internet Survey?

   ___Yes   ___No

4. What is your age (yrs)?

   ___<20   ___60-69

   ___20-29   ___70-79

   ___30-39   ___80-89

   ___40-49   ___>9

   ___50-59

5. Please specify your gender.   ___Female   ___ Male

6. What type of watercraft do you typically use?

___Hardshell Kayak   ___Cataraft

___Inflatable kayak   ___Open canoe with flotation

___Closed-deck canoe

___Other, Please list _____________________________________

7. How many years have you been using this type of craft?

   Years: ___

8. How would you rate your skill level with this type of craft?

   ___ Novice (comfortable running Class II)

   ___ Intermediate (comfortable running Class III)

   ___ Advanced (comfortable running Class IV)

ERM

___ Expert (comfortable running Class V)

9. In general, how many days a year do you spend whitewater boating

___ 1

___ 2-5

___ 6-10

___ 11-20

___ 21-30

___ 31-50

___>50

10. How many boating trips have you made to the Project Study Reach of the Weber River over the years?

___0 times

___1 to 5 times

___6 to 10 times

___11 to 20 times

___More than 20 times

11. How many boating trips have you made to the Project Study Reach of the Weber River in the last twelve months?

___0 times

___1 to 5 times

___6 to 10 times

___11 to 20 times

___More than 20 times

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Recreation Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
Comments on the Draft Technical Report (Review period Dec. 20, 2016 – Jan. 19, 2017)			
NP/Kayaker	N/A	See attached comment letter	No changes were made to the document in response to this comment letter. The commenter was reportedly unaware that PacifiCorp was working with AW and other stakeholders to develop potential PM&E measures that may be beneficial to recreation users. Specifically however, PacifiCorp has proposed annual releases/curtailment of generation to support whitewater boater use. The upcoming Draft License Application and subsequent Final License process will determine what mitigation measures are required through the next license period.
Comments on the Preliminary Draft Technical Report (Review period Nov. 15- Dec. 15, 2016)			
PT/UDWR	N/A	The Utah Division of Wildlife Resources does not have any substantial comments on the Recreational Plan. We feel that the plan was well thought out and analyzed all recreational uses adequately. The UDWR agrees that angling is the primary use of the site and improving angling access is our highest priority of which a part would be improving the trail leaving the site downstream as well as access points to the river. We would like to partner with PacifiCorp, the Forest Service, and Trout Unlimited to make improvements to angling access at this location and we could talk in the future if there is a need for in-stream restoration work.	N/A
PT/UDWR	Background Information section, paragraph 5	We have finalized our 2013 Weber River Creel report, so you can remove draft when you reference it. The information you referenced should not have changed.	Change has been incorporated

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Recreation Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
RB/BOR	N/A	I've reviewed the recreation report and I have no changes/edits or comments on it.	N/A
KO/FERC	N/A	I have reviewed the draft and have no comments at this time. I look forward to reviewing the complete license application.	N/A
DA/USFS	N/A	The Forest Service does not have any substantive comments on the report, and we are fine with the report being filed with FERC for public comment.	N/A
DA/USFS	N/A	One item that is being discussed at the national level in the Forest Service is the need to ensure that all recreation facilities on hydropower projects on National Forest System (NFS) land comply with the Architectural Barriers Act (ABA) of 1968 going forward. ABA rather than ADA applies for facilities on NFS land. The accessibility guidelines can be found here: http://www.fs.fed.us/recreation/programs/accessibility/ I don't know that this is something that needs to be in the report or referenced in it, but I thought I would mention it now.	No text changes have been made to reflect this comment. PacifiCorp will work with the Forest Service on this issue as more information becomes available.
CV/AW	Background Information section, para 7, next to last sentence	"...when the Project is operating, there is rarely enough flow in the bypass reach to boat" (add: ***without suspending generation)***.	Change has been incorporated
CV/AW	Results section, Whitewater Boating Hydrology Analysis, para 4, sentence 2.	"During periods of Project operation, flows greater than 750 cfs are necessary at Gateway gage for a 450 cfs flow, and thus have a whitewater opportunity, in the Study Reach" (add: ***without reduction of generation***).	Change has been incorporated

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Recreation Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
CV/AW	Results section, Whitewater Boating Hydrology Analysis, para 5.	"In short, flows sufficient to boat the Study Reach, from the accessible put-in at the recreation site to a safely accessible take-out downstream ~~are rare"~~ (add: ***would continue to be rare (based on <u>the most</u> recent flow data) without interrupting generation***).	Change has been incorporated, with one additional clarification: "the most".
CV/AW	Results section, Whitewater Boating Use and Demand Analysis, River Access para 6	Debatable which limits the use more, but I believe the lack of flows is a much bigger deterrent. Both issues need to be worked together.	Consistent with our collaborative process, PacifiCorp is working with AW and other stakeholders to discuss potential PM&E measures that may be beneficial to recreation users.
CV/AW	Results section, Whitewater Boating Needs Analysis, para 3, next to last sentence	'Additionally, due to the run-of-river design and lack of water storage at the Weber Hydroelectric Project, the Project cannot provide flows sufficient to augment whitewater boating opportunities without significantly compromising generation.' AW: Federal Power Act suggests this isn't a deterrent, however.	The comment does not suggest a change. PM&E measures required to address project impacts have been developed in cooperation with the various Project stakeholders.
CV/AW	Results section, Recreation Needs Analysis, Current Needs, para 8	"One surprising result of the survey and trail camera data was the small number of kayakers." AW: Why is this surprising? As stated previously there has rarely been sufficient flows for recreation in this reach.	Surprising was related to the fact that of the 11 trips reported in 2016, only 5 boaters were observed in the camera data. Text has been revised to reflect the issue more accurately.

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Recreation Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
CV/AW	N/A	What is also lacking from the document is a discussion around potential ways in which the whitewater recreation could be restored to historical levels. Specifically, weekly suspension of generation when inflows exceed the 450 cfs that was determined to be the minimum preferred flow for whitewater recreation flows. The timing of such releases would need to be determined, but weekday evenings and weekends are possibilities. In addition, assistance with negotiating access to the identified potential takeout just upstream of the Davis and Weber Counties Canal Company's diversion structure or any other legal access that can be identified for use during such releases.	Consistent with our collaborative process, PacifiCorp is working with AW and other stakeholders to discuss potential PM&E measures that may be beneficial to recreation users.

Nathan Packham, Ogden, UT.
RE: Weber Hydroelectric Project Relicensing - FERC PROJECT NO. P-1744

I am a kayaker living in Ogden (a few miles downstream of the dam and diversion). I have lived here fifteen years and boated the Weber river extensively during that time. The stretch of water left de-watered most of the year by the power diversion contains, by far, the best rapids and most exciting whitewater on the entire Weber River.

Living in Utah, we already are at the mercy of upstream irrigation dams but for the most part, those tend to prolong and control the boating season. Those dams release a steady stream of water that keep the river usable even in low-water seasons. The power project, on the other hand, relentlessly removes water from the streambed even during low-water seasons and times of year, resulting in an un-navigable streambed most of the time. As a kayaker, this is a death knell when we depend on those low steady summer and fall flows.

I suppose the same characteristics that make for good whitewater make for a good place for a dam and power plant -- namely high gradient and canyon constriction. The folks that built that dam decades ago knew what they were doing. I believe times have changed since 1910, we are more conscious now of the multiple roles a river has. It breathes life into our communities and offers enjoyment to the creatures that live on its banks, including humans. We have since developed other sources of energy that dwarf the amount produced by this project.

I do not believe that the amount of energy produced warrants the wholesale sacrifice of that stretch of river. That part of the canyon is a wonderful piece of history. The wagoneers coming down through the treacherous "Devil's gate" were required to build a rickety wooden structure to skirt the chasm where the river constricts. That structure is long gone now, replaced today by a large highway. As I drive by, I always crane my neck to peer down into that S-curve as it slices away from the road into its own little pocket. It is the most scenic stretch in a canyon otherwise dominated by the road. Unfortunately I usually see only a rocky remnant of what the river could be.

I've never considered myself a green 'activist' or a 'tree hugger'. This is my first foray into the red-tape world of big energy and government entities. While I appreciate the checks and balances that seem to be in place, I am a little disappointed by what I foresee as a rubber-stamping of this project. Pacificorp has certainly checked the boxes and jumped through the hoops in front of them. In the end though, I fear it is all a song-and-dance. It is hard to unwind the interests of the parties involved. In the end even the people executing the study are in it for the money.

The trail camera to count kayakers was placed a few yards downstream of the put-in, pointing down-stream. This means that the majority of boat traffic was never counted. Any kayakers spotted on film were for some reason carrying their boats back upstream on the trail and not running the typical shuttle.

In a perfect world, I would like to see the FERC mandate the removal of a dam that has seen its time come and go. It has served its purpose.

If the wheels of corporate interests and government oversight are too heavy to stop turning at this point, please consider dictating that the river flow freely each Saturday, restoring the river into a source of enjoyment for those of us who get out of work on the weekends to enjoy nature.

Please restore my faith in the system of checks and balances we have so conscientiously put in place. I have a job and a family that keeps me occupied. I rely on organizations like yours to fight on my behalf.
Please contact me if you have any questions,

Nathan

FINAL

TERRESTRIAL THREATENED, ENDANGERED, AND SENSITIVE SPECIES AND NOXIOUS WEEDS TECHNICAL REPORT

WEBER HYDROELECTRIC PROJECT RELICENSING FERC PROJECT NO. 1744

Prepared for

PacifiCorp—Hydro Resources
1407 West North Temple
Salt Lake City, UT 84116

Prepared by

SWCA Environmental Consultants
257 East 200 South, Suite 200
Salt Lake City, UT 84111
(801) 322-4307
www.swca.com

June 30, 2017

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APPENDICES

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1.0 INTRODUCTION AND BACKGROUND

PacifiCorp owns and operates 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, Utah. The current FERC license will expire on May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. 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.

Surveys for special-status species and noxious weeds have not been conducted in the Project Area since the late 1980s to 1990 during the previous relicensing effort. During the preparation of the PAD, PacifiCorp evaluated existing information on potential terrestrial habitat and species in the Project Area to inform the analysis of Project impacts to these resources. Based on information from the PAD, PacifiCorp prepared a study plan for terrestrial threatened, endangered, and sensitive species and noxious weeds. The study plan proposed four terrestrial resource surveys to gain further information on potential impacts of the Project on these resources.

1. Special-status plant survey for Ute ladies'-tresses orchid (*Spiranthes diluvialis*)
2. Special-status plant survey for Utah angelica (*Angelica wheeleri*) and Wasatch fitweed (*Corydalis caseana*)
3. Noxious weed survey
4. Special-status wildlife survey for smooth greensnake (*Opheodrys vernalis*)

In August 2015, PacifiCorp contracted with SWCA Environmental Consultants (SWCA) to conduct these four surveys and prepare a survey report for the Weber Hydroelectric Project. SWCA conducted the initial requested surveys on August 6, 2015 (a stakeholder requested repeat surveys for Ute ladies-tresses orchid for two additional years; the 2016 and 2017 surveys are completed and planned, respectively). This document provides the results of the surveys.

2.0 PROJECT AREA

The Project Area is on the Weber River in Weber, Morgan, and Davis Counties in Utah (Figure A1; Figures A-1 through A-5 are included in Appendix A). The Project Area is defined as the area containing all Project features and also encompasses the FERC Project Boundary. For the purposes of characterization and analysis, the Project Area extends from the furthest edge of the FERC Project Boundary, across the Weber River to the far riverbank, and includes the river. The FERC Project Boundary is defined as all lands and waters within the existing FERC Project Boundary for the Weber Hydroelectric Project. The Project Area is partially located on federal lands managed by the Uinta-Wasatch-Cache National Forest (Intermountain Region 4). The FERC Project Boundary contains approximately 14.5 acres (5.9 hectares [ha]) and the Project Area consists of approximately 65.1 acres (26.3 ha).

