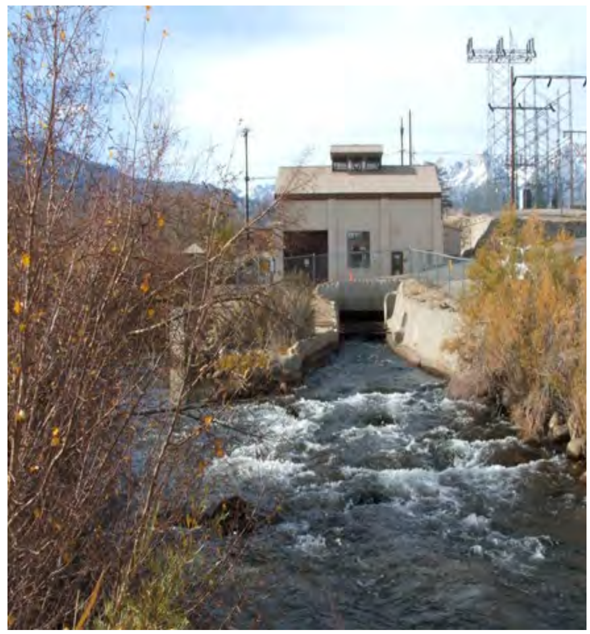
SOUTHERN CALIFORNIA EDISON

Bishop Creek Hydroelectric Project

(FERC Project No. 1394)



FINAL LICENSE APPLICATION

FINAL TECHNICAL REPORTS

VOLUME III

SOUTHERN CALIFORNIA EDISON

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JUNE 2022

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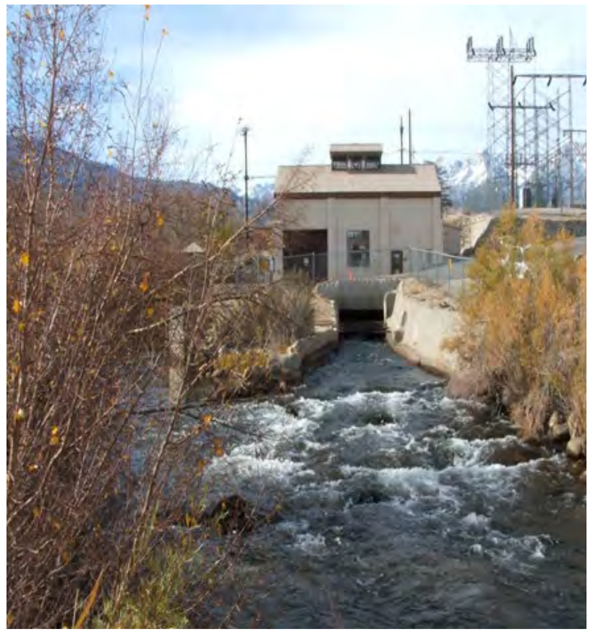

FINAL LICENSE APPLICATION

FINAL TECHNICAL REPORTS

VOLUME III (2 OF 4)

SOUTHERN CALIFORNIA EDISON
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SOUTHERN CALIFORNIA EDISON
Bishop Creek Hydroelectric Project
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FINAL TECHNICAL REPORT
BISHOP CREEK INSTREAM FLOW NEEDS ASSESSMENT (AQ 1)

SOUTHERN CALIFORNIA EDISON

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Bishop Creek Hydroelectric Project

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FINAL TECHNICAL REPORT BISHOP CREEK INSTREAM FLOW NEEDS ASSESSMENT (AQ 1)

Southern California Edison
1515 Walnut Grove Ave
Rosemead, CA 91770

June 2022

Support from:

Kleinschmidt

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List of Acronyms

1-D	one-dimensional
B	
Bishop Creek Project	Bishop Creek Hydroelectric Project
BLM	Bureau of Land Management
C	
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
D	
DLA	Draft License Application
F	
FERC	Federal Energy Regulatory Commission
G	
GIS	geographic information system
H	
HCM	Habitat Criteria Mapping
HSI	habitat suitability index
I	
IFIM	Instream Flow Incremental Methodology
ISR	Initial Study Report
N	
NEPA	National Environmental Policy Act

P

PHABSIM	Physical Habitat Simulation
PM&E	Protection, Mitigation, and Enhancement

S

SCE	Southern California Edison
Study Plan	Instream Flow Needs Study Plan

T

TWG	Technical Working Group

U

USFS	U.S. Forest Service
USR	Updated Summary Report

W

WUA	weighted usable area

1.0 INTRODUCTION

During Technical Working Group (TWG) meetings, Southern California Edison (SCE) and stakeholders identified the need for an Instream Flow Needs Study Plan (Study Plan) that focused on creeks located below the Bishop Creek Hydroelectric Project (Bishop Creek Project) plant diversions, and to a lesser extent on Birch and McGee creeks below the Project diversions. The Study Plan detailed SCE's study objectives, study area, methods, results, and discussion of the proposed study effort. A preliminary Instream Flow Needs Technical Report was prepared in March 2020 summarizing data collected in 2019, along with draft results from data collected in early 2020. The modeling effort for this report included the Physical Habitat Simulation (PHABSIM) modeling for brown trout (*Salmo trutta*) and Owens sucker (*Catostomus fumeiventris*) in most study reaches designed by the TWG, and Habitat Criteria Mapping (HCM) analyses of empirical data from a stream segment where modeling was infeasible. The remaining analyses were completed in 2020 and are reported below.

This report builds on the preliminary *Instream Flow Needs Technical Report* discussed above, the Initial Study Report (ISR) submitted November 4, 2020, the Updated Summary Report (USR) filed in November 2021 and includes data and results of study plan implementation not previously discussed in other reports or memorandums. This report does not evaluate station operations, habitat suitability, water quality, sediment transport, or hydrology data. These analyses were completed in conjunction with the rest of relicensing studies as part of the overall National Environmental Policy Act (NEPA) process and in consultation with the TWG.

SCE received various comments from California Department of Fish and Wildlife (CDFW) on the preliminary *Instream Flow Needs Technical Report* in May 2020, June 2021, and October 2021. Responses to those comments are provided in Section 5.0 of this report.

2.0 STUDY OBJECTIVES

The goal of this study is to evaluate the potential effects of the Bishop Creek Project operation, including the current minimum instream flow releases and channel maintenance flows on aquatic resources of Project streams, including the South and Middle forks of Bishop Creek, the Bishop Creek plant bypass reaches, and Birch and McGee creeks. A separate Sediment and Geomorphology Study addresses the effect of Project operations and facilities on recruitment and movement of large woody debris and coarse sediment on aquatic habitat, specifically of macroinvertebrates.

Project operations may potentially affect habitat suitability in Bishop Creek below each plant diversion depending on the amount of spill allocated to the creek. CDFW proposes to manage Bishop Creek below Plant No. 4 primarily for species indigenous to the Owens Watershed and lower Bishop Creek (specifically Owens sucker and speckled dace). CDFW manages Bishop Creek upstream from Plant No. 4 primarily as a self-sustaining fishery for introduced brown trout. Birch and McGee creeks currently maintain passively managed brook trout (Salvelinus fontinalis) populations and are managed for speckled dace.

