Weber Hydroelectric Project
FERC Project No. 1744

Final Study Plan
Fisheries

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For Public Review

TABLE OF CONTENTS

List of Figures

1.0 INTRODUCTION

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

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

The Project is located partially on federal lands managed by the Wasatch-Cache National Forest (Intermountain Region 4) in the state of Utah. The following U.S. Forest Service (USFS) region and state specific resources were consulted to identify special status species with the potential to occur within the Project Area.

- USFS R4 sensitive species list (USFS 2013).

- The Utah sensitive species list maintained by the Utah Division of Wildlife Resources (UDWR), **w**hich includes federally listed threatened and endangered species (UDWR 2007).

The PAD identifies 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 will be evaluated further as part of this study plan.

This document focuses on these two sensitive aquatic species. The document provides proposed monitoring to assess the extent of downstream fish migration through the Project and an upstream fish passage engineering feasibility study. This plan also provides information on the two species and other aquatic species that occur in the Project vicinity but are not proposed for specific surveys. In consideration of available information, PacifiCorp proposes two resource studies to gain information on potential impacts of the Project on these resources. Agencies and other relicensing participants have expressed that there has been enough study of upstream passage within the Project Area and that there is no need to further study that issue. Therefore, the proposed aquatic species studies provided herein include the following:

- An engineering feasibility study of potential upstream fish passage through Weber dam; and,
- Assessment of downstream passage through the Weber diversion dam and turbine intake (Section 3.1.1).

These studies are being conducted, in part, to determine ways to protect the sensitive fish species in the Project Area and to meet water quality standards by improving beneficial uses for aquatic species.

2.0 PROJECT AREA

For the purposes of this document, the FERC Project Boundary (or Project Boundary) is defined as all lands and waters within the existing FERC Project Boundary for the Weber Hydroelectric Project No. 1744, as denoted on the Project's Exhibit G. The Project Area is the area that contains all project features (encompassing the FERC Project Boundary 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.

The existing Project consists of:

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

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

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

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

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

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

Figure 1. Weber Hydro Relicensing Project Location

3.0 PROPOSED FISHERIES STUDIES

PacifiCorp proposes to conduct two fisheries studies within the Project Area, in addition to supporting an on-going UDWR bluehead sucker spawning study. In a separate study, water quality monitoring will establish a current baseline from which assessment of impacts to water quality can be assessed.

3.1 Existing Information

Other than the two fish species mentioned previously, fish identified in prior studies in the Project bypass reach or the Project Area are rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*); mountain whitefish (*Prosopium williamsoni)*, mottled sculpin (*Cottus bairdii*), mountain sucker (*C. platyrhynchus*), Utah sucker (*C. ardens*), speckled dace (*Rhinichthys osculus*), longnose dace (*R. cataractae*), redside shiner (*Richardsonius balteatus*), and common carp (*Cyprinus carpio*). Cutthroat trout, mountain whitefish, and brown trout make up more than 95% of the total biomass of game species in the bypass reach. UDWR rates the project reach of the Weber River as Class IIIB, a quality fishery with species of special concern (Bonneville cutthroat trout and bluehead sucker). Bonneville cutthroat is also listed as a sensitive species. UDWR does not stock fish in the vicinity of the Weber Project Area and relies primarily on natural production (Paul Thompson – pers. comm. 2015). The state used to stock 3-inch brown trout but that was discontinued several years prior to 2015. UDWR now manages the area for native Bonneville cutthroat trout. There are some catchable sterile rainbow trout stocked in Echo, East Canyon, and Lost Creek reservoirs and it is possible some of these fish can make it downstream to the Project Area. Historical stocking of fertile rainbow trout may have resulted in a few fertile rainbow trout or *cutthroat x rainbow trout* hybrids occurring within the Project Area, although these fish are removed when discovered during annual fisheries surveys and other work.

The following is a description of the aquatic species present in the Project reach beginning with native species and followed by introduced species.