3.0 SURVEYS

SWCA conducted surveys for special-status species (Ute ladies'-tresses, Utah angelica, and Wasatch fitweed), noxious weeds, and smooth greensnake. Special-status plant and smooth greensnake surveys were conducted in the Project Area, and noxious weeds surveys were conducted in the FERC Project Boundary.

3.1 Special-Status Plant Survey

The study plan identifies one federally listed plant species, Ute ladies'-tresses, as having the potential to occur in the Project Area and recommends surveys for this species in the Project Area. The study plan also recommends a survey in the Project Area for two U.S. Forest Service (USFS) R4 sensitive plant species, Utah angelica and Wasatch fitweed, at the request of the Uinta-Wasatch-Cache National Forest (USFS 2013). SWCA qualified biologists conducted these surveys on August 6, 2015.

3.2 Noxious Weed Survey

Thirty-one state- and county-listed noxious weed species have the potential to occur in the FERC Project Boundary (Utah Department of Agriculture 2010, 2015). Weed species with potential to occur in the Project Area and FERC Project Boundary are listed in Table 1. SWCA conducted weed surveys in the FERC Project Boundary to document the location and extent of any noxious weed infestations.

Table 1. Utah State-Listed Noxious Weed Species and County Declared Noxious Weed Species with Potential to Occur in the Project Area and the FERC Project Boundary

Common Name	Scientific Name
Class A Noxious Weeds*	
Black henbane	*Hyoseyamus niger*
Diffuse knapweed	*Centaurea diffusa*
Leafy spurge	*Euphorbia esula*
Medusahead	*Taeniatherum caput-medusae*
Oxeye daisy	*Chrysanthemum leucanthemum*
Perennial sorghum	*Sorghum* species, *S. halepense*, *S. almum*
Purple loosestrife	*Lythrum salicaria*
Spotted knapweed	*Centaurea maculosa*
St. Johnswort	*Hypericum perforatum*
Sulfur cinquefoil	*Potentilla recta*
Yellow starthistle	*Centaurea solstitialis*
Yellow toadflax	*Linaria vulgaris*
Class B Noxious Weeds†	

Table 1. Utah State-Listed Noxious Weed Species and County Declared Noxious Weed Species with Potential to Occur in the Project Area and the FERC Project Boundary

Common Name	Scientific Name
Bermudagrass	*Cynodon dactylon*
Broad-leaved peppergrass	*Lepidium latifolium*
Dalmation toadflax	*Linaria dalmatica*
Dyers woad	*Isatis tinctoria*
Hoarycress	*Cardaria draba*
Musk thistle	*Carduus nutans*
Poison hemlock	*Conium maculatum*
Russian knapweed	*Centaurea repens*
Scotch thistle	*Onopordium acanthium*
Squarrose knapweed	*Centaurea virgata*
Class C Noxious Weeds ‡	
Field bindweed	*Convolvulus arvensis; C.* species
Canada thistle	*Cirsium arvense*
Houndstongue	*Cynoglossum officianale*
Saltcedar	*Tamarix ramosissima*
Quackgrass	*Agropyron repens*
County-Declared Noxious Weeds	
Buffalobur (Davis County)	*Solanum rostratum*
Yellow nutsedge (Davis County)	*Cyperus esculentus*
Burdock (Morgan County)	*Arctium minus*
Puncturevine (Weber County)	*Tribulus terrestris*

Source: Utah Department of Agriculture (2010, 2015).

* Class A: (Early Detection Rapid Response [EDRR]) Declared noxious weeds not native to the state of Utah that pose a serious threat to the state and should be considered as a very high priority.

† Class B: (Control) Declared noxious weeds not native to the state of Utah that pose a threat to the state and should be considered a high priority for control.

‡ Class C: (Containment) Declared noxious weeds not native to the state of Utah that are widely spread but pose a threat to the agricultural industry and agricultural products with a focus on stopping expansion.

3.3 Smooth Greensnake

The study plan identifies one state-sensitive species, the smooth greensnake, with some potential to occur in the Project Area and recommends surveys to identify any occurrence of smooth greensnake in the Project Area. There are no known or documented occurrences of smooth greensnake in the Project Area, and the Project Area does not include smooth greensnake-specific Utah habitats (i.e., mountain riparian assemblage with mixed conifer, conifer-deciduous, and subalpine forests; defined meadows/grasslands and wetlands). However, there is some marginal quality general riparian habitat so a precursory/ reconnaissance-level survey of the species was conducted. SWCA qualified biologists conducted the survey for smooth greensnake on August 6, 2015.

4.0 METHODS

Before the surveys were conducted, a shapefile of the Project Area was created in ArcGIS 10. The shapefile was uploaded to handheld Trimble GeoXT global positioning system (GPS) units, which have an estimated accuracy of less than 1.0 meter (3.3 feet) when data are post-processed.

4.1 Special-Status Plant Surveys

The Project Area was first evaluated for the presence of any potential special-status plant species habitat. Surveys were completed in the Project Area, with particular focus on any suitable habitats. Potential habitats are areas that satisfy the broad criteria of the species' habitat description and are usually determined by a pre-survey assessment. Suitable habitats are areas that exhibit the specific habitat features necessary for species' persistence, as determined by field inspection and/or surveys, but that may or may not contain the species. SWCA conducted surveys in the Project Area where reasonable and safe access to potential and/or suitable habitat was available, given the proximity and boundaries of the adjacent freeway lanes and railroad tracks.

4.1.1 Ute Ladies'-Tresses

After evaluating the Project Area for the presence of any potential Ute ladies'-tresses habitat, surveys to identify the presence of Ute ladies'-tresses within habitat were conducted by qualified personnel in compliance with U.S. Fish and Wildlife Service (USFWS) protocols (USFWS 2011). SWCA conducted the Ute ladies'-tresses surveys during the flowering period (as verified by the Utah USFWS species lead, Jena Lewinsohn) and focused on suitable habitat consisting of wetland areas and the banks of the Weber River in the Project Area. Surveys were conducted by walking or otherwise closely scrutinizing areas of potential habitat looking for flowering stalks. Two surveyors walked a parallel line approximate 0.9 m (3 feet) apart, as the terrain allowed, with each surveyor scrutinizing the area in front of the other surveyor (looking sideways or diagonally rather than directly downward into the vegetation).

4.1.2 Utah Angelica and Wasatch Fitweed

After evaluating the Project Area for the presence of any potential Utah angelica and Wasatch fitweed habitat, surveys to identify the presence of these species within habitat were conducted in the Project Area, with particular focus on any suitable habitat identified. Utah angelica is found in very wet or boggy areas, typically in riparian communities, springs, and seeps from 1,705 to 2,070 m (5,600 to 6,800 feet) in elevation (Utah Native Plant Society 2015) Wasatch fitweed occurs in or along streams or drainages in mid-montane areas from 2,285 to 2,590 m (7,500 to 8,500 feet) in elevation (Utah Native Plant Society 2015).

4.2 Noxious Weeds

Noxious weed surveys were conducted using a GPS-based weed mapping data dictionary to map the size and density of any infestations of Utah state-listed or county-listed noxious weeds in the FERC Project Boundary. Weed surveys focused on disturbance margins within the FERC Project Boundary. Any weed locations identified were mapped as buffered points showing the approximate extent of the infestation.

4.3 Smooth Greensnake

Although there is no specific protocol for surveying for this species, qualified biologists looked for the smooth greensnake in areas with suitable habitat while conducting the Ute ladies'-tresses and noxious weed surveys. The smooth greensnake is easily identified by its unmarked, bright, satiny green dorsal surface (Redder et al. 2006).

5.0 RESULTS

On August 6, 2015, surveys were conducted for Ute ladies'-tresses, Utah angelica, Wasatch fitweed, noxious weed species, and smooth greensnake for the Weber Hydroelectric Project in areas where access was reasonable and safe.

5.1 Special-Status Plant Surveys

5.1.1 Ute Ladies'-Tresses

Small patches of suitable habitat for Ute ladies'-tresses were documented in the Project Area along the northern bank of the Weber River west of the Weber Diversion Dam (Figure 1; Figure A2). This area was dominated by willow species (*Salix* spp.) and reed canarygrass (*Phalaris arundinacea*), with patches of common spikerush (*Eleocharis palustris*). A gravel bar, located directly south of the river bank where suitable Ute ladies'-tresses habitat was documented, was unvegetated near the river's edge and densely vegetated with reed canarygrass in the center (Figure 2). No Ute ladies'-tresses individuals were observed during the survey. Most of the banks of the Weber River consist of steep rip-rap and/or dense vegetation that are not suitable habitats for Ute ladies'-tresses.

The USFWS requested that surveys for this species be repeated during the appropriate survey window in 2016 and 2017. The USFWS announced that the survey window was open on July 29, 2016. SWCA conducted a second survey for Ute ladies' –tresses in areas of suitable habitat on August 10, 2016 during the survey window. No Ute ladies'-tresses individuals were observed during the survey. The 2017 survey will be reported to the USFWS for informational purposes, and the biological assessment (BA) and draft license application will be modified, if necessary, based on this additional future information.

Figure 1. Suitable Ute ladies'-tresses habitat on the Weber River.

Figure 2. Gravel bar on the Weber River.

5.1.2 Utah Angelica and Wasatch Fitweed

No suitable habitats for Utah angelica and Wasatch fitweed were observed in the Project Area, which is generally considered to be too low in elevation to support these species, and no individuals were observed during the survey.

5.2 Noxious Weeds

Eight state-listed noxious weed species were documented in and adjacent to the FERC Project Boundary: spotted knapweed, Dalmatian toadflax, musk thistle, dyer's woad, field bindweed, Canada thistle, houndstongue, and saltcedar (Figure A3–A5). One Morgan County noxious weed species, lesser burdock, was also documented in the FERC Project Boundary. Most of the noxious weeds observed were concentrated near the parking lot of the Interstate 84 (I-84) rest stop and along the access road to the recreation site west of the rest stop. Weed occurrences within buffered points mapped were typically patchy with 1%–5% density. Field bindweed was documented at the Weber Powerhouse in the lawn (Figure A3) and south of the FERC Project Boundary (Figure A4). Dalmatian toadflax and Dyer's woad occur in the upland areas of the Project Area, typically adjacent to roads (Figures A3–A5). Houndstongue and lesser burdock were documented in the upland margins of the FERC Project Boundary east of the Weber Diversion Dam (Figure A5). Musk thistle and spotted knapweed were common in upland margins of the Weber River and adjacent to roads (Figures A4 and A5). Canada thistle occurs in the upland margins east of the Weber River Diversion Dam and in the FERC Project Boundary adjacent to the Weber River (Figure A5). A single saltcedar tree was documented along the road to the recreation site (Figure A5).

5.3 Smooth Greensnake

No smooth greensnakes were observed during the field surveys.

6.0 RECOMMENDATIONS

No suitable habitats for either Utah angelica or Wasatch fitweed were identified in the Project Area and no individuals were observed during the surveys; therefore, the relicensing of the Project will have no impacts to these species.

As noted previously, surveys for Ute ladies'-tresses will be conducted for three consecutive years (2015–2017) at the request of the USFWS. PacifiCorp will use results from all three years of survey (2015-2017) to assess potential impacts and to inform the BA. Results from the 2017 survey will be reported to the USFWS for informational purposes, and the BA and draft license application will be modified, if necessary, based on this additional information. Patches of suitable habitat for Ute ladies'-tresses were identified in the Project Area; however, no Ute ladies'-tresses individuals were documented during the 2015 and 2016 surveys (as of the date of this report, the 2017 surveys have not yet been conducted as the plants do not flower until late July-August). The Project will not impact Ute ladies'-tresses, even if present, as no changes to the Project operations are proposed.

Eight state-listed noxious weed species were documented in and adjacent to the FERC Project Boundary. Weed control considerations within the Project boundary will be addressed as the Weber draft license application is developed.

No smooth greensnakes were observed during the field surveys. The Project will not impact smooth greensnakes.

7.0 LITERATURE CITED

Redder, A.J., B.E. Smith, and D.A. Keinath. 2006. Smooth Green Snake (*Opheodrys vernalis*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/smoothgreensnake.pdf. Accessed August 14, 2015.