Year-round minimum flow requirements were established for most of the subject reaches during the prior relicensing, based on the result of a 1986 PHABSIM model (EA, 1988). These flows vary by stream segment, ranging up to 18 cubic feet per second (cfs). CDFW was concerned that these flows may potentially be outdated for purposes of habitat protection, due to changes in stream morphology, mesohabitat distribution, habitat management and applicable habitat suitability criteria that have ensued over recent decades.

2.1 STUDY AREA

The South and Middle forks of Bishop Creek above Plant No. 2, and Bishop Creek between the Plant No. 2 spillway and Plant No. 6 (Figure 2.1-1) were identified by the CDFW as the overall study area for this study. Reaches below Plant No. 4 are managed primarily for native non-game species including Owens sucker and speckled dace, whereas reaches upstream of Plant No. 4 are managed as a self-sustaining brown trout fishery. On Birch and McGee creeks, the study area extends from each respective diversion downstream to a point that captures both upper and lower stream geomorphology.

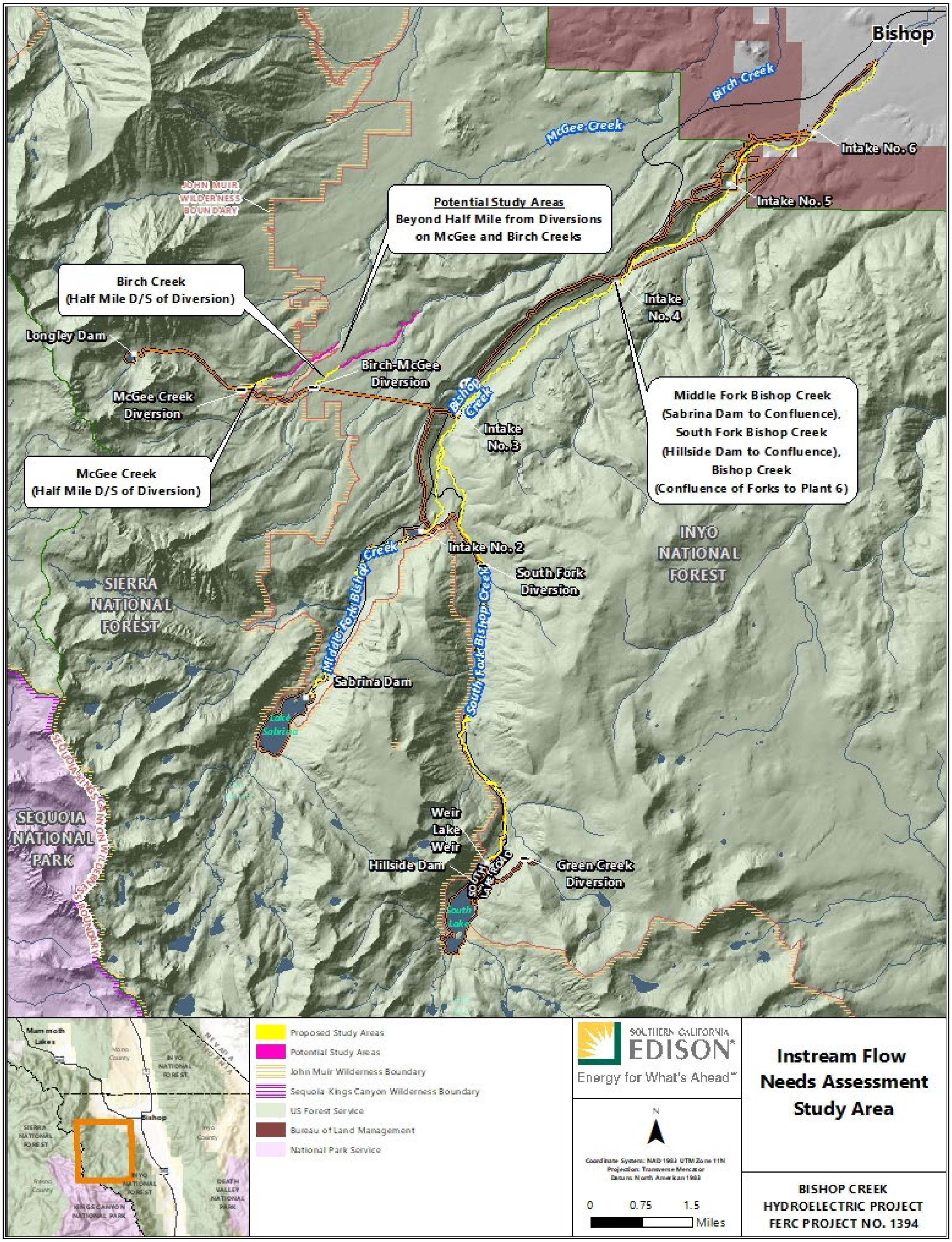


Figure 2.1-1 Instream Flow Needs Assessment Study Area

3.0 METHODS

The scope of this study was to quantify the effects of Bishop Creek Project bypass reach flows on aquatic habitat suitability for both the Bishop Creek watershed, and the Birch and McGee creeks aquatic community to support its managed fish resources. These data were used in conjunction with hydrologic, operational, and other models to evaluate the costs and benefits of providing alternate flows to the targeted reaches of the Project.

CDFW recommended an Instream Flow Incremental Methodology (IFIM) study for Bishop Creek watershed to develop an understanding of key habitat-flow relationships in the study area and to serve as a basis for negotiating instream flow recommendations for the Project. This may be quantified by models such as PHABSIM or its equivalent, which simulates reach-specific habitat suitability at various flow increments representing selected fish species. One-dimensional (1-D) (transect-based) hydraulic models were used to simulate channel hydraulics in various areas of interest.

A simplified IFIM approach using empirical data collected at a range of flows, rather than simulation was used to assess flows in reaches of Bishop Creek unsuitable for PHABSIM modeling, and on Birch and McGee creeks.

Consistent with IFIM protocol, a study team comprised of agency and SCE biologists, along with aquatic TWG members, made technical decisions regarding input parameters and review of study results. Specifically, the team provided input on:

- Specific spatial and temporal habitat management goals
- Boundaries of the study area and reaches
- Locations of specific representative or critical study sites, and study site transects
- Habitat suitability index (HSI) criteria for applicable species and life stages
- Calibration of flows and the range of flows to be assessed

Technical decisions were made during the winter and spring of 2019-2020 on multiple conference calls with TWG participants, agencies, and SCE.

3.1 MODIFICATIONS TO METHOD

No modifications to the Study Plan were necessary.

3.2 STUDY SITE SELECTION AND MESOHABITAT MAPPING

The study methods involved a phased approach, beginning with mapping mesohabitat distribution in the study area as Phase 1.