3.1.1 Bonneville Cutthroat Trout

The Bonneville cutthroat trout (BCT) is a subspecies of cutthroat native to the historic Lake Bonneville basin of Utah, Wyoming, Idaho, and Nevada. Pure-strain BCT are relatively rare throughout their historic range, but several Utah populations exist. BCT have been petitioned twice for federal listing under the Endangered Species Act in 1992 and 1998. In both cases the U.S. Fish and Wildlife Service found the species not warranted for federal protection. Major threats to BCT include habitat loss or alteration, predation by and competition with nonnative fishes, and hybridization with nonnative fishes including rainbow trout. Because of this, BCT have a State of Utah (1997) and Range-wide (2000a) Conservation Agreement and Strategy developed to further cooperation toward protection of the species. Because of these numerous threats, this cutthroat subspecies is included on the *Utah Sensitive Species List* (UDWR 2011). The Bonneville cutthroat trout is also Utah's official state fish. Despite the overall threats, recent genetic studies conducted by UDWR indicate that BCT in the Project Area have a very low level of hybridization.

BCT primarily eat insects, but large individuals have been known to also eat other fish. Like most cutthroat trout, this subspecies spawns in streams over gravel substrate in the spring and early summer. Fry typically emerge mid-to late-summer and will usually remain in their natal stream for up to 3 years before migrating to a mainstem river (Wallace and Zaroban 2013). Adults usually move back to the mainstem river approximately 30 days after spawning. Once summer locations are reached, BCT rarely move more than 0.3 km (Wallace and Zaroban *ibid.*). BCT can be found in a variety of habitat types ranging from high elevation mountain streams and lakes to low elevation grassland streams but can also be found in natural lakes, such as Bear Lake, or in reservoirs. Within each different habitat type, BCT require a functional stream riparian zone which provides structure, cover, shade, and bank stability plus crucial spawning habitat. During a study in 2011 and 2012, UDWR marked several BCT downstream of Weber dam (Matt McKell – pers. comm. 2015). The UDWR has also placed PIT tag antennas at eight of the tributaries upstream of Weber dam to detect movement into and out of those tributaries.

In 2013, seven individual BCT were detected upstream of the dam in tributaries, and in 2014, 20 of those marked fish exhibited a similar upstream migration pattern indicating the first documented presence of a fluvial strain of BCT in the lower Weber River. Fluvial-type BCT reside in a major river much of the year, but annually migrate to smaller tributaries to spawn. Current information among regional biologists is that there is only one other known fluvial population of BCT, found in the Bear River system in southeastern Idaho. Based on the timing of the documented movements, there is some thought that the migrating fish travelled downstream through the low flow sluice gate but there is no evidence available to prove or disprove that hypothesis. Through tagging and monitoring, 28 BCT have been shown to navigate upstream past Weber dam. However, there is also no evidence available to show the path taken by these fish moving upstream past the dam. Regardless, there are only two likely pathways: through the spillway area during spill events; or through the low level outlets. Some BCT have been observed leaping at the sluice area/fish ladder but they did not appear to be successful at passing upstream (M. McKell, UDWR, pers. comm.).

3.1.2 Bluehead Suckers

Bluehead suckers are native to parts of Utah, Idaho, Arizona, New Mexico and Wyoming. The species occurs in the upper Colorado River system, the Snake River system, and the Lake Bonneville Basin, although recent work suggests the Snake and Lake Bonneville populations (including the Weber River fish) are a genetically distinct group from those occurring in the Colorado River system (Hopken, et. al., 2013). In Utah, bluehead suckers have been reduced in numbers and distribution due to flow alteration, habitat loss or alteration and the introduction of nonnative fishes. Consequently the bluehead sucker is included on the *Utah Sensitive Species List* (UDWR 2011); the recent genetics work may make the Weber River fish additionally vulnerable to status updates of the species. Bluehead suckers have a UDWR Range-wide (2006) and State of Utah (2006) Conservation Agreement and Strategy developed to further cooperation toward the protection of this species.

The bluehead sucker is a benthic species with a mouth modified to scrape algae from the surface of rocks. Algae is the primary food of the species. Bluehead suckers spawn in streams during the spring and early summer. Fast flowing water in high gradient reaches of mountain streams is the most important habitat for this species. Bluehead suckers do not thrive in impoundments (Sigler and Sigler 1996).

Bluehead suckers generally spawn in the spring and early summer when water temperatures exceed 15.6°C (Sigler and Sigler *ibid.*). The young hatch after about seven days when water temperatures exceed 18°C (Holden 1973) and the larvae drift into near-shore, low velocity habitats (Robinson, et al. 1998) where they eat mostly invertebrates (Childs, et al. 1998).