United States Fish and Wildlife Service (USFWS). 2011. *Utah Field Office Guidelines for Conducting and Reporting Botanical Inventories and Monitoring of Federally Listed, Proposed and Candidate Plants*. August 31, 2011. West Valley City, Utah: USFWS Ecological Services Field Office. Available at: http://www.fws.gov/utahfieldoffice/SurveyorInfo.html. Accessed August 3, 2015.

U.S. Forest Service (USFS). 2013. *Intermountain Region (R4) Threatened, Endangered, Proposed, and Sensitive Species List*. February 2013 update. U.S. Department of Agriculture, Forest Service, Uinta-Wasatch-Cache National Forest.

Utah Department of Agriculture and Food. 2010. Utah Noxious Weed List. Available at: http://ag.utah.gov/documents/UtahNoxiousWeeds.pdf. Accessed August 12, 2015.

———. 2015. County Declared Noxious Weeds in Utah. Available at: http://ag.utah.gov/documents/ISM_CountyNoxiousWeeds_2015.pdf. Accessed August 12, 2015.

Utah Native Plant Society. 2015. Utah Rare Plant Guide. Available at: http://www.utahrareplants.org/rpg_species.html. Accessed August 14, 2015.

Appendix A

Maps

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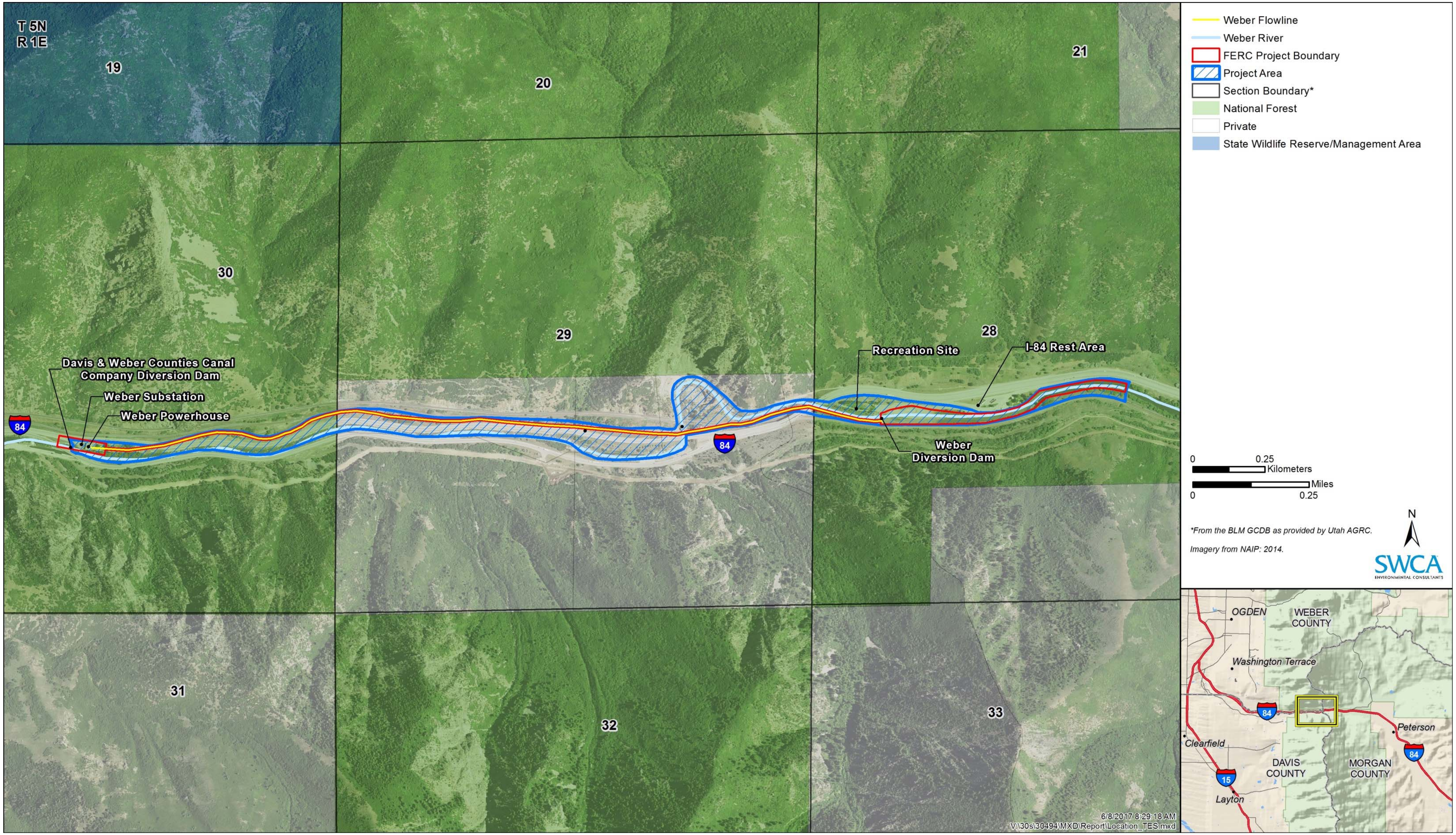

Figure A1. Location map showing Project Area and FERC Project Boundary.

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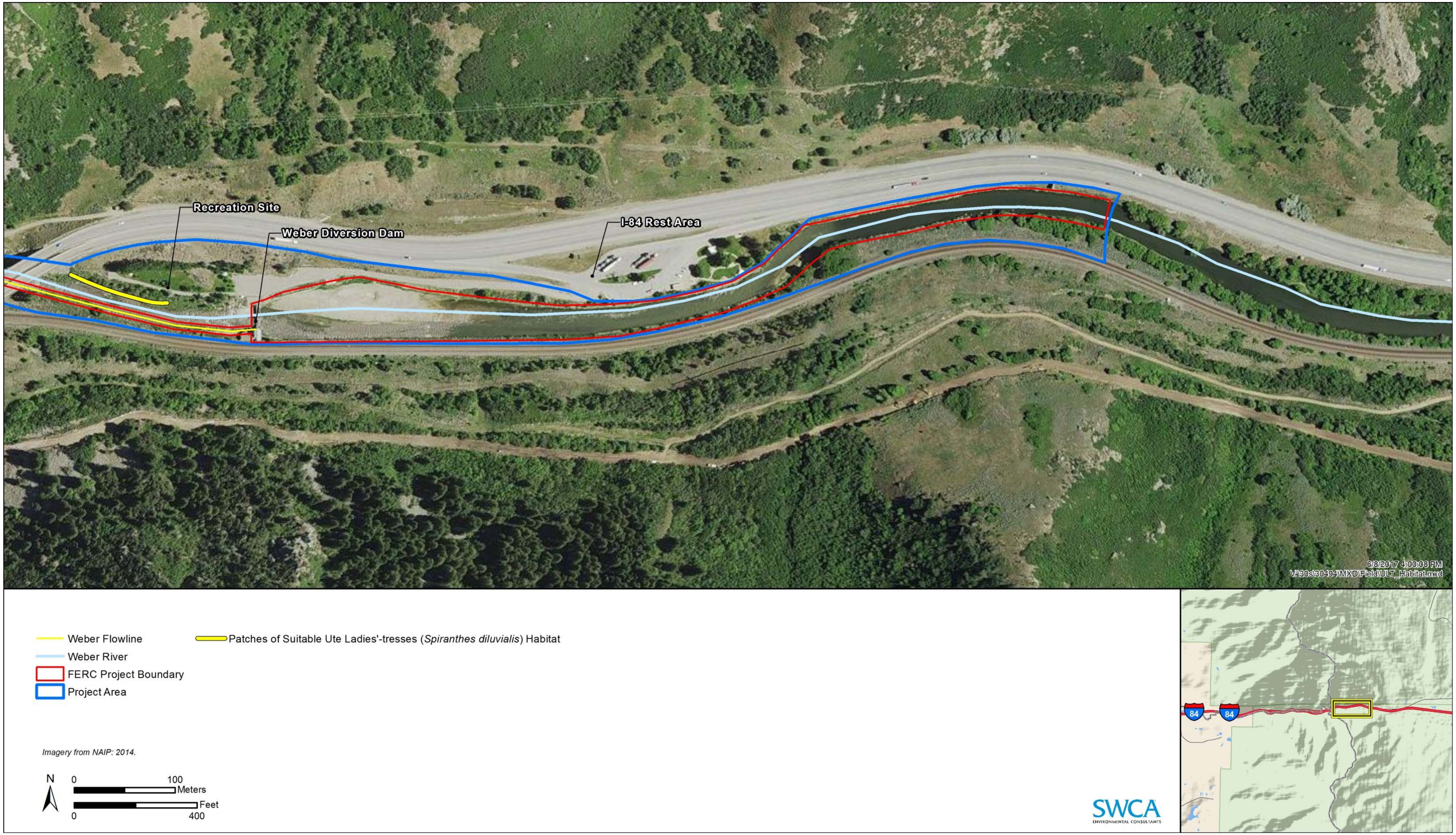

Figure A2. Suitable Ute ladies'-tresses habitat in the Project Area.

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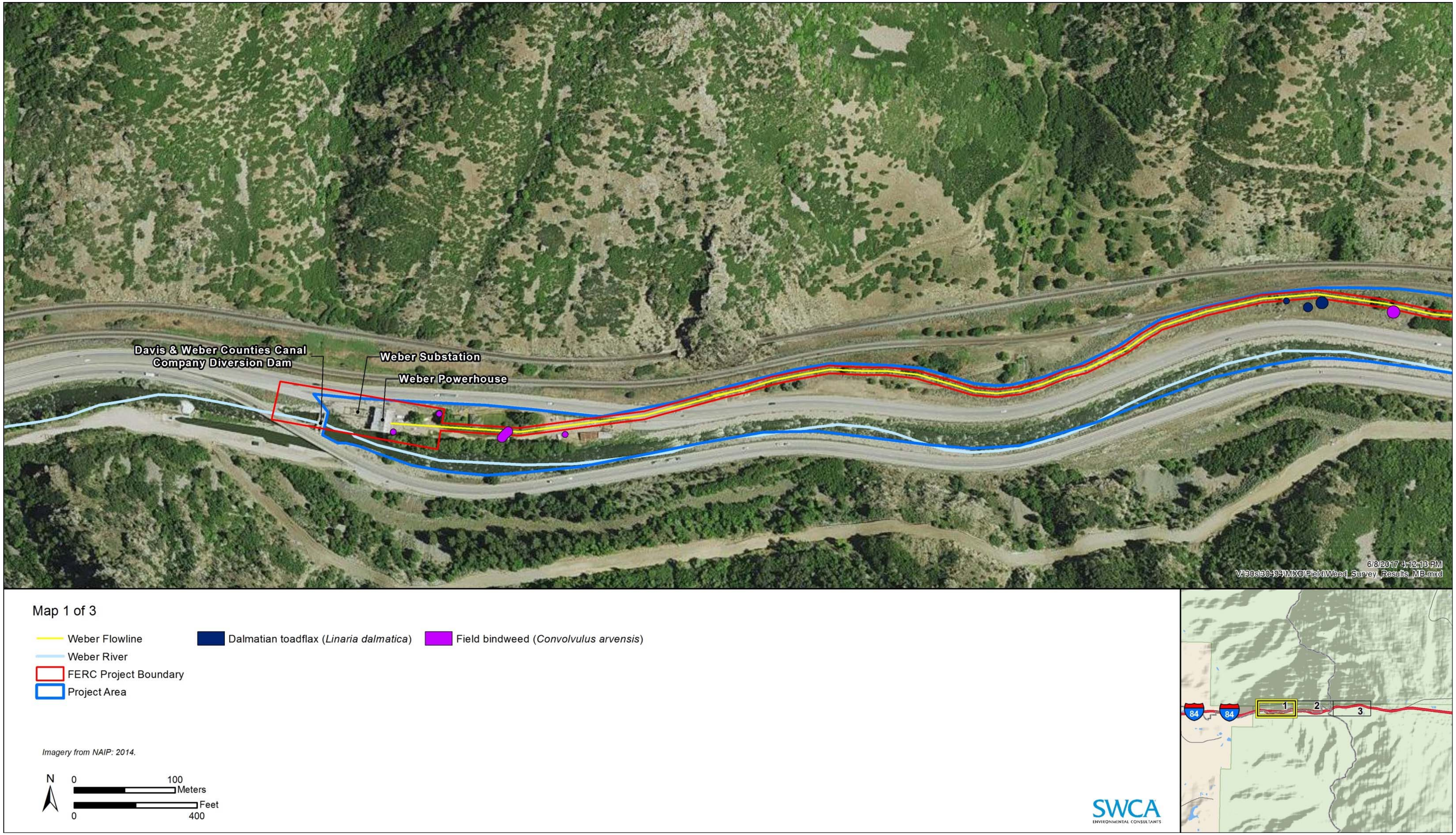

Figure A3. State- and county-listed noxious weed occurrences in and near the FERC Project Boundary, western portion of Project Area.