Delineation was conducted using a drone to mark mesohabitat boundaries and identify dominant substrates and hydraulics and to take detailed photographs and video of mesohabitat and candidate study sites. The upstream and downstream boundary of each mesohabitat unit within the study area was geo-referenced, and the information transferred to both a geographic information system (GIS) format and annotated photos and video clips for TWG review. Details were provided in the May 2020 *Instream Flow Needs Report.*

3.2.1 Data Collection and Modeling

A detailed description of data collection and modeling methods was presented in the *Instream Flow Needs Technical Report* reviewed and discussed by the TWG in May 2020 and are hereby incorporated by reference. In summary, habitat-discharge relationships were modeled for selected species and life stages in the study area using standard PHABSIM data collection and flow modeling procedures (Bovee, 1982; Bovee et al., 1998). An empirical flow demonstration study adapting the HCM (Stillwater Sciences, 2009) method was substituted for PHABSIM in reaches 4, 6, and a portion of reach 8 because these study sites were not conducive to hydraulic simulation with PHABSIM.[1] This kind of approach can be used when a PHABSIM simulation would not be feasible or cost-effective.

3.2.2 Macroinvertebrates

The CDFW comments on the May 2020 Technical Report included the following:

> “The scope of this study is to quantify the effects of Project bypass reach flows on aquatic habitat suitability for both the Bishop Creek watershed, and Birch and McGee creeks aquatic community to support its managed fish resources. These data would be used in conjunction with hydrologic, operational, and other models to evaluate the costs and benefits of providing alternate flows to the targeted reaches of the Project. This goal was accomplished as written in the Technical Memo, but …The Technical Memo did not address…Macroinvertebrates in Technical Study Plans.”

SCE addressed the potential impacts within the Phase 1 IFIM study by characterizing the dominant substrates inventoried during the mesohabitat survey and applying literature to discuss how the presence/absence of suitable substrates affect their distribution. The October 4, 2019, Mesohabitat Survey memorandum briefly described reach-specific dominant substrates and were discussed with the TWG during the related conference call. These were subsequently quantified in greater detail on each PHABSIM transect, as representative of habitat conditions within each reach. In general, substrates were dominated by boulders, but with patches of gravel and cobble, all of which are substrates

[1] This includes turbulent, high gradient channel conditions in reaches 4 and 6, and complex braided channel conditions in part of reach 8.

suitable for macroinvertebrates. SCE described these substrates in the context of macroinvertebrate habitat as part of this Final Technical Report (Section 5.0).

3.2.3 Analysis

The preliminary *Instream Flow Needs Technical Report* (SCE, 2020) provided with Progress Report No. 3 documented the methods and results of the study. The report completed the data gathering and analysis for Birch and McGee creeks as well as previously un-surveyed reaches in Bishop Creek. It was anticipated that in subsequent stages of relicensing, the basic flow and weighted usable area (WUA) relationships would be applied in consultation with the Aquatics TWG to evaluate station operations, habitat suitability, water quality, sediment transport, and hydrology data.

3.2.4 Modified Approach for Birch and McGee Creeks

An empirical flow study adapting the HCM method was conducted at one site on each creek in September 2020 in accordance with TWG recommendations. SCE consulted with the TWG to determine species (brook trout and speckled dace), and general areas for study site locations during 2020.

4.0 STUDY RESULTS

Results from the 2020 field study season are provided in following the text.

4.1 HABITAT SUITABILITY SUMMARY RESULTS

Table 4.1-1 summarizes habitat suitability provided by existing minimum flows in each study reach. This is the existing condition against which proposed alternatives may be compared. Habitat suitability varied among reaches, species, and life stages from 11 percent (adult brown trout in Middle Fork below the Intake No. 2 diversion) to 100 percent (speckled dace, McGee Creek). In general, existing flows provide a relatively high level of suitability for brown trout juveniles and speckled dace, with mixed results for other species and life stages. A large number of sites registered 90 percent or greater habitat suitability under existing flows for:

- Juvenile sucker and brown trout, Intake No. 5 Bypass
- Juvenile brown trout, Intake No. 4 Bypass, Middle Fork below Sabrina Lake; South Fork below Intake No. 2 Diversion and below South Lake
- All life stages, Intake No. 2 Bypass below the confluence of South and Middle forks

It was not feasible to model hydraulics in the Intake No. 5 Bypass (Reach 1) at the existing 1 cfs; however, speckled dace habitat achieved 97-100 percent suitability at flows of 4 to 6 cfs respectively. The Owens sucker suitability is gradually increasing throughout the lower end of the modeled range. Existing minimum flows on Birch and McGee creeks provide 90 and 100 percent habitat suitability, respectively, for speckled dace, and 76 and 87 percent habitat suitability, respectively, for brook trout.

One consideration for flows in the Intake No. 4 Bypass below Coyote Creek (Reach 3) is the varying additional contribution of inflow from Coyote Creek, which was gaged at the time of the study (November 2019) was flowing at 3 cfs. This is an unregulated tributary that provides varying inflow and therefore, unlike other reaches, is a dynamic influence independent of Project operation. Thus, a flow release of 5 cfs from the Intake No. 4 spillway may result in Reach 4 experiencing a net of 8 cfs under the observed conditions.

Table 4.1-1 Relative Habitat Suitability of Existing Minimum Flows in 10 Bypass Reaches of Bishop Creek, and in Birch and McGee Creeks

Location	Fishery Management Priority	Species	Life stage	Current Min Flow	Percent Of Max WUA
Intake No. 6 Bypass	Indigenous species	Speckled dace	Adult	1 cfs	Unavailable[1]
		Owens sucker	Juvenile		
		Owens sucker	Adult		
		Brown trout	Juvenile		
		Brown trout	Adult		
Intake No. 5 Bypass	Indigenous species	Speckled dace	Adult	18 cfs	41%
		Owens sucker	Juvenile		94%
		Owens sucker	Adult		41%
		Brown trout	Juvenile		92%
		brown trout	Adult		23%
Intake No. 4 Bypass (below Coyote Creek)	Self-sustaining brown trout	Brown trout	Juvenile	5 cfs[2]	~99%
		Brown trout	Adult		~55%
Intake No. 4 Bypass (above Coyote Creek)	Self-sustaining brown trout	Brown trout	Juvenile	5 cfs	98%
		Brown trout	Adult		85%
Intake No. 3 Bypass	Self-sustaining brown trout	Brown trout	Juvenile	13 cfs	~76%
		Brown trout	Adult		~16%
Intake No. 2 Bypass (below south and middle forks)	Self-sustaining brown trout	Brown trout	Juvenile	14 cfs	~90%
		Brown trout	Adult		~97 %
Intake No. 2 Bypass (Middle Fork above South Fork)	Self-sustaining brown trout	Brown trout	Juvenile	7 cfs	80%
		Brown trout	Adult		11%
Middle Fork (below Sabrina Lake)	Self-sustaining brown trout	Brown trout	Juvenile	13 cfs	93%
		Brown trout	Adult		23%
South Fork (below Intake No. 2 diversion)	Self-sustaining brown trout	Brown trout	Juvenile	7 cfs	~99%
		Brown trout	Adult		~36%
South Fork (below South Lake)	Self-sustaining brown trout	Brown trout	Juvenile	13cfs	~90%
		Brown trout	Adult		~44%
Birch Creek	Indigenous species	Speckled dace	Adult	0.25 cfs	90%
		Brook trout	Adult		76%
McGee Creek	Indigenous species	Speckled dace	Adult	1 cfs	100%
		Brook trout	Adult		87%

1 This PHABSIM model was not accurate at flows less than 4 cfs.

2 Exclusive of flow contributed by Coyote Creek

4.2 2020 Field Results

The TWG reviewed the preliminary *Instream Flow Needs Technical Report* on May 7, 2020, which included a detailed discussion of results, including discussion of study reach-specific trends in the data for Bishop Creek Reaches 1 through 5, and 7 through 10. This report incorporates by reference the tables and figures from Appendix AQ-1 of the ISR submitted to FERC in November 2020 (refer to Appendix A).