It has recently been determined that the bluehead sucker exists in the area of the Weber River occupied by the hydroelectric project but also extending upstream and downstream of the project (Webber, et al. 2012). Bluehead sucker populations occur in the Weber River from the confluence of the Ogden River upstream to above Echo Reservoir. The populations in the lower river (Weber Project Area and downstream) appear to be the most robust (Webber et al *ibid*).

Bluehead sucker spawning in Weber Canyon is currently being studied by UDWR, in conjunction with Utah State University fisheries scientists; PacifiCorp will assist in supporting this project as part of the overall fisheries study plan.

3.1.3 Mountain Suckers

Mountain suckers occur in most of the western United States and parts of western Canada. A native species in Utah, the mountain sucker is found in the Lake Bonneville basin and the Colorado River system. This species prefers clear, cold water of streams with gravel substrate. Mountain suckers are benthic oriented and feed on algae, higher plants, and sometimes invertebrates. The species spawns during the spring and early summer in gravel riffles. Because mountain suckers are small (about six to eight inches) and are often found in trout waters, this species is an important food item for trout.

3.1.4 Mountain Whitefish

This species is native to the western United States and western Canada. Mountain whitefish prefer cold mountain lakes and are common in many areas of Utah. Food habits include insect larvae, insects, fish eggs, and small fish. They feed most actively at night and during the winter. Mountain whitefish spawn in the late fall to early winter, usually in stream riffle habitat with gravel substrate.

3.1.5 Mottled Sculpin

The mottled sculpin is native to both eastern and western North America. The species is common in Utah and can be found in many of Utah's coldwater streams. Mottled sculpin are benthic organisms and are important forage for stream dwelling trout. These sculpin feed on aquatic insects, small fishes, crayfishes, fish eggs and plant matter. Mottled sculpin spawn in the late winter through early spring.

3.1.6 Utah Sucker

Utah suckers are still found within their native range in southeastern Idaho and western Wyoming in the Bear River drainage and along the western front range of the Wasatch Mountains in Utah along with parts of Nevada and the Snake River above Shoshone Falls; all of which is part of the ancient Lake Bonneville (Sigler and Sigler 1987 and 1996). The Utah sucker spawns in the spring over shallow gravel or sand in small streams or lakeshores.

3.1.7 Speckled Dace

Speckled dace are widely distributed in western North America and are found in a variety of habitats. They are primarily invertivores feeding on insects, plankton, freshwater shrimp and plant material. These fish typically spawn in mid-summer in stream riffles.

3.1.8 Longnose Dace

The longnose dace has a much more extensive range than the speckled dace, ranging from northern Mexico to the Northwest Territories in Canada and southward in the Appalachians to Georgia. They are adapted to benthic life in fast-flowing streams and feed on drift organisms or immature aquatic insects. Longnose dace typically spawn in late spring or early summer over gravelly riffle areas.

3.1.9 Redside Shiner

Redside shiners are found in North America generally west of the Rocky Mountains. These fish are a schooling species found in lakes, ponds, and slower moving rivers and streams. Redside shiners feed primarily on invertebrates, zooplankton and algae but may also consume mollusks, fish eggs and smaller fishes. Redside shiners spawn in the late spring or early summer in shallow gravelly areas.

3.1.10 Brown Trout

Brown trout, a nonnative species, have become established in many of the cool and cold water streams in Utah. Their diet consists primarily of fishes, but they are opportunistic and are known to consume amphibians, rodents, and invertebrates including insects, snails and crayfish. Because of their piscivorous nature, brown trout often have a detrimental effect on populations of native and nonnative sport fishes. The brown trout spawn in the fall in the gravel substrate of streams. While brown trout do not appear to be the majority species in the Weber project reach, they are sought after by anglers because of their size.

3.1.11 Rainbow Trout

The rainbow trout is native to western North America but it is not native to Utah. It has been introduced to cool waters throughout the state. Because it is a popular sport fish and because most of the stocks used by UDWR are now considered sterile, millions of fish are stocked in Utah state waters.

Rainbow trout prefer to eat invertebrates including insects, worms, zooplankton, and insect larvae. Larger rainbows can become piscivorous. The species spawns in streams over gravel substrate during the spring. In areas where rainbow trout and cutthroat trout co-exist rainbow-cutthroat hybrids can occur. Loss of genetic purity of cutthroat trout is considered one of the major threats to Utah’s native cutthroat trout, especially the Bonneville strain.