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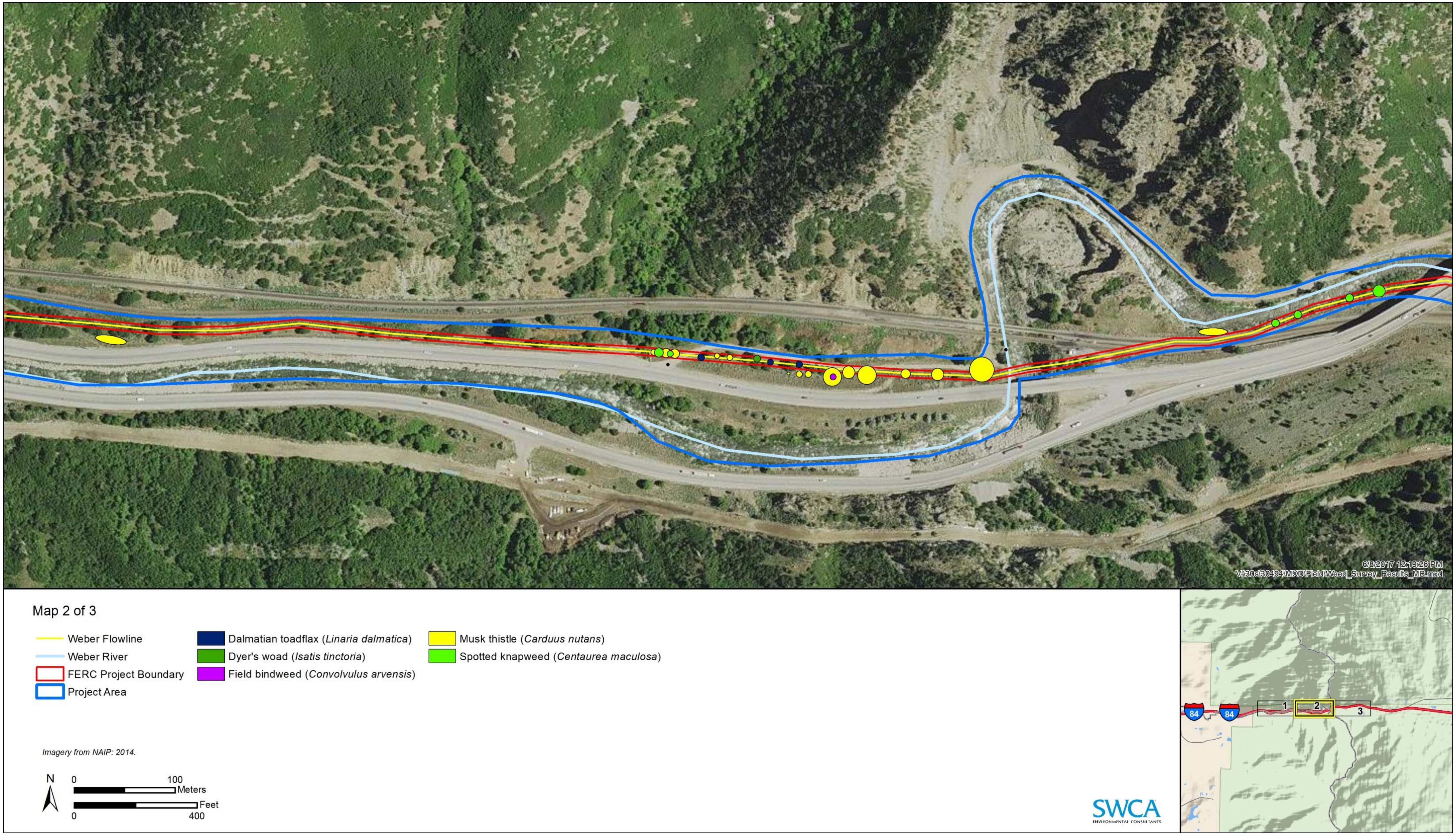

Figure A4. State- and county-listed noxious weed occurrences in and near the FERC Project Boundary, central portion of Project Area.

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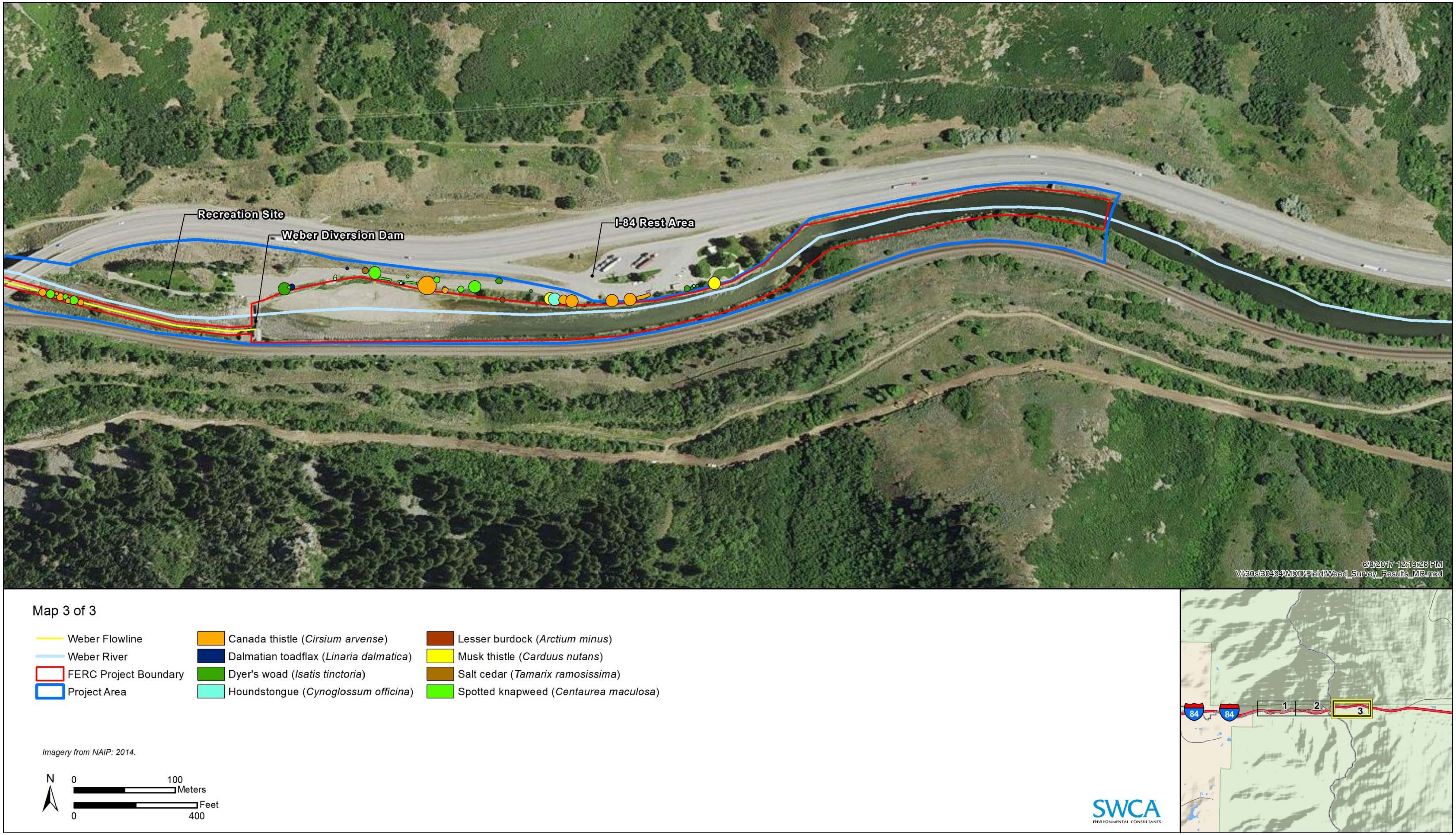

Figure A5. State- and county-listed noxious weed occurrences in and near the FERC Project Boundary, eastern portion of Project Area.

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Comment Matrix: Terrestrial Threatened, Endangered and Sensitive Species (TES) and Noxious Weeds Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
Comments on the Draft Technical Report (Review period Sept. 13 – Oct. 13, 2016)			
None			
Comments on the Preliminary Draft Technical Report (Review period Aug. 2 – Sept. 1, 2016)			
BJ/UDWR	N/A	Approval/acceptance of the technical report. Additionally noted that: "smooth greensnake did not rank as a Species of Greatest Conservation Need in our [UDWR's] new and improved, more scientifically rigorous *Utah Wildlife Action Plan*, which supplants the 2005 edition. The link to that newly finalized WAP is http://wildlife.utah.gov/wap/Utah_WAP.pdf."	N/A
KL/UDWQ	N/A	No comments	N/A
RS/WRWUA	Appendix A, Figures A1 & A3	The maps, Figures A1 & A3, notes our diversion, but calls it out as a dam too. "Davis-Weber Canal Diversion" may be the best description for both documents. ***Note***: Facility title subsequently revised on figures in all technical reports to "Davis & Weber Counties Canal Company diversion dam" per discussion and agreement with commenter 6/6/2017. Stated concern is that the structure may be misconstrued as a full spanning dam. Agreed to retain "diversion dam" nomenclature for continuity between reports.	Figures revised to rename diversion. Davis-Weber Canal revised to Davis & Weber Counties Canal Company (DWCCC). "Diversion dam" nomenclature retained.
QE/FERC	N/A	The FERC team assigned to the Weber project has no comments.	N/A
In addition to the revisions noted above, the following updated information on 2016 and 2017 surveys for the special status plant Ute ladies'-tresses was added to the Results section (p. 5): *The USFWS requested that surveys for this species be repeated during the appropriate survey window in 2016 and 2017. The USFWS announced that the survey window was open on July 29, 2016. SWCA conducted a second survey for Ute ladies' –tresses in areas of suitable habitat on August 10, 2016 during the survey window. ~~at the request of the USFWS;~~ No Ute ladies'-tresses individuals were observed during the survey. ~~surveys~~ The 2017 survey will be reported to the USFWS for informational purposes, and the biological assessment (BA) and draft license application will be modified, if necessary, based on this additional future information.* Correlative changes were made to the Recommendations section (p.7): As noted previously, surveys for Ute ladies'-tresses will be conducted for three consecutive years (2015–2017) at the request of the USFWS. ~~However, survey results and a Project impact analysis must be submitted as part of the BA before the completion of the third survey season in 2017 to meet the FERC relicensing schedule. For this reason,~~ PacifiCorp will use results from ~~the first and second~~ all three years of survey (2015~~and 2016~~-2017) to assess potential impacts and to inform the BA. ~~Survey for the third year (2017) will be conducted to confirm the presence or absence of Ute ladies'-tresses in the Project Area.~~ Results from the 2017 survey will be reported to the			

USFWS for informational purposes, and the BA and draft license application will be modified, if necessary, based on this additional ~~future~~ information. Patches of suitable habitat for Ute ladies'-tresses were identified in the Project Area; however, no Ute ladies'-tresses individuals were documented during the 2015 and 2016 surveys (as of the date of this report, the 2017 surveys have not yet been conducted as the plants do not flower until late July-August). The Project will not impact Ute ladies'-tresses, even if present, as no changes to the Project operations are proposed.