The results reported below are from:

- 2020 data from Birch and McGee creeks
- 2020 data from reaches 4 and 6 on Bishop Creek
- Supplemental PHABSIM modeling in reaches 1 and 2 for speckled dace

Study site HCM habitat suitability heatmaps showing the spatial distribution of suitability quartiles among cells and transects for each life stage at each flow increment are provided in Appendix A. Surveyed cross-sections showing channel profiles and changes in depth and wetted width are provided in Appendix B.

4.2.1 Birch Creek

The Birch Creek study site (Photo 4.2-2) was in a run-riffle complex in the vicinity of the junction of the Buttermilk Road and highway 168 on Bureau of Land Management (BLM) land (Figure 2.1-1) where the creek has a gradient of approximately 2 percent. The creek bed is typically less than 10-feet-wide with a dense woody riparian canopy, well-defined banks, and boulder/cobble/small gravel substrates (Photo 4.2-1). The study site was approximately 100-feet-long, with transects spaced at 10-foot intervals using a longitudinally oriented measuring tape to guide transect interval spacing.

Verticals were arranged on each transect at approximately 1-foot intervals; headpins and tailpins were driven into the bank crests to define endpoints of each transect (Photo 4.2-3). This divided the area into a mosaic of rectangular 1-foot by 10-foot cells. Data collection followed methods described in the draft technical report. One additional step was to conduct limited tree branch pruning to facilitate data collection in areas of dense tree canopy. Three flow increments were measured, including one which was half the existing minimum flow and another that was double the existing flow. Depth, velocity, and wetted width were therefore measured at 0.10, 0.25 (current minimum flow) and 1.0 cfs.

Habitat suitability of the three flows were empirically measured (Figure 4.2-1 and Table 4.2-1). The greatest gains in wetted area occurred between 0.1 and 0.25 cfs, as 0.25 cfs typically wets the channel toe to toe and additional flow does not add any significant wetted area. Wetted area at 0.25 cfs is 86 percent of that achieved by a 400 percent flow increase to 1 cfs. Similarly, habitat suitability for speckled dace reaches an inflection point at 0.25 cfs, where 90 percent of the suitability occurs that is achieved at 1 cfs.

Brook trout suitability was much lower than speckled dace and did not reach an inflection point but increased gradually throughout the flow range. A flow of 0.25 cfs provides 76 percent of the suitability achieved at 1 cfs.

Photo 4.2-1 Transect Tape in Centerline of Stream Channel to Guide Placement of Transect Locations

Photo 4.2-2 Birch Creek Study Area

Photo 4.2-3 Birch Creek Typical Transect Arrangement

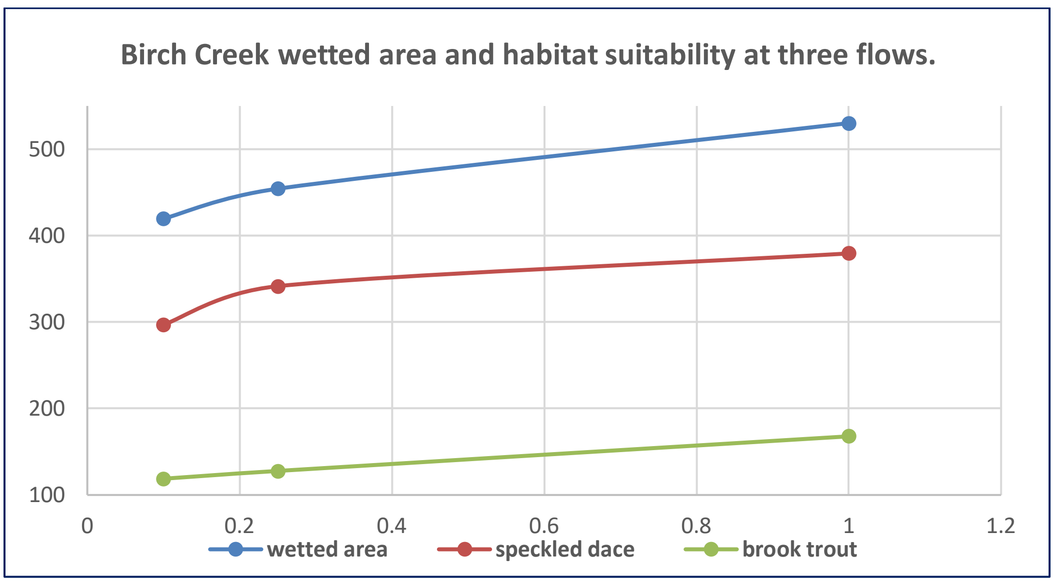


Figure 4.2-1 Birch Creek Wetted Area and Habitat Suitability at Three Flows

Table 4.2-1 Birch Creek Wetted Area (Square Feet) and Habitat Suitability at Three Flows

Discharge (CFS)	Wetted Area		Speckled Dace		Brook Trout	
0.1	419.6	79%	296.9	78%	118.8	71%
0.25	454.3	86%	341.5	90%	127.8	76%
1.0	530.2	100%	379.4	100%	167.8	100%

4.2.2 McGee Creek

The McGee Creek study site was in a run-riffle complex approximately 2 miles west of the Birch Creek site at a trailhead along the Buttermilk Road on U.S. Forest Service (USFS) land (Figure 2.1-1) where the creek has a gradient of approximately 2 to 3 percent. The creek bed is typically 10-feet-wide with a dense woody riparian canopy, well-defined banks, and boulder/cobble/small gravel substrates (Photo 4.2-4 and Photo 4.2-5). The study site was approximately 100-feet-long, with transects spaced at 10-foot intervals using a longitudinally oriented measuring tape for guidance. A small, ephemeral, man-made dam composed of piled rocks created a backwater for a short distance in the middle of the study reach (Photo 4.2-6 and Photo 4.2-7). The dam and backwater segments do not represent typical or natural stream conditions and were thus excluded from the survey.

Data collection followed the same procedures as at Birch Creek; verticals were arranged on each transect at approximate 1-foot intervals; headpins and tailpins were driven into the bank crests to define endpoints of each transect (Photo 4.2-4). Limited tree branch pruning was conducted to facilitate data collection in areas of dense tree canopy. Three flow increments were measured, including one which was half the existing minimum flow and another that was double the existing flow. Depth, velocity, and wetted width were therefore measured at 0.5, 1.0 (current minimum flow) and 2.0 cfs.