3.1.12 Common Carp

The common carp is not native to North America but is found in every mainland state in the Union. Carp feed primarily on zooplankton but their diet may also include detritus and benthic organisms. They typically spawn in large groups over silt or vegetation in the shallow, warmer areas of lakes or rivers. Spawning and feeding activities can create a lot of turbidity which can inhibit feeding behavior of other species in the vicinity.

3.2 Study Area

The Study Area will include the project reservoir from just upstream of the Rest Stop and extending downstream to the dam and the project bypass reach from the dam to the powerhouse discharge. From the discharge point, the water immediately enters the Weber-Davis Canal Company diversion, so fish monitoring will not extend into that unrelated project area.

3.3 Methods for the Upstream Passage Engineering Feasibility Study

3.3.1 Existing Information

Prior to this relicensing proceeding, investigators from UDWR and Utah State University conducted several studies on the Bonneville cutthroat and bluehead suckers. Those study results are detailed above. In terms of conducting any further study, UDWR and Trout Unlimited (TU) have commented in the draft PAD that *"...further movement studies are not needed for the adult life stage. One question with regard to movement that has not been addressed is if the Bonneville cutthroat trout population below the PacifiCorp Dam is maintained from downstream drifting juvenile fish or from reproduction in the mainstem Weber River below the PacifiCorp Dam. While some adult BCT have been documented to move downstream over the PacifiCorp Dam, the size of the BCT population below the dam cannot be explained solely from the downstream movement of adults. Since the information exists to justify upstream fish passage at the PacifiCorp Dam, downstream movement or entrainment may be a more important question. It would be helpful if a study were completed to help answer some of the following questions: 1) how much entrainment or loss of fish occurs in the turbines?; 2) what size classes or life stages may or may not be affected?; 3) will this potential problem, if it exists, be exacerbated with the creation of an upstream fish passage channel or with changes in instream flows?; 4) what might be potential solutions, if entrainment issues are discovered?; and, 5) what might be the costs associated with various potential solutions? Implicit in the last question is an acknowledgement that certain costs would not be considered reasonable to the group, and hence may not be advanced. Let us explore options before we discount any of the otherwise valid options, however."*

3.3.2 Level of Effort and Cost

An experienced fish passage design engineering group will be selected by PacifiCorp to work with the interested relicensing participants (Fish Passage Work Group) to complete several steps:

1) The consulting engineer and PacifiCorp will work with the Fish Passage Work Group to determine the criteria for safe and efficient upstream passge for BCT and bluehead suckers;

2) PacifiCorp and their consultant will work with the Fish Passage Work Group to brainstorm possible fish passage designs and determine the preferred design;

3) PacifiCorp and their consultant will provide conceptual designs for the preferred fish passage facility to the Fish Passage Work Group and lead a discussion on rough details to take forward and develop 30% design drawings;

4) A 15% design package will be provided to the Fish Passage Work Group for review and comment;

5) Based on comments, PacifiCorp and their consultant will develop a 30% design package for reviw and approval by the Fish Passage Work group;

6) Once approved, PacifiCorp and their consultant will produce final designs to be submitted to the FERC along with the License application.

The estimated cost for the design effort is approximately $250,000.

3.4 Methods for the Study of Migration Downstream of the Project

3.4.1 Existing Information

Very little is known about downstream migration of fish in the Project Area, especially for the two species of concern. It is assumed that downstream passage of BCT does occur, thus supporting the fluvial life history. However, since there is not much information on bluehead suckers upstream of Weber dam, any information of downstream passage is unknown. The UDWR and TU commented on the draft PAD stating, "*Since the information exists to justify upstream fish passage at the PacifiCorp dam, downstream movement or entrainment may be a more important question. It would be helpful if a study were completed to help answer some of the following questions: 1) how much entrainment or loss of fish occurs in the turbines?; 2) what size classes or life stages may or may not be affected?; 3) will this potential problem, if it exists, be exacerbated with the creation of an upstream fish passage channel or with changes in instream flows?; 4) what might be potential solutions, if entrainment issues are discovered?; and, 5) what might be the costs associated with various potential solutions?"* The two commenting entities expressed that they would like to see PacifiCorp explore options for reduction or prevention of entrainment.