FINAL
CULTURAL RESOURCES TECHNICAL REPORT

WEBER HYDROELECTRIC PROJECT RELICENSING
FERC PROJECT NO. 1744

Prepared for

PacifiCorp—Hydro Resources
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Utah State Antiquities Project No. U-15-ST-0777fp
Public Lands Policy Coordination Office Permit No. 20
Public Lands Policy Coordination Office Permit No. 180

SWCA Project No. 35579
SWCA Cultural Resource Report No. 15-580

June 30, 2017

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ABSTRACT

Report Title. Cultural Resources Technical Report for PacifiCorp's Weber Hydroelectric Project Relicensing, Weber, Morgan, and Davis Counties, Utah, FERC Project No. 1744

Report Date. June 20, 2017

Agency Name. Federal Energy Regulatory Commission (FERC); Uinta-Wasatch-Cache National Forest (U-W-CNF)

Permit Number. Public Lands Policy Coordination Office (PLPCO) Permit Nos. 20 and 180

Land Ownership Status. U-W-CNF; Private

Project Description. PacifiCorp owns and operates 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, Utah. The current FERC license will expire on May 31, 2020. Accordingly, PacifiCorp is seeking a new FERC license through a formal relicensing process. In July 2015, PacifiCorp requested SWCA Environmental Consultants (SWCA) to conduct a formal cultural resource inventory of the Project Area to support the relicensing process.

Project Number. SWCA Project No. 35579; Utah State Antiquities Project No. U-15-ST-0777fp

Project Location. The Project Area is located in Sections 28–30, Township 5 North, Range 1 East, Weber, Morgan, and Davis Counties, Utah, Salt Lake Meridian, on the Ogden (2001) U.S. Geological Survey, Utah, 7.5-minute quadrangle.

Number of Acres Surveyed. SWCA inventoried a total of 59.97 acres (24.27 hectares [ha]). Of these, 17.05 acres (6.88 ha) were intensively surveyed, 34.45 acres (13.94 ha) were surveyed at a reconnaissance level, and 8.46 acres (3.40 ha) were not surveyed because they are existing paved roads. Of the 59.97 acres (24.27 ha), 29.93 acres (12.11 ha) are on privately owned lands and 30.04 acres (12.16 ha) are on lands administered by the U.S. Forest Service.

National Register of Historic Places– (NRHP–) Eligible Sites. Three sites: 42DV184/42WB344/42MO59, 42MO75/42WB523, and 42WB328.

NRHP-Ineligible Sites. None.

Recommendations. SWCA documented two sites during the inventory of the Project Area: 42DV184/42WB344/42MO59 (a segment of the Union Pacific Railroad) and 42MO75/42WB523 (a previously unrecorded segment of historic U.S. Highway 30 South (U.S. 30S). The new segment of the Union Pacific Railroad is considered a contributing segment of the site and is recommended eligible for the NRHP under Criterion A. U.S. 30S is a historic highway through Weber Canyon that is now Interstate 84. SWCA recommends U.S. 30S eligible for the NRHP under Criterion A. The Devil's Gate Weber Hydroelectric Power Plant Historic District

(42WB328) has been previously documented, and no updated documentation is needed; the district was added to the NRHP in 1989.

With the exception of potential fish passage facilities, there are no proposed changes to the existing Project facilities or infrastructure that could adversely affect these sites. Any impacts from fish passage construction or continued operation of the Project would occur within the FERC Project Boundary. PacifiCorp prepared and implemented a cultural resource management plan as part of their 1990 FERC license to address potential adverse impacts from the Project. PacifiCorp will follow the standards and procedures outlined in the plan (and modify the document as necessary) in coordination with the State Historic Preservation Office for proposed fish passage construction and continued operation and maintenance, as well as any new proposed construction. No significant impacts to cultural resources are expected from this re-licensing effort. Therefore, SWCA recommends a finding of **no adverse effect** for this project.

CONTENTS

APPENDICES

FIGURES

TABLES

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1.0 INTRODUCTION

PacifiCorp owns and operates 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, Utah.. The current FERC license will expire on May 31, 2020. Accordingly, PacifiCorp is seeking a new license through a formal relicensing process. The Project has a generation capacity of 3.85 megawatts (MW) and is located partially on federal lands managed by the Uinta-Wasatch-Cache National Forest (U-W-CNF) and partially on private 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 FERC's Alternative Licensing Process (ALP) for the Project on May 29, 2015.

During preparation of the PAD (PacifiCorp 2015), PacifiCorp conducted a desktop-level assessment to evaluate existing information on potential cultural resources in the Project Area and to assess potential Project impacts on these resources. In summary, the desktop assessment identified two cultural resource sites located in the Project Area (the Union Pacific Railroad and the Devil's Gate Weber Hydroelectric Power Plant Historic District [the Weber Plant's historic name]) and one potential historic resource (a historic road feature depicted on an 1891 General Land Office [GLO] map). The assessment determined that it is unlikely that cultural resource surveys within the Project Area would have identified additional cultural resources because of the existing development along the narrow canyon floor (e.g., multiple pipelines, railroads, Interstate (I) 84, and the Project). The assessment further determined that it is unlikely that any subsurface deposits containing important information on regional prehistory or history are present. No significant impacts to cultural resources are expected from continued operation of the Project because no new ground-disturbing activities are proposed in any previously undisturbed areas. PacifiCorp prepared and implemented a cultural resource management plan (PacifiCorp 1991) as part of their previous FERC license to address potential impacts to the existing historical district. PacifiCorp will follow the standards and procedures outlined in this plan, in coordination with the State Historic Preservation Office (SHPO), for continued operation and maintenance and new proposed construction.

Based on information in the PAD, PacifiCorp prepared a cultural resource study plan (PacifiCorp 2016). In August 2015, PacifiCorp requested that SWCA Environmental Consultants (SWCA) implement the cultural resources study plan by conducting a formal cultural resource inventory of the Project Area to verify the results of the PAD assessment.

All cultural resource work for the Project was conducted under authority of Utah State Antiquities Project No. U-15-ST-0777fp and Public Lands Policy Coordination Office Principal Investigator Permit Nos. 20 (issued to Lisa Krussow) and 180 (issued to Dave N. Schmitt). All photographs, field notes, and geographical information system (GIS) data are archived at the SWCA office in Salt Lake City, Utah, under project number 35579.

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. The Project Area includes all Project features (encompassing the FERC Project Boundary as defined above), and which extends out for the purposes of characterization and analysis from the furthest edge of the Project Boundary, and 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:

- a 27-foot-high, 79-foot-long concrete diversion dam on the Weber River with two radial gates that are approximately 29 feet wide and a 35-foot-wide intake structure, for a total width of 114 feet;
- a 9,107-foot-long, 5.0-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;
- a 3 × 18-foot, non-operative fish passage structure that will also serve to pass the minimum flow through the calibrated slide gate opening;
- a powerhouse containing a generating unit with a rated capacity of 3,850 kilowatts (kW) operating under a head of 185 feet producing a 30-year average annual energy output of 16,932 megawatt-hours (MWh);
- a discharging pipe returning turbine flows into the Weber River at the powerhouse; and
- a 77-foot-long, 46-kilovolt (kV) transmission line that connects to the Weber substation.

SWCA inventoried a total of 59.97 acres (24.27 hectares [ha]). Of these, 17.05 acres (6.88 ha) were intensively surveyed, 34.45 acres (13.94 ha) were surveyed at a reconnaissance level, and 8.46 acres (3.40 ha) were not surveyed because they are existing paved roads. Of the 59.97 acres (24.27 ha), 29.93 acres (12.11 ha) are on privately owned lands and 30.04 acres (12.16 ha) are on lands administered by the U.S. Forest Service (USFS). The Project Area is located in Sections 28–30, Township 5 North, Range 1 East.

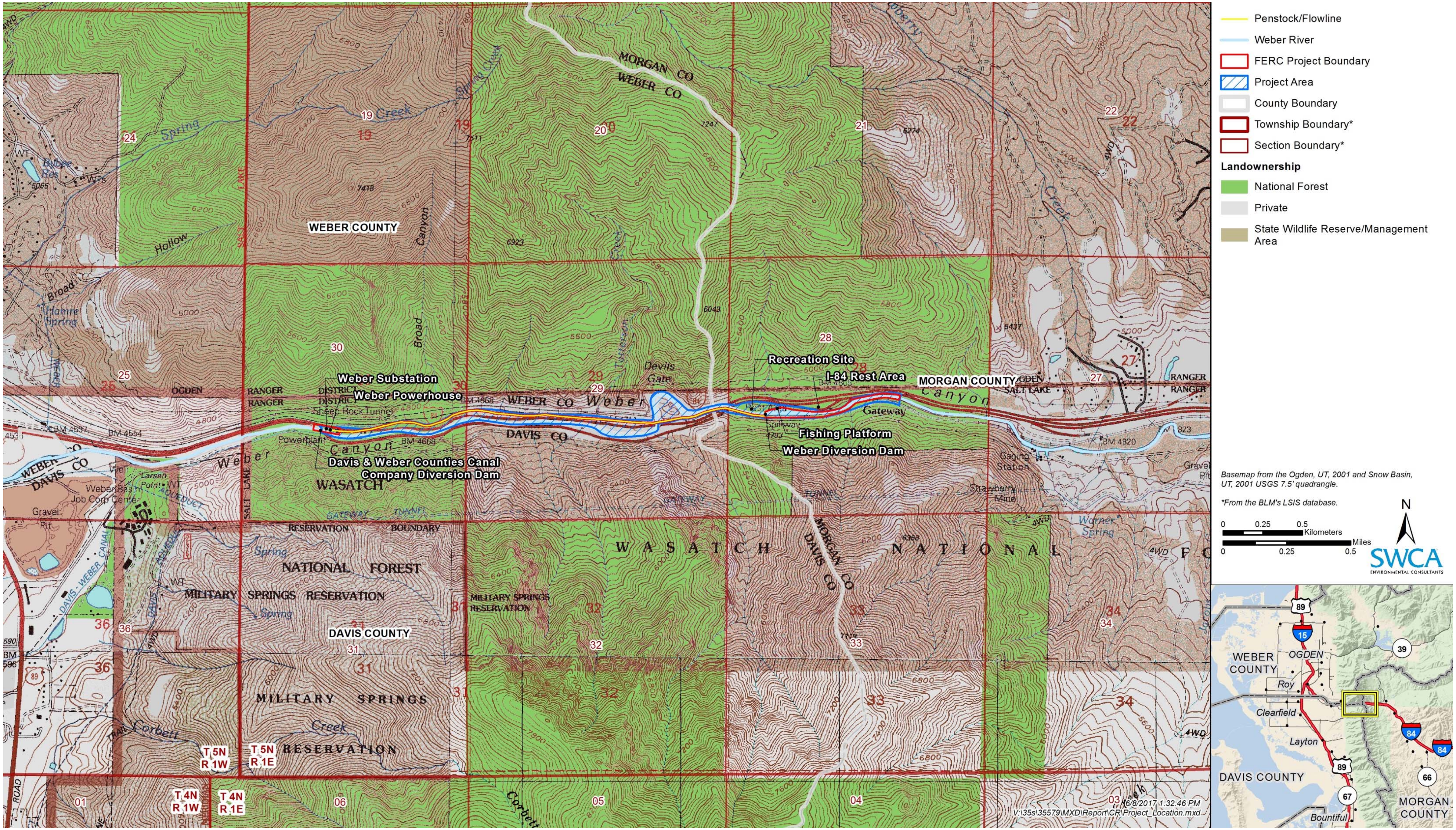

Figure 1. Location of the Weber Hydroelectric Project.