Habitat suitability of the three flows were empirically measured (Figure 4.2-2 and Table 4.2-2). The greatest gains in wetted area occurred between 0.5 and 1.0 cfs, as 1.0 cfs typically wets the channel toe to toe and additional flow does not add any significant wetted area (Appendix B). Wetted area at 1.0 cfs is 93 percent of that achieved by doubling the flow to 2 cfs. Habitat suitability for speckled dace peaks at 1.0 cfs; habitat suitability at 2 cfs is similar to that achieved at 0.5 cfs. Brook trout suitability was much lower than speckled dace and increased gradually throughout the flow range. The existing minimum flow of 1.0 cfs provides 87 percent of the suitability achieved at 1 cfs.

Photo 4.2-4 McGee Creek Channel Looking Downstream Study Area

Photo 4.2-5 McGee Creek Channel from Above

Note: Excluded from survey

Photo 4.2-6 McGee Creek Study Area Manmade Stone Dam

Note: Excluded from survey

Photo 4.2-7 McGee Creek Manmade Dam Related Backwater Area

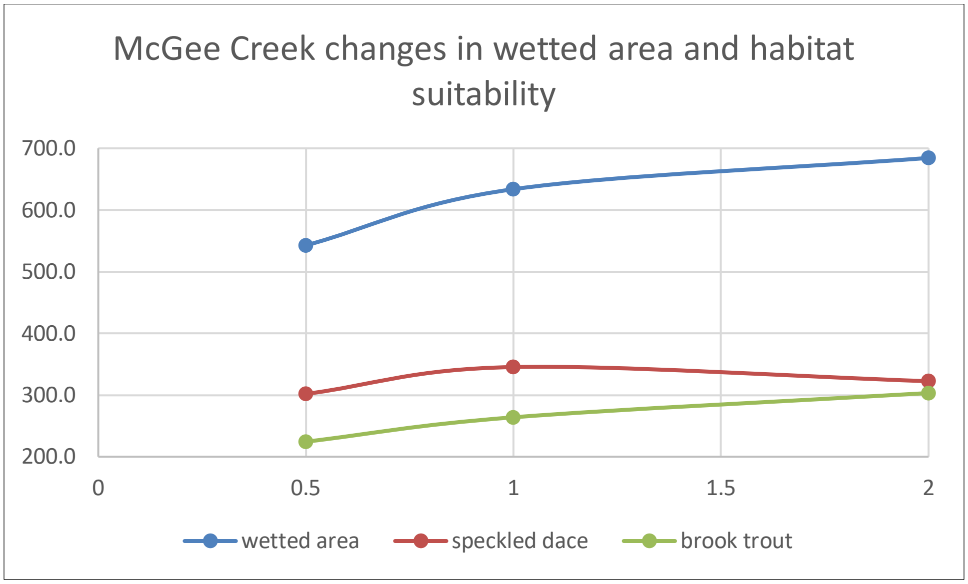


Figure 4.2-2 McGee Creek Changes in Wetted Area and Habitat Suitability

Table 4.2-2 McGee Creek Wetted Area (Square Feet) and Habitat Suitability at Three Flows

Discharge (CFS)	Wetted Area		Speckled Dace		Brook Trout	
0.5	542.7	79%	301.9	87%	224.4	74%
1	633.8	93%	345.4	100%	264.0	87%
2	684.5	100%	322.4	93%	303.3	100%

4.2.3 Bishop Creek Reach 4

The Bishop Creek Reach 4 study site was in a high gradient run-riffle approximately 300-feet-upstream from the confluence with Coyote Creek (Figure 2.1-1) where the creek has a high gradient slope dominated by riffles, short runs, plunge pools, and cascades. The creek bed is typically 30-feet-wide with steep well-defined banks and forest canopy, and boulder-dominated substrates (Photo 4.2-8). The study site was approximately 100-feet-long, with transects spaced at 5-foot intervals, encompassing run and steep gradient riffle habitat.

Three flow increments were measured, including one which was approximately half the existing minimum flow and another that was double the existing flow. Depth, velocity, and wetted width were therefore measured at approximately 2.0, 5.0 (current minimum flow) and 10 cfs.

Habitat suitability of the three flows were empirically measured (Figure 4.2-3 and Table 4.2-3). The greatest gains in wetted area occurred between 2 and 5 cfs; flows greater than 5 do not add any significant wetted area but primarily increase depth (Appendix B). Wetted area at 5 cfs is 92 percent of that achieved by doubling the flow to 10 cfs. Habitat suitability for juvenile brown trout has an inflection point at 5 cfs and only increased another 2 percent at 10 cfs. Adult brown trout suitability was much lower than juvenile habitat suitability, has a less-pronounced inflection at 5 cfs, and increases gradually by another 15 percent to 10 cfs.

Note: Looking upstream

Photo 4.2-8 Bishop Creek Study Area Run Habitat

Note: Looking downstream

Photo 4.2-9 Bishop Creek Steep Gradient Riffle/Cascades

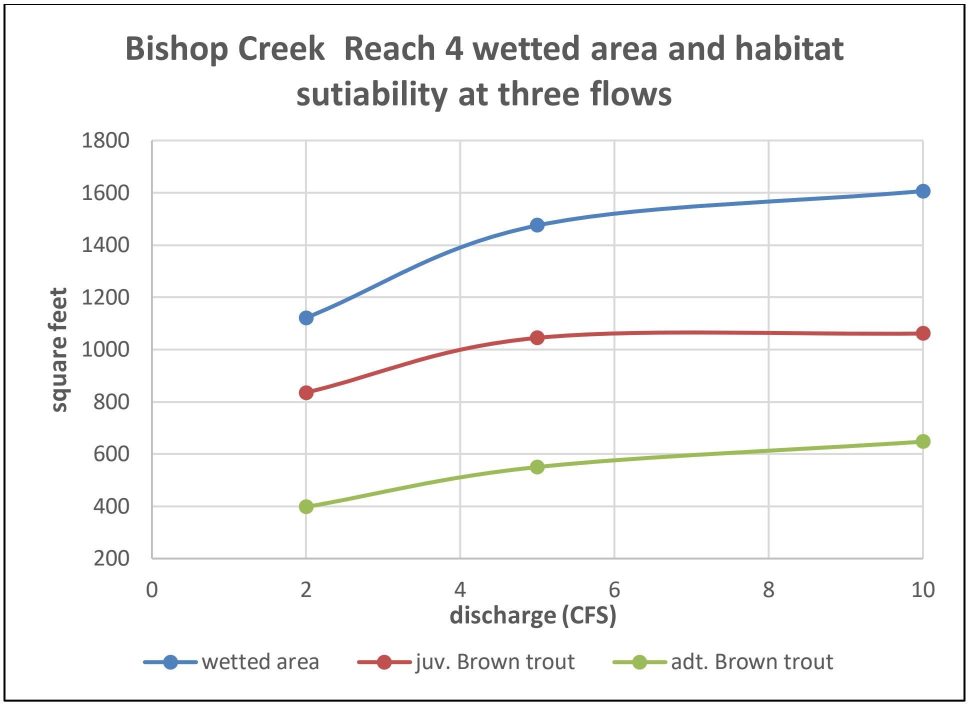


Figure 4.2-3 Bishop Creek Reach 4 Wetted Area and Habitat Suitability at Three Flows

Table 4.2-3 Bishop Creek Reach 4 Wetted Area (Square Feet) and Habitat Suitability at Three Flows

Discharge (CFS)	Wetted Area		Juvenile Brown Trout		Adult Brown Trout	
2	1,121.6	70%	835.5	79%	397.7	61%
5	1,474.9	92%	1,044.6	98%	550.3	85%
10	1606.5	100%	1,061.1	100%	647.4	100%

4.2.4 Bishop Creek Reach 6

The Bishop Creek Reach 6 study site was in a high gradient run-riffle approximately 500-feet upstream from the confluence with the Intake 3 forebay pool (Figure 2.1-1 and Photo 4.2-11) where the creek is dominated by riffles, short runs, plunge pools, and cascades. The creek bed is typically 30-feet-wide with steep well-defined banks and forest canopy, and boulder-dominated substrates (Photo 4.2-10).