3.4.2 Study Plan Methods

Entrainment at hydropower plants is very difficult to measure and often requires expensive custom-made equipment to do an adequate job. One less expensive method involves hydroacoustics, where hydroacoustic cameras are strategically placed to document fish movement into turbine intakes along with relative sizes of the entrained fish (Moursund et al. 2003). Acoustic cameras such as the DIDSON (Dual-Frequency Identification Sonar) have been used for this purpose but they tend to be very expensive and unwieldy in size. The BlueView acoustic camera, also a relatively expensive technology, is relatively new on the market and has the potential to have application on this project.

PacifiCorp proposes a phased approach to investigating downstream passage at the Weber Project. Phase One would be a pilot project where various sizes of triploid trout are uniquely marked and sent down the Weber penstock to determine the extent of injury and overall survival. Depending on the outcome of Phase One, Phase Two would involve the use of an acoustic camera to determine how many and which approximate size range(s) of fish may be actually entrained at the Weber intake. Following results of the study, PacifiCorp will work with the stakeholders to determine a course of action to address entrainment of downstream migrants, if significant.

Phase One

The testing period will occur in June or July, 2016, depending on water conditions, and near the tail end of the spring run-off. Investigators will secure a group of sterile triploid rainbow trout or some other species of sterile trout from local UDWR hatchery facilities. There will be three size classes for this investigation that represent the likely size of fish that could become entrained at the Project: 3-inch, 6-inch, and 12-inch. A group of 100 fish from each size class will be used in this study. These fish will have two marks to distinguish the different-sized test fish since size in any group can vary. Each group will be marked with an adipose fin clip plus one other mark (a hole punch in the opercle or tail or other fin clip).

Beginning with the smallest size, 100 fish will be introduced to the penstock intake behind the intake rack through a standpipe inserted in the surge relief vent pipe. The penstock is 9,107 feet. long and the estimated velocity is approximately 11.7 feet per second (fps) so it takes about 13 minutes for water and fish to travel through the entire penstock under full load. During placement of the fish, the project will be operating at full load for a period of 15 minutes to allow all fish placed in the penstock to pass through the turbines. The plant will then be shut down and a group of biologists will enter the tailrace with nets and electrofishing gear to collect as many test fish as possible. A SCUBA diver will also inspect the bottom of the stream in the tailrace to look for any dead or stunned fish. A block net will be placed at the intake to the Weber-Davis diversion and upstream of the tailrace water to prevent any test fish from leaving the tailrace before they can be captured by investigators. All fish captured will be recorded as either alive or dead and examined for injury and descaling. Following NOAA fisheries standards for entrained fish, any descaling that exceeds ten percent of the body area and visible trauma consisting of open, fresh wounds or hemorrhaging will be considered lethal.

This procedure will be followed for each size class of test fish. A report will be developed that describes the methods used and the results of this pilot study by size class. Phase Two will not be undertaken until stakeholders have reviewed the results from Phase One and there is consensus to move forward with that portion of the study; the methodology for Phase Two is described below.

Phase Two

In this phase, investigators will attempt to determine how many fish are entrained and their approximate size. This will be accomplished using an acoustic camera such as DIDSON or Blue View.

The camera will be mounted on a specialized frame in the surge pipe shooting a beam downward through the opening. The mount will be secured such that the camera can see as much of the penstock pipe area as possible (see Figure 2). As noted in the drawing, a BlueView camera will be able to sample approximately 95 percent of the penstock pipe. The camera will be set to observe and record any fish that come near the penstock intake and are entrained. The expected size detection is > 60 mm and fish can be measured using the acoustic video that is recorded and read later. Fish identification is not precise but it is possible to distinguish between a salmonid (trout) and a catostomid (sucker) or cyprinid (carp and minnows) because fins and general morphology are distinguishable.

The acoustic camera will be placed and set to record continuously during the study period, which would be the expected downstream migration time. The most likely time for downstream migration is late spring and early summer with the majority of the migration occurring during the crepuscular hours. The recording will be set up to broadly cover that timeframe but, if after several days of recording, the travel time window becomes obvious then the recording time could be shortened. This would help the investigators, who will need to review hours of video to note fish movement and then several more hours of efforts to calculate size and identify the potential family for each fish or school of fish.

A report will be provided to the stakeholders for review and comment. Next steps will be defined by the discussions that ensue at the end of Phase Two.