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3.0 ENVIRONMENT

The Project Area is located along the bottom of Weber Canyon. The Weber River flows through the center of the canyon. Vegetation in the canyon consists of Gambel oak (*Quercus gambelii)*, mountain mahogany (*Cercocarpus* ssp.), rabbitbrush (*Chrysothamnus* ssp.), big sagebrush (*Artemisia tridentate)*, willows (Salicaceae), Russian olive (*Elaeagnus angustifolia*), and various riparian grasses and forbs. Soils are the result of colluvial and alluvial deposition. The Weber River, which begins in the Uinta Mountains, runs through Weber Canyon and empties into the Great Salt Lake.

4.0 CULTURAL CONTEXT

The following sections provide a general context in which to evaluate the resources that have been newly identified in the Project Area. Only those periods where known or suspected cultural resources are present in the Project Area are discussed here.

4.1 Early Exploration and Settlement (A.D. 1776–1870)

The first documented occurrence of non-native peoples to visit northern Utah happened in 1776, when an expedition led by Spanish friars Francisco Atanasio Dominguez and Silvestre Velez de Escalante entered the Utah Valley (May 1987:24). The Spanish expedition never made it as far north as the Salt Lake Valley, and no permanent Spanish presence was established along the Wasatch Front as a result of their explorations (Sillitoe 1996:17). Other Euro-American explorers soon followed the Spaniards, and by the 1820s trappers Louis Vasquez, Etienne Provost, and Jim Bridger had all been separately credited with "discovering" the Great Salt Lake (Sillitoe 1996:17). Famed fur trader Jedediah Strong Smith was also reported to have explored the northern portion of the Salt Lake Valley in 1826 and 1827 on behalf of the Smith, Jackson, and Sublette Fur Company (DeLafosse 1998; May 1987:35–36).

In the following decades, trappers and traders frequented the streams and lakes of the area in search of beaver and other fur-bearing mammals. Numerous trading posts and rendezvous locales were soon established across the entire Great Basin where pelts could be traded or sold for money or goods. Many Native Americans in the region benefited from the fur trade, trading pelts and other goods for weapons, iron utensils, and other items of use; however, in the process of interacting with Euro-American trappers, many Native Americans were also exposed to new diseases for which they had no immunity and which reduced their overall health and ultimately their population (Alexander 1996:65; Sillitoe 1996:18). The availability of liquor also introduced alcoholism, a Euro-American vice, to the tribes, thus further undermining native cultures (Alexander 1996:65; Sillitoe 1996:18). Declining beaver populations, shifting fashions, and falling fur prices eventually led to a nation-wide collapse of the fur trade by the early 1840s (Alexander 1996:62; May 1987:37; Sillitoe 1996:18). By 1844, the majority of regional trading posts had been abandoned, effectively ending the fur business in Utah.

In the early 1840s, the federal government took a more concerted interest in the area, sending several surveyors to develop more accurate and comprehensive maps of the western U.S. Among these surveyors was John C. Frémont who, in 1843 and 1845, issued reports on the Salt Lake Valley and Wasatch Mountain Range. Frémont's reports would later serve as a reference for Brigham Young during the Mormon migration westward (Leonard 1999:8; May 1987:52).

In 1841, an immigrant party led by John Bidwell and John Bartleson traveled along the northern boundary of the Great Salt Lake while in search of an alternate route to California (May 1987:50). The establishment of this route to California through the Great Basin increased the number of travelers through northern Utah. Within a few years, five wagon-parties had followed the alternate route through what would later become Davis County. Among these groups was the ill-fated Donner-Reed party who passed through the area in 1846. The Donner-Reed party deviated from the well-known immigrant route through Weber Canyon, opting instead to travel a route proposed by Lansford Hastings through Emigration Canyon, the route that would be followed later by the Mormon pioneers (Carlstrom and Furse 2003:23–26; Leonard 1999:2).

4.2 Railroads

Following the passage of the Pacific Railway Act of 1862, Union Pacific was organized on October 29, 1863. The railroad officially arrived in Utah by way of Echo Summit the last week of December in 1868. Construction was completed to the mouth of Weber Canyon by February 28, 1869. The first Union Pacific train arrived in Ogden on March 8, 1869 (Strack 1997). While the Union Pacific line was being constructed, the Central Pacific line originating in Sacramento was moving eastward and was making considerable progress. Both railroad companies were operating with grants under the Pacific Railway Act, and right-of-way was being granted according to how much construction was completed. Central Pacific had design plans for track extending into Weber Canyon. It came to the attention of Congress that both railroad designs were parallel and were very close to overlapping in many places, and the government quickly mandated that a meeting point would have to be established by the two companies or else it would be decided for them. As a result, the meeting at Promontory Point was fixed. On May 9, 1869, an official telegraph was sent stating that the road to Promontory Point was completed. It was also established in the agreement that a permanent junction between the two lines would be located within 8 miles of Ogden (Strack 1997). This junction eventually came to be known as Hot Springs, but as a result of the mediocre response by the public to purchasing lots there a new location was chosen near present-day Harrisville and was named "Junction City." The first locally generated freight shipped on this line was ore from mining operations in the Wasatch and the Oquirrh Mountains (Strack 1997).

Within a week of the golden spike ceremony held to commemorate the junction of the Union Pacific and Central Pacific lines at Promontory Point, ground-breaking for a railway connecting Ogden with Salt Lake City had begun. Brigham Young began construction of the Utah Central line in late May 1869 when he realized that the Union Pacific and Central Pacific lines were to be routed north of the Great Salt Lake, not through Salt Lake City and south around the Great Salt Lake. Union Pacific provided the equipment and track to construct the line. Young also collected on the debts owed to him by Union Pacific to assist in constructing grades for the line heading to Promontory. The Utah Central line was completed in early January 1870, connecting the largest city between Denver and San Francisco to the trans-continental line and to Ogden.

4.3 Highways

Road construction during the early history of Utah was funded by tolls, poll taxes, private funds, and, occasionally, the Territorial Government of Utah. Wagon roads were in demand to help transport goods and people across the state, especially before the completion of the railroad in 1869. It was not until 1909 that the Utah State Road Commission was created to address the issue of state highways (Knowlton 1963:135). "By 1920, the commission had inventoried 1,200 miles of roads" and "almost all roads were constructed or maintained by federal money" (Haymond 2008). With the passage of the Federal Highway Act of 1921, "which provided money to improve seven percent of states' road systems," Utah began building even more roads (Haymond 2008). A consistent, national method of numbering highways was recommended by the American Association of State Highway Officials to the federal government in 1924, and this method was officially adopted in 1925 (Weingroff 2013). This would lead to Utah's efforts to get one of their roads officially designated U.S. Highway 30 (U.S. 30). Eventually, the numbering committee decided to split the number into U.S. 30 North (N) and U.S. 30 South (S), with Utah being given the U.S. 30S designation in 1926 (Weingroff 2013). With the creation of the national system of interstate and defense highways in the 1950s, Utah found itself with several interstate highways: 15, 70, 80, and 80N (U.S. Department of Transportation 1976:474). Eventually, I-80N through Weber Canyon would be renumbered I-84 in 1977 to reduce confusion over the I-80 and I-80N designations (Utah Department of Transportation 2008).

5.0 PREVIOUS RESEARCH

A search of project, site, and preservation files was conducted using the Utah Division of State History's (UDSH) Preservation Pro on February 23, 2015, and updated on July 16, 2015. In addition, a file search was conducted by the U-W-CNF on July 21, 2015. In all, 20 archaeological projects have been conducted within 1 mile of the Project Area (Table 1). Of the 20 projects, three have been conducted within the Project Area. In the course of the 20 projects, 12 sites were documented with two of these sites (42WB328, the Devil's Gate Weber Hydroelectric Power Plant Historic District and 42MO59 the Union Pacific Railroad) occurring within the immediate Project Area (Table 2). Although the Devil's Gate Plant was formally renamed the Weber Plant in 1917, the National Register of Historic Places (NRHP) registration form retains both names. The Weber Historic District was added to the NRHP in 1989. While several historic canal sites were identified within 1 mile of the Project Area during the file search, none of the canals cross the Project Area. One historic architectural locality (Union Pacific Gateway Bridge Record No. 112955) was identified in the UDSH historic files, but it is not located within the Project Area.

In addition, GLO plat maps and several GIS layers were examined for potential cultural resources. These layers, available from state and federal agencies, include the NRHP properties, Utah historic trails, Utah historic districts, historic topographic maps, and other historic aerial imagery. Two NRHP properties were identified within 1 mile of the Project Area: the previously mentioned Devil's Gate Weber Hydroelectric Power Plant Historic District (42WB328) and Farmington Main Street Historic District. The Farmington Main Street Historic District is not located in the Project Area.

Table 1. Previous Projects Conducted within 1 Mile of the Project Area

Project Number	Project Title	Consultant
U84SJ0416	2 GrvlProspts/Weber Cyn nr Mt Green Cemetery/UDOT	Sagebrush Archaeological Consultants (Sagebrush)
U84SJ0425	Historical Assessment/W Gateway Hydroelectric Project	Sagebrush
U87CN0615*	AT&T Fiber Optics Cable Cheyenne-Sacramento	Centennial Archaeology
U88NP0463	El Monte-Weber 46 KV Relocation	A.K. Nielson and Associates
U89BC0057†	–	–
U89BC0578	Stoddard Diversion Dam and Gateway Canal	BYU - Office Of Public Archaeology (BYU-OPA)
U90FS0228*	Weber Power Plant Picnic Area	USFS
U96JB0167	3 Pipeline Segments for Ogden Valley Project	JBR
U04UQ0416	Uintah U	Utah Division of Wildlife Resources (DWR)
U05FS0495	Mountain Green Hazardous Fuels (WS-05-730)	USFS
U06ST1822*	Rocky Mountain Pipeline- Legacy to SLC 16" Exploration	SWCA
U08LI1172	Questar Pipeline Replacement	Logan Simpson Design Inc. (LSD)
U08ST0600	Addendum To CRI Of The RMPS SLC 16" Pipeline	SWCA
U09ST0590	Davis & Weber Canal Improvements	SWCA
U09UQ0582	Lower Weber River Diversion Dam Modernization	UDWR
U11BC1133	DOGM Foothill Mine Inventory	BYU - OPA
U11LI0050	A Class II Cultural Resources Reconnaissance of the Questar Pipeline's ML3 Peterson and Henefer Segments Replacement Project in Morgan and Summit Counties, Utah	LSD
U12LI0642	A Class III Cultural Resources Inventory of Questar Pipeline's ML3 Weber Canyon Segment Replacement Project in Davis and Morgan Counties, Utah	LSD
U12XN0453	Cultural Resources Inventory for the 2012 Davis County Emergency Watershed Protection (EWP) Project Davis County, Utah	Native-X Inc
U13TD0314	Additional Work For Questar's Mainline 3 In Weber County	Tetra Tech

Note: The project titles listed in this table are taken directly from Preservation Pro, and have not been edited.

*Projects conducted in the Project Area.

†Copies of this report are not available from UDSH.

Table 2. Previously Documented Cultural Resources within 1 Mile of the Project Area

Site Number	Site Class	Site Type	NRHP Eligibility
42DV120	Historic	Canal (Davis & Weber Canal)	Eligible
42DV121	Historic	Retaining walls	Not eligible

Table 2. Previously Documented Cultural Resources within 1 Mile of the Project Area

Site Number	Site Class	Site Type	NRHP Eligibility
42DV131	Historic	Canal (Davis & Weber Canal)	Eligible
42DV143	Historic	Canal (South Weber Irrigation Canal)	Eligible
42MO5	Prehistoric	Open campsite	Undetermined
42MO7	Prehistoric	Lithic scatter	Undetermined
42MO16*	–	–	–
42MO59†	Historic	Railroad (Union Pacific Railroad)	Eligible
42MO68	Historic	Historic hard rock mine (Strawberry Mine)	Not eligible
42WB142	Prehistoric	Open campsite	Undetermined
42WB328†	Historic	Devil's Gate/Weber Hydroelectric Power Plant Historic District	NRHP-listed
42WB465	Historic	Canal (Uintah Central Canal)	Eligible

*Copies of these site forms are not available from UDSH.