The study site was approximately 100-feet-long, with four transects encompassing run and steep gradient riffle habitat. Three flow increments were measured, including one which was approximately half the existing minimum flow and another that was more than double the existing flow. Depth, velocity and wetted width were therefore measured at approximately 6.0, 10.0 (current minimum flow) and 25 cfs.

Habitat suitability of the three flows were empirically measured (Figure 4.2-4 and Table 4.2-4). Wetted area does not change significantly between 6 cfs and 10 cfs and then gradually increases toward 25 cfs. Habitat suitability for juvenile brown trout is highest at 6 cfs and declines at higher flows due to increased areas of unsuitably high velocity. Adult brown trout suitability is similar at both 6 cfs and 10 cfs, lower than juvenile habitat suitability (approximately 94 percent of the suitability present at 25 cfs), and increases gradually throughout the flow range.

Note: Looking Upstream

Photo 4.2-10 Bishop Creek Study Site 6 Area Pocket Run Habitat

Note: Looking downstream

Photo 4.2-11 Bishop Creek Site 6 Steep Gradient Riffle

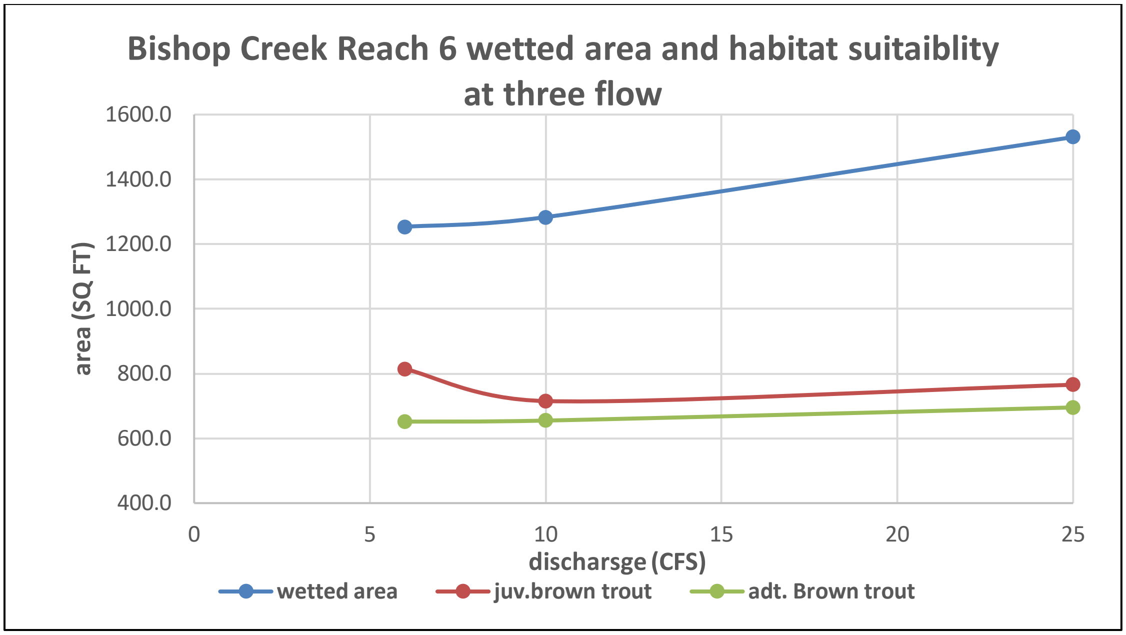


Figure 4.2-4 Bishop Creek Reach 6 Wetted Area and Habitat Suitability at Three Flow

Table 4.2-4 Bishop Creek Reach 6 Wetted Area (Square Feet) and Habitat Suitability at Three Flows

Discharge (CFS)	Wetted Area		Juvenile Brown Trout		Adult Brown Trout	
6	1,253.5	82%	814.0	100%	651.7	94%
10	1,283.3	84%	715.2	88%	655.0	94%
25	1,530.5	100%	765.6	94%	695.5	100%

4.2.5 Bishop Creek Reach 1

The Bishop Creek Reach 1 study site is in the mid-point of the Intake 6 bypass reach. Reach 1 extends from Plant No. 6 upstream to the Intake No. 6 forebay pool spillway and is generally 15- to 40-feet-wide; substrate is dominated by small and large boulder and patches of cobble substrate, with a narrow band of riparian vegetation comprised of bushes and some small tree canopy. Riffle and pockets of pool/riffle complex mesohabitat types dominate this reach. Flow increments were modeled from 6 cfs to 100 cfs. PHABSIM modeling results for brown trout and Owens sucker were previously described in the 2020 Technical Report; this report updated prior modeling results for speckled dace.

Flows of 6 cfs to 10 cfs provide between 95 and 100 percent of maximum speckled dace habitat suitability, and suitability gradually declines at higher flows due to increases in both velocity and depth (Figure 4.2-5 and Table 4.2-5).

Table 4.2-5 Bishop Creek Project Brown Trout, Owens Sucker and Speckled Dace Habitat Suitability between 6 and 100 Cfs in Reach 1

Discharge (cfs)	Wetted Area	Trout Adult	% Optimal	Trout Juvenile	% Optimal	Owens Sucker Adult	% Optimal	Owens Sucker Juvenile	% Optimal	Speckled Dace	% Optimal
6	31,468	326	24	6,163	68	5,184	23	16,237	79	3,777	97%
8	33,731	374	27	6,927	77	6,977	31	17,630	86	3,875	100%
10	36,267	521	38	7,052	78	8,329	37	18,441	90	3,690	95%
12	37,808	598	43	7,541	84	9,356	42	18,365	90	3,506	90%
14	39,157	655	47	7,741	86	10,407	47	18,480	90	3,336	86%
16	40,032	716	52	7,901	88	11,256	50	18,730	91	3,240	84%
18	41,089	764	55	7,998	89	12,061	54	19,022	93	3,196	82%
20	42,658	805	58	8,490	94	13,090	59	19,502	95	3,206	83%
25	46,045	875	63	9,008	100	15,031	67	20,517	100	3,053	79%
50	50,812	1,057	76	8,284	92	18,313	82	19,080	93	2,224	57%
75	59,722	1,235	89	7,877	87	21,319	95	19,357	94	1,616	42%
100	61,323	1,387	100	4,356	48	22,345	100	19,436	95	1,323	34%