3.4.3 Level of Effort and Cost

The estimated cost for the study of downstream migration effort is currently unknown due to the uncertain level of involvement by other PacifiCorp Weber license stakeholders, and will be refined once the Fish Passage Working Group meets to discuss how this study will be implemented.

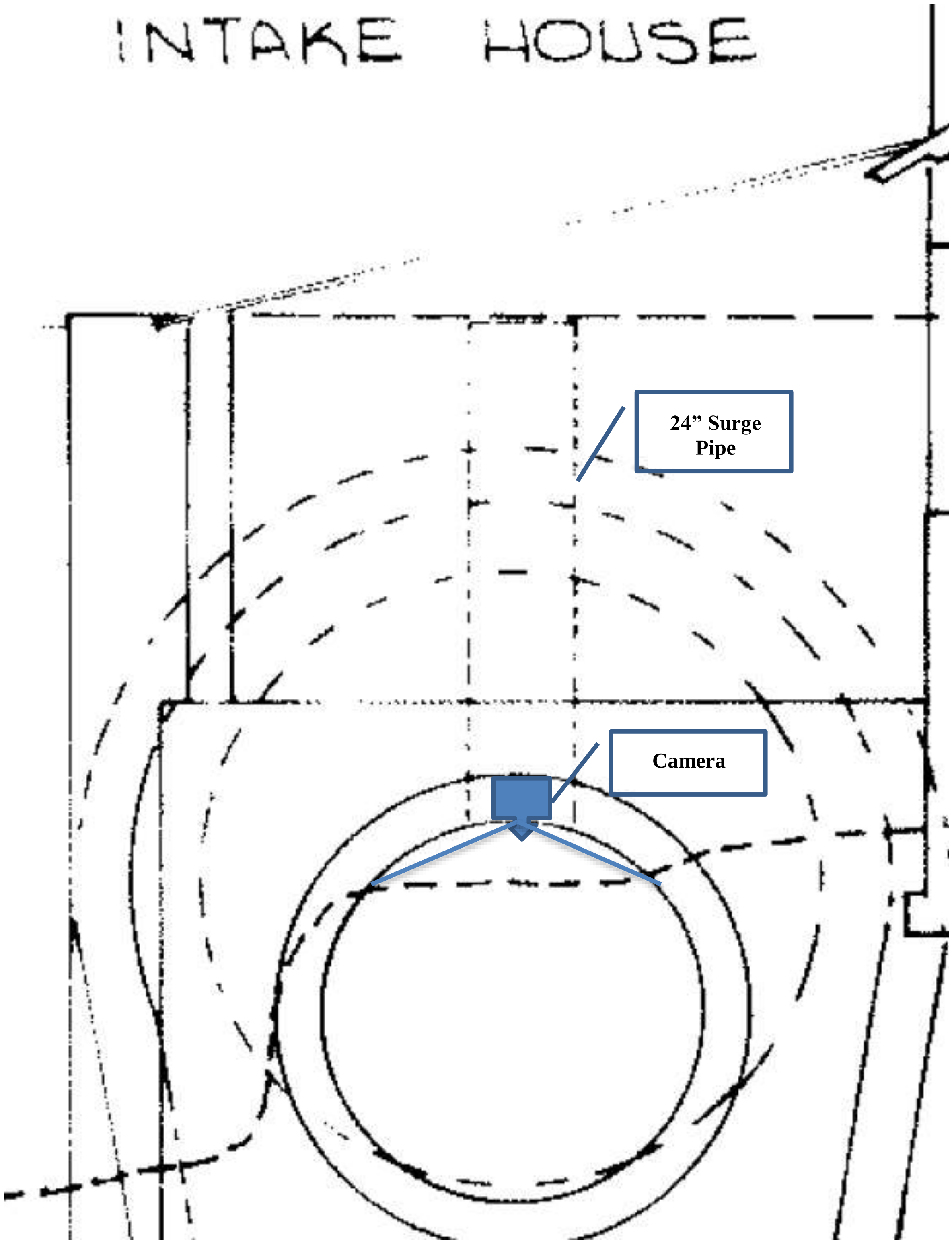

Figure 2. Penstock pipe at the Weber dam intake showing camera placement and coverage area. The BlueView camera has a 130-degree field of view and appears to cover over 95 percent of the pipe opening.

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