† Sites located in the Project Area.

Several potential historic resources were identified within 1 mile of the Project Area on GLO maps (Salamon 1891 T 5N R 1E; Ferron 1871 T 5N R 1E; Ferron 1871 T 5N R 1W): three unnamed roads, two unnamed buildings, two unnamed bridges, a flag station, a section house, a field, and the Union Pacific Railroad. Only two of these resources are located in the Project Area: the Union Pacific Railroad and one of the unnamed roads. This portion of the railroad has not been previously documented but is part of the historic alignment of the Union Pacific Railroad. The unnamed road is historic highway U.S. 30S. In addition, the flag station, the section house, and one of the unnamed bridges are related to the Union Pacific Railroad, but they do not fall within the Project Area.

The previous cultural inventory projects conducted within 1 mile of the Project Area have covered only a small portion of the Project Area (Appendix A). It is unlikely that additional survey within the Project Area would identify new cultural resources due to the heavy disturbances from I-84 and various Union Pacific Railroad and pipeline rights-of-way, as well as the construction of the hydroelectric project. Given the number and extent of these undertakings, it is unlikely that any subsurface deposits containing important information about the prehistory or history of the region remain intact.

6.0 METHODS

Prior to conducting field surveys, SWCA obtained a permit and notice to proceed for archaeological investigations on U-W-CNF land from the U-W-CNF Heritage archaeologist. SWCA executed an intensive pedestrian survey using parallel transects spaced 15 meters (m) (50 feet) apart across the Project Area to identify any cultural resources. The archaeologist visually inspected the ground on each side to an approximate distance of 7.5 m (25 feet). The survey line was abandoned only when necessary to evaluate a particular feature or area. After inspection of such a feature or area, the survey line was resumed. Data gathered during the file search were loaded onto the global positioning system (GPS) units and plotted on field maps carried by the crew, which enabled known archaeological sites or potential cultural resources such as GLO features to be located while surveying.

Portions of the Project Area were not intensively surveyed but were visually inspected for cultural resources from the closest safe distance (i.e., reconnaissance-level survey) due to safety reasons and/or lack of access (Appendix B). These areas included the fenced-off portions of the Weber River banks and a small area of slope exclusion at the western extent of the Project Area. Areas not surveyed include the I-84 pavement. These areas are noted on the survey results map in Appendix B. This reconnaissance-level survey consisted of careful visual investigation from the nearest accessible point to identify features that are common with steep terrain and exposed river cut-banks (e.g., mining features, granaries, and rock art) or along river banks (e.g., artifact deposits). See Appendix B for the Class III results map showing areas of intensive survey versus reconnaissance survey.

The field crew used a Trimble GeoExplorer XT GPS unit with the SWCA-created data dictionary to collect Project Area data and to map and document encountered cultural resources while surveying. Trimble's Pathfinder Office software was used to process the GPS data in the office. The GPS data were differentially corrected and exported in Esri's ArcView shapefile format using the Universal Transverse Mercator (UTM) Zone 12 North, North American Datum (NAD) 83 datum coordinate system. A Project-specific geodatabase was generated in Esri's ArcGIS 10.3. The shapefiles were loaded into the Project-specific geodatabase and cleaned, and the attribute table of the cultural resources database was then populated with the appropriate values. All maps for this report were generated using ArcGIS 10.3.

When cultural resources were identified during the survey, SWCA archaeologists applied the BLM guidelines to determine if the resources constituted a site or isolate. All resources were documented to the standards of the Utah SHPO and USFS on Intermountain Antiquities Computer System (IMACS) forms. Site and isolated occurrence (IO) definitions given by BLM guidelines were followed throughout the survey (Bureau of Land Management 2002:6). In general, a site is defined as a location of purposeful prehistoric or historic human activity. An activity is considered to have been purposeful if it resulted in a deposit of cultural materials beyond the level of one or a few artifacts. BLM definitions are as follows:

Sites should contain remains of past human activity that are at least 50 years old and should consist of one or more of the following:

1. At least 10 artifacts of a single class (e.g., 10 sherds) within a 10-m diameter, except when all pieces appear to originate from a single source (e.g., one ceramic pot, one glass bottle).
2. At least 15 artifacts that include at least two classes of artifact types (e.g., sherds, nail, glass) within a 10-m-diameter area.
3. One or more archaeological features in temporal association with any number of artifacts.
4. Two or more temporally associated archaeological features without artifacts.

All linear cultural resources were documented as per the Utah Professional Archaeological Council linear sites guidelines (Utah Professional Archaeological Council 2008). Sites were delineated based on Project Area and land ownership boundaries. If a site extended into an area that was not accessible, this was clearly indicated on the site record. In addition, SWCA revisited all previously documented sites in the Project Area and documented them on an IMACS form. SWCA documented digital datums and did not place physical datums for this project.

Site recording included a written description of a site's general location and setting, as well as a description of the observed artifacts and features. Recording also included creating a site sketch map; photographing the site, features, and artifacts; and mapping the site boundaries, datum, features, and diagnostic artifacts by GPS. All photographs were taken using a high-resolution digital camera. Sites were documented on a combination of IMACS paper forms and tablet computers. All data from the tablet computers were collected in an application that incorporates all of the information required on the IMACS forms. Tablet data were uploaded to SWCA's in-house IMACS generator when the survey was complete. The IMACS forms for all recorded sites are presented in Appendix C. No artifacts were collected during this inventory.

7.0 INVENTORY RESULTS AND EVALUATIONS

The intensive- and reconnaissance-level inventory was conducted by an SWCA archaeologist on October 5, 2015. SWCA documented a new segment of the previously recorded Union Pacific Railroad 42DV184/42WB344/42MO59 and one newly recorded site, a previously unrecorded segment of U.S. 30S (42MO75/42WB523). The original documentation of the Devil's Gate Weber Hydroelectric Power Plant Historic District (42WB328), prepared for the previous license, was reviewed by the SHPO and found to be adequate; therefore, no updated documentation was needed (email correspondence between Lindsey Kester, SWCA, and Chris Hansen, SHPO, on July 2, 2015). Complete IMACS site forms are provided in Appendix C.

7.1 42DV184/42WB344/42MO59, Union Pacific Railroad

Site Type/Function: Railroad

Period: Historic

Eligibility: Eligible

SWCA recorded a new segment of the Union Pacific Railroad along the Weber River in Weber Canyon. The new segment is located in Davis, Weber, and Morgan Counties (42DV184/42WB344/42MO59) and measures 2,380 m (7,808 feet). Other segments of the Union Pacific Railroad site have been previously documented in multiple Utah counties: Davis (42DV87 and 42DV184), Grant (42GR3429), Iron (42IN1751 and 42IN2731), Juab (42JB1041), Millard (42MD1581 and 42MD1792), Morgan (42MO59 and 42MO60), Sanpete (42SA183 and 42SA550), Salt Lake (42SL300 and 42SL344), Summit (42SM452), Tooele (42TO1298), Utah (42UT1029), Wasatch (42WA75 and 42WA291), Box Elder (42BO822), and Beaver (42BE2012 and 42BE2013).

The construction of the railroad was of vital importance to the development of the western United States. The Union Pacific Railroad became the first transcontinental railroad in 1869 when the eastern and western tracks met in Promontory Point, Utah (Ambrose 2000). The Weber Canyon section was first built in 1868, and the second line was placed in 1916 (Strack 1997). The railroad has experienced modifications and upgrades since that time and is still in use.

The newly recorded segment of the Union Pacific Railroad consists of two active railroad tracks and an upgraded modern bridge. One of the bridge supports is stamped with "1916," the date of the second line construction, and, although this alignment appears historic, it has been subjected to modern modifications including standard-gauge tracks, modern ties, and modern utility facilities (Figure 2). The grade is non-native crushed rock fill, and no artifacts or additional historic features were associated with this newly recorded segment.

Figure 2. The Union Pacific Railroad and modern modifications, view facing northwest.

7.1.1 NRHP Recommendation

In 2015, SWCA recorded a new segment of the Union Pacific Railroad (42DV184/42WB344/42MO59) in Weber Canyon that retains historic integrity of location, setting, context, and association. However, because of modern modifications and surrounding developments, the integrity of workmanship, feeling, and material have been compromised. Overall, the Union Pacific Railroad is recommended eligible for the NRHP under Criteria A and C because of its importance in the role of transportation during the early 1900s, and because of specific railroad features that are considered examples of early railroad construction style (Corbeil 2008).

The site, as a whole, is associated with "a specific event marking an important moment in American prehistory or history and a pattern of events or a historical trend that made a significant contribution to the development of a community, a State, or the nation" (National Park Service 1997:12) and, therefore, has been recommended eligible for the NRHP under Criterion A. The newly documented segment retains those criteria and is recommended as a contributing segment to the site's overall eligibility under Criterion A.

Many individuals contributed to the construction of the Union Pacific Railroad. Although Brigham Young is often credited as being instrumental to the construction of the railway through Weber Canyon, this segment of the railroad cannot be positively associated with any specific "individuals whose activities are demonstrably important within a local, State, or national historic context" (National Park Service 1997:14). Because the newly recorded segment does not add additional information under this criterion, SWCA concurs with previous recommendations and recommends that the site is not eligible for the NRHP under Criterion B.

Other segments of the Union Pacific Railroad have contributing historic features that are indicative of early railroad construction, but the newly recorded segment has undergone rather extensive modern construction and upkeep and does not include any of these features. Moreover, this segment does not show distinctive architectural or engineering characteristics, patterns, types, or styles, nor does it "embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic values; or represent a significant and distinguishable entity whose components may lack individual distinction" (National Park Service 1997:21). Therefore, this segment of the Union Pacific Railroad is considered a noncontributing portion of the site's overall eligibility under Criterion C, and is recommended as not eligible under this criterion.

The Union Pacific Railroad is still active and has had many modern modifications. The railroad grade is composed of non-native gravels on the ground surface. Although excavation must have occurred to build the bridge supports, there is little (if any) potential for subsurface cultural features or artifacts because of the general methods used in railroad construction (i.e., placing crushed gravel on the ground surface and laying down steel ties). Because of these reasons, the Union Pacific Railroad as a whole has been recommended as not eligible for the NRHP under Criterion D. No historic artifacts or additional features were observed in the newly recorded segment, and, as with the overall Union Pacific Railroad site, it is unlikely to "have, or have had, information to contribute to our understanding of human history or prehistory" that is "considered important" (National Park Service 1997:21). Consequentially, SWCA concurs with previous recommendations and recommends that the Union Pacific Railroad be considered not eligible under Criterion D.

In summary, SWCA recommends that the newly recorded segment contributes to the Union Pacific Railroad's eligibility for the NRHP under Criterion A.

7.2 42MO75/42WB523, Historic U.S. 30S

Site Type/Function: Historic feature

Period: Historic

Eligibility: Eligible

In October 2015, SWCA recorded a segment of the U.S. 30S alignment in Weber Canyon. The road segments follow the northern bank of the Weber River and the Union Pacific Railroad through the bottom of Weber Canyon. Surrounding sediments consist of light brown gray loam with some gravels. Vegetation consists of various riparian grasses and forbs growing up through the remaining asphalt road. The depositional context consists of primarily colluvium with some alluvial deposits.

The segment of U.S. 30S is approximately 13 feet wide with an asphalt and dirt surface. Approximately 650 feet of the east end of the segment is dirt, and the portion from the edge of I-84 to the start of a major oxbow in the western portion of the segment (Figure 3) is also dirt. The portion along the oxbow has an asphalt surface and concrete retaining walls (Figure 4) on the river side. The retaining walls were built with two different construction methods, but the walls extend only 5–12 inches above the roadbed. One section was built using formed concrete and has a footer along the bottom portion where the wall meets a layer of riprap. The other section is built of mortared rock using shaped stones and a formed concrete cap. The formed concrete portion is in poor condition, and the rock wall is in fair to good condition. The roadbed is approximately 3 inches thick and is visible in areas where the roadbed is damaged. Overall, the road is in poor condition, and although it is suspected that the road continued east and west along Weber Canyon, no evidence of the historic alignment was observed.