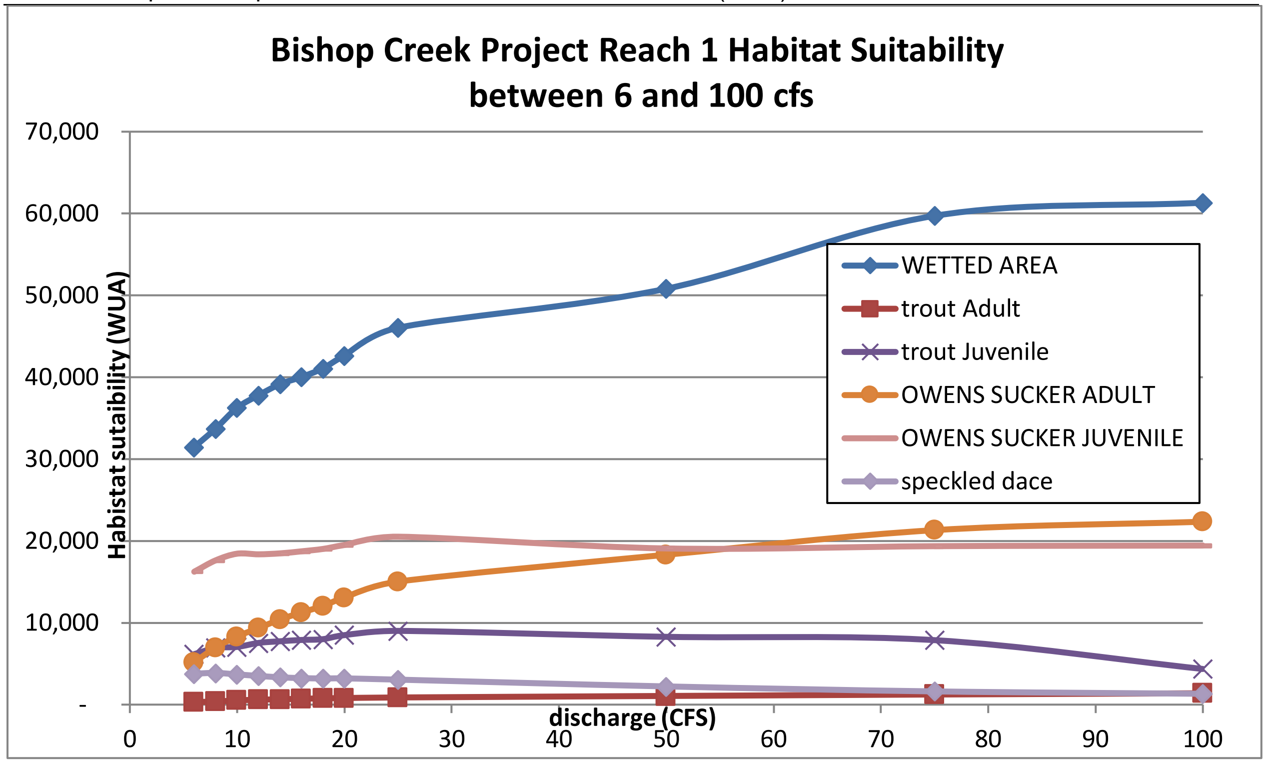


Figure 4.2-5 Reach 1 Habitat Suitability between 6 and 100 cfs

4.2.6 BISHOP CREEK REACH 2

The Bishop Creek Reach 2 study site is in the mid-point of the Intake No. 5 Bypass Reach where the creek is dominated by riffles and runs and is generally 25- to 30-feet-wide; substrate is dominated by small boulder and patches of cobble, with a narrow band of riparian vegetation comprised of bushes and some small tree canopy. This reach is incrementally steeper than Reach 1, and thus riffle mesohabitat dominates this reach. PHABSIM modeling results for brown trout and Owens sucker were described in detail in the 2020 Technical Report. Flow increments were modeled between 4 cfs and 100 cfs. This report updates prior modeling with results for speckled dace.

There is a bimodal peak in habitat suitability for speckled dace (Table 4.2-6 and Figure 4.2-6). The first occurs at 6 cfs where 65 percent of maximum WUA occurs. As flow increases, areas in the thalweg decline in suitability as depth and velocity increases exceed preferences for the species. Flows of 6 cfs to 10 cfs provide between 90 and 100 percent of maximum juvenile habitat suitability, and suitability gradually declines at flows above 8 cfs as the thalweg becomes unsuitably deep and fast, limiting usable habitat to the stream margins. WUA remains depressed until approximately 25 cfs (Figure 4.2-6 and Table 4.2-6). At higher flows, a perched sand bar at a relatively high bed elevation captured by transect 2.3 begins to be inundated and this provides additional WUA (Figure 4.2-7).

Table 4.2-6 Bishop Creek Project Brown Trout, Owens Sucker and Speckled Dace Habitat Suitability between 6 and 100 cfs in Reach 2

Discharge	Wetted Area	Trout Adult	Percent Optimal	Trout Juvenile	Percent Optimal	Sucker Adult	Percent Optimal	Sucker Juvenile	Percent Optimal	Speckled Dace	Percent Optimal
4	18,163	581	6	3,299	51	1,620	8	9,335	55	2,453	64%
6	19,902	785	8	4,218	65	2,619	13	11,168	66	2,495	65%
8	21,386	988	10	4,992	77	3,739	18	12,948	76	2,196	57%
10	22,859	1,216	13	5,470	84	4,810	24	14,030	83	1,964	51%
12	23,724	1,434	15	5,702	88	5,792	28	14,656	86	1,803	47%
14	24,516	1,645	17	5,822	89	6,722	33	15,169	89	1,725	45%
16	25,100	1,885	20	5,924	91	7,578	37	15,628	92	1,646	43%
18	25,783	2,163	23	6,012	92	8,401	41	16,026	94	1,575	41%
20	26,449	2,479	26	6,103	94	9,233	45	16,370	96	1,549	40%
25	28,109	3,340	35	6,319	97	11,126	55	16,831	99	1,654	43%
50	31,349	6,643	70	6,509	100	16,809	82	16,451	97	2,679	69%
75	34,051	8,655	91	6,340	97	19,285	95	16,990	100	3,863	100%
100	35,214	9,493	100	6,162	95	20,395	100	15,973	94	2,445	63%