Figure 3. View of U.S. 30S from its eastern end toward the oxbow, facing west.

Figure 4. Retainer walls of U.S. 30S along the Weber River, view facing east.

The old road alignment ran between Granger, Wyoming, and Burley, Idaho, via Ogden, Utah (U.S. Geological Survey 1956 [1955]; Weingroff 2013; Workers of the Writers' Program of the Works Projects Adminstration for the State of Utah 1941:353–354). The road was likely constructed over the original paths used by settlers and pioneers who traveled through Weber Canyon, and was used between 1926 and 1972 (Droz 2010; Weingroff 2013). It was designated I-80N as part of the development of the interstate system (Droz 2008, 2010) and was re-designated I-84 in 1977 by the Utah Department of Transportation, and conditionally approved by the American Association of State Highway and Transportation Officials (Utah Department of Transportation 2008).

The road has also been affected by the construction and subsequent updates to the Union Pacific Railroad and the construction of I-80N/I-84. The portion of the road within the FERC Project Area is located partially within the historic district and partially within the Utah Department of Transportation right-of-way, where it has been disturbed by road construction activities and the installation of a buried pipeline through the area. The current Project will not adversely affect the site.

7.2.1 NRHP Recommendation

Site 42MO75/42WB523 is a newly recorded segment of historic U.S. 30S and represents a portion of one of the early federal aid roads in Utah. It is associated with the beginnings of what would become the national system of interstate and defense highways. The system allowed improved travel between states and provided maintained routes for commercial interstate commerce. U.S. 30S was considered an important road to the state of Utah when it was numbered in 1926, and, therefore, the site can be positively associated with “a specific event marking an important moment in American prehistory or history and a pattern of events or a historic trend that made a significant contribution to the development of a community, a State, or the nation" (National Park Service 1997:12). Therefore, 42MO75/42WB523 is recommended eligible for the NRHP under Criterion A.

Site 42MO75/42WB523 cannot be associated with "individuals whose activities are demonstrably important within a local, State, or national historic context" (National Park Service 1997:14). Therefore, 42MO75/42WB523 is recommended not eligible for the NRHP under Criterion B.

Although different retaining wall construction styles were observed at the site, they do not demonstrate distinctive architectural or engineering characteristics, patterns, types, or styles. Moreover, the site does not "embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic values; or represent a significant and distinguishable entity whose components may lack individual distinction" (National Park Service 1997:17). Therefore, 42MO75/42WB523 is recommended not eligible for the NRHP under Criterion C.

Given that 42MO75/42WB523 is a road, it is a surface manifestation that lacks deposition and the potential to provide any subsurface deposits. Also, since the road has been upgraded several times to accommodate improvements, construction has disturbed any subsurface deposits in the area surrounding it. Finally, no artifacts were observed in association with the road. Site 42MO75/42WB523 is not likely to "have, or have had, information to contribute to our understanding of human history or prehistory" that is "considered important" (National Park Service 1997:21). Therefore, 42MO75/42WB523 is recommended not eligible for the NRHP under Criterion D.

In summary, 42MO75/42WB523 is recommended eligible for the NRHP under Criterion A.

8.0 MANAGEMENT SUMMARY

In July 2015, PacifiCorp requested SWCA to conduct a formal cultural resource inventory of the Project Area to verify the results of the 2015 desktop-level assessment (PacifiCorp 2015) and fulfill the cultural resources study plan (PacifiCorp 2016). In all, SWCA inventoried a total of 59.97 acres (24.27 ha). Of these, 17.05 acres (6.88 ha) were intensively surveyed, 34.45 acres (13.94 ha) were surveyed at a reconnaissance level, and 8.46 acres (3.4 ha) were not surveyed because they are existing paved roads. Of the 59.97 acres (24.27 ha), 29.93 (12.11 ha) are on privately owned lands and 30.04 acres (12.16 ha) are on USFS-administrated lands. The Project Area is located in Sections 28–30, Township 5 North, Range 1 East on U-W-CNF managed-land and private land in Weber, Morgan, and Davis Counties in Utah.

SWCA documented a previously unrecorded segment of U.S. 30S (42MO75/42WB523) and a new segment of the Union Pacific Railroad (42DV184/42WB344/42MO59) during the inventory. Chris Hansen, the Deputy Utah SHPO Officer, reviewed the original documentation of the Devil's Gate Weber Hydroelectric Power Plant Historic District (42WB328) that was prepared for the previous license and found it to be adequate, with no updated documentation needed (email correspondence between Lindsey Kester, SWCA, and Chris Hansen, SHPO, on July 2, 2015). Therefore SWCA did not update the existing site record for this inventory.

SWCA recommends 42DV184/42WB344/42MO59 and 42MO75/42WB523 eligible for the NRHP under Criterion A. The previously documented historic district (42WB328) was added to the NRHP in 1989. Site 42DV184/42WB344/42MO59 is also located in the Project Area, but only a small portion of the railroad—the location where the Project pipeline was bored under the active railroad—is intersected by the FERC Project Boundary. The pipeline is associated with the Weber Hydroelectric Plant and crosses the railroad near the eastern end of the Project Area. Based on aerial imagery from Google Earth, the pipe appears to have been bored under the active Union Pacific Railroad line; PacifiCorp records also indicate this. Because this is a previous disturbance that does not impact the site, no further impacts are anticipated by the actions of the Project. Site 42MO75/42WB523 is located in the Project Area, but the portions that intersect with the FERC Project Boundary have been heavily impacted by modern roads and utility and railroad construction, and they do not retain integrity to contribute to the overall eligibility of the site. Therefore, potential Project effects will not further impact the site.

With the exception of potential fish passage facilities, there are no proposed changes to the existing Project facilities or infrastructure that could adversely affect these sites. Any impacts from fish passage construction or continued operation of the Project would occur within the FERC Project Boundary. PacifiCorp prepared and implemented a cultural resource management (PacifiCorp 1991) plan as part of their 1990 FERC license to address potential from the Project. Chris Hansen, the Deputy Utah SHPO Officer, reviewed the plan and found it to be adequate for continued use and consultation with SHPO (email correspondence between Lindsey Kester, SWCA, and Chris Hansen, SHPO, on July 2, 2015). PacifiCorp will follow the standards and procedures outlined in the plan (and modify the document as necessary) in coordination with SHPO for proposed fish passage construction, continued operation and maintenance, and any new proposed construction. No significant impacts to cultural resources are expected from this re-licensing effort. Therefore, SWCA recommends a finding of **no adverse effect** for this project.

9.0 REFERENCES CITED

Alexander, Thomas G.

1996 Utah, the Right Place: The Official Centennial History. Gibbs-Smith Publisher, Salt Lake City, Utah.

Ambrose, Stephen E.

2000 *Nothing Like It in the World: The Men Who Built the Transcontinental Railroad 1863-1869*. Simon and Shuster, New York City, New York.

Bureau of Land Management

2002 Bureau of Land Management Guidelines for Identifying Cultural Resources, Handbook H-8110. Bureau of Land Management, Salt Lake City, Utah.

Carlstrom, Jeffrey and Cynthia Furse

2003 *The History of Emigration Canyon: Gateway to Salt Lake Valley*. Utah State University Press, Logan, Utah.

Corbeil, Marcel

2008 *IMACS Form for 42MO000059 (Union Pacific Railroad)*. U-08-ST-0600. Prepared by SWCA, Inc., Salt Lake City, Utah. Copies available from Utah Division of State History, Salt Lake City.

DeLafosse, Peter H.

1998 *Utah Historical Trails*. Utah State Historical Society, Salt Lake City.

Droz, Robert V.

2008 U.S. Highways: Divided (Split) Routes. Available at: http://www.us-highways.com/usdiv.htm. Accessed October 14, 2015.

2010 East - West US Highways With Daughter Routes From US 2 to US 98 (with US 400). Available at: http://www.us-highways.com/us2.htm. Accessed October 14, 2015.

Haymond, Jay M.

2008 Transportation. Available at: http://www.uen.org/utah_history_encyclopedia/t/TRANSPORTATION.html. Accessed October 15, 2015.

Knowlton, Ezra C.

1963 *History of Utah Highway Development in Utah*. Utah State Department of Highways, Salt Lake City, Utah.

Leonard, Glen M.

1999 *A History of Davis County*. Utah Centennial County History Series. Utah State Historical Society, Salt Lake City.

May, Dean L.

1987 *Utah: A People's History*. University of Utah Press, Salt Lake City.

National Park Service

1997 *How to Apply the National Register Criteria for Evaluation*. Revised ed. National Register Bulletin 15. National Park Service Interagency Resources Division, National Register Branch, Washington, D.C.

PacifiCorp

1991 *Weber Hydroelectric Project Cultural Resources Management Plan. FERC Project No. 1744.* Prepared by PacifiCorp, Salt Lake City, Utah.

2015 *Weber Hydroelectric Project Pre-Application Document, FERC No. 1744.* Prepared by PacifiCorp Hydro Resources, Salt Lake City, Utah.

2016 *Weber Hydroelectric Project Final Study Plan Cultural Resources.* FERC Project No. 1744. Prepared by PacifiCorp Hydro Resources, Salt Lake City, Utah.

Sillitoe, Linda

1996 *A History of Salt Lake County*. Utah Centennial County History Series. Utah State Historical Society, Salt Lake City.

Strack, Donald

1997 *Ogden Rails: A History of Railroads in Ogden, Utah from 1869 to Today.* Withers Publishing, Pennsylvania.

U.S. Department of Transportation

1976 *America's Highways 1776-1976: A History of the Federal-Aid Program*. U.S. Government Printing Office, Washington, D.C.

U.S. Geological Survey

1956 [1955] Ogden, UT, U.S. Geological Survey Historical Topographic Map Collection, scale 1:24,000, Available online at http://ngmdb.usgs.gov/maps/Topoview/viewer/.

Utah Department of Transportation

2008 Route 84. Available at: http://www.dot.utah.gov/main/uconowner.gf?n=200609181109591. Accessed October 15, 2015.

Utah Professional Archaeological Council

2008 *Linear Sites: Guidance for Identifying and Recording under Section 106 of the National Historic Preservation Act.* Utah Professional Archaeological Council, Salt Lake City.

Weingroff, Richard F.

2013 From Names to Numbers: The Origins of the U.S. Numbered Highway System. Available at: http://www.fhwa.dot.gov/infrastructure/numbers.cfm. Accessed April 21, 2015.

Workers of the Writers' Program of the Works Projects Adminstration for the State of Utah
1941 *Utah: A Guide to the State*. Hastings House, New York.

Weber Hydroelectric Project
FERC Project No. 1744
Comment Matrix: Cultural Resources Technical Report

Commenter (initials/ agency)	Page #/Title	Comment	Resolution
Comments on the Draft Technical Report (Review period Sept. 13 – Oct. 13, 2016)			
None			
Comments on the Preliminary Draft Technical Report (Review period Aug. 2 – Sept. 1, 2016)			
BJ/UDWR	N/A	No comment	N/A
KL/UDWQ	N/A	No comment	N/A
RS/WRWUA	Figure 1 & Table 1	On the map, Figure 1, I'm not sure if we want to call our canal diversion a dam. Maybe just note the D&W Canal Diversion instead. In Table 1, there is reference of previous projects, and one is entitled "D Well Canal Improvements," I assume that should be "D&W Canal Improvements." ***Note:*** Facility title subsequently revised on figures in all technical reports to "Davis & Weber Counties Canal Company diversion dam" per discussion and agreement with commenter 6/6/2017. Stated concern was that the structure may be misconstrued as a full spanning dam. Agreed to retain "diversion dam" nomenclature for continuity between reports.	Figure 1 and Table 1 have been revised as noted. Davis-Weber Canal revised to Davis & Weber Counties Canal Company on figure. "Diversion dam" nomenclature retained.