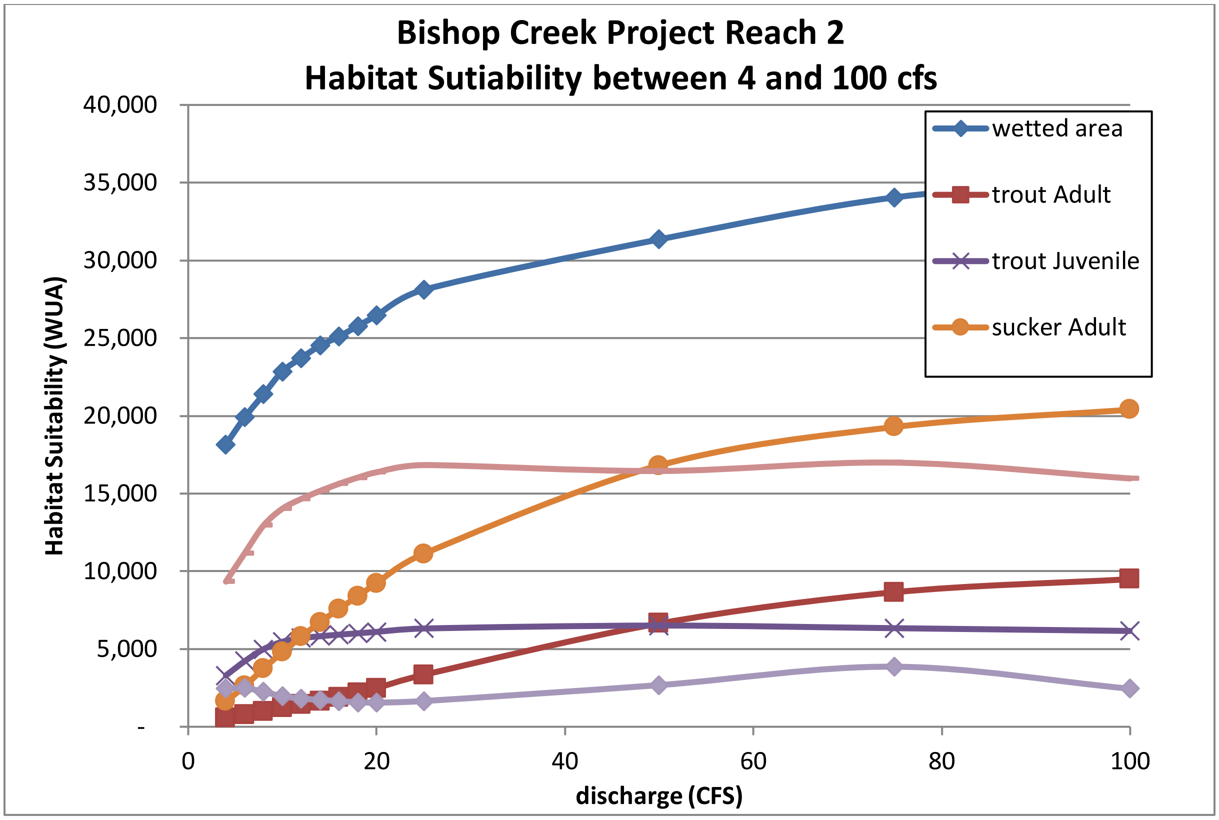
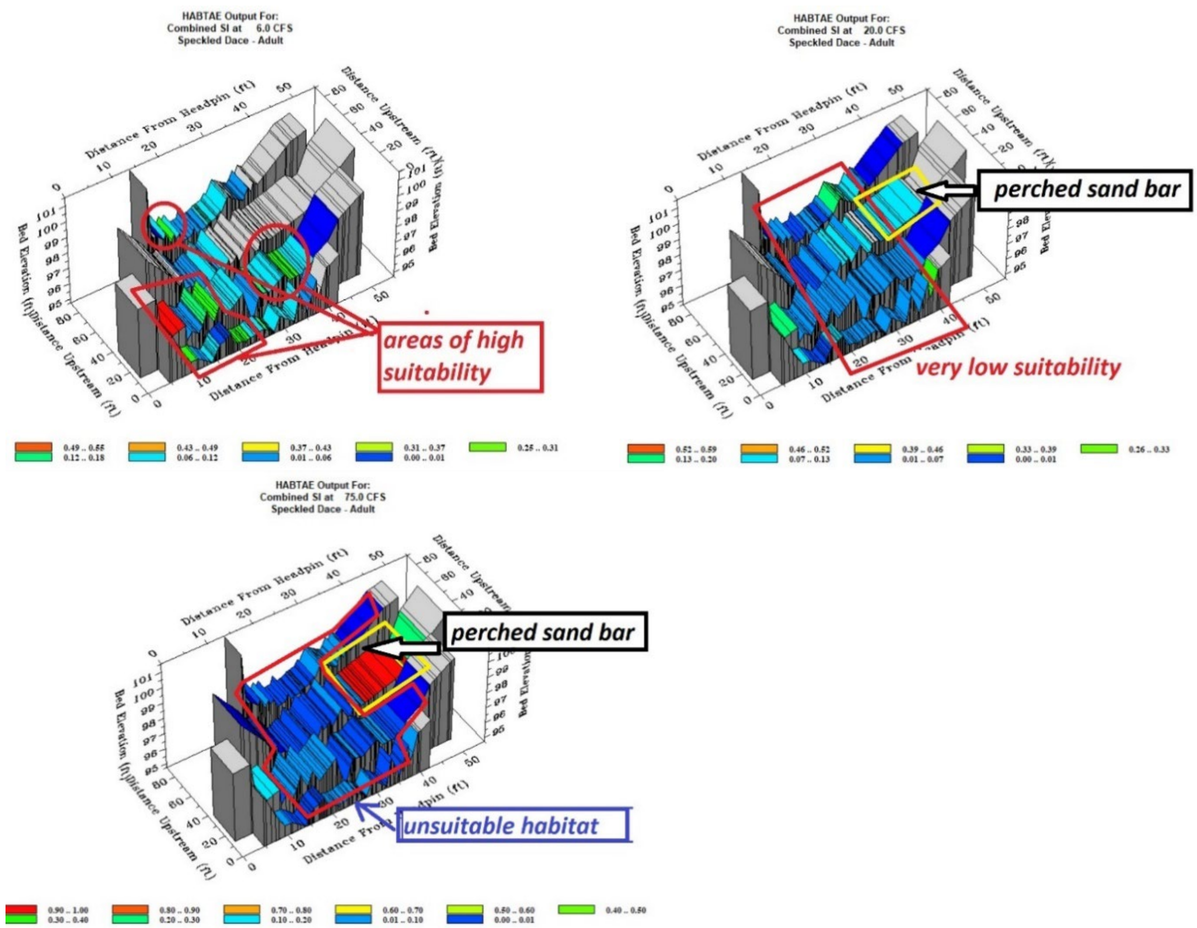


Figure 4.2-6 Reach 2 Habitat Suitability between 4 and 100 cfs



Note: Heat Color Spectrum: Red is Most Suitable, Yellow/Green is Moderate Suitability, Dark Blue is Unsuitable

Figure 4.2-7 Reach 2 Study Area; Changes in Speckled Dace Habitat Suitability at 6, 20 and 75 cfs

4.2.7 MACROINVERTEBRATES

Benthic macroinvertebrates that occupy creeks in the study area may include various aquatic insects such as mayflies and stoneflies. Larval life stages of these insects inhabit streambeds where they provide potential forage for other ecosystem members such as fish and other vertebrates. These invertebrates utilize interstitial spaces between substrates for shelter and feeding, gravel, cobble and small boulder are preferred substrates (Vermont ANR [unpublished data]). Conversely, fines such as silt and sand are less suitable as there is little if any interstitial water flow within the benthic layer to support the life stage.

Mesohabitat mapping (SCE 2019) and subsequent IFIM analyses of study reaches (SCE 2020) demonstrates that the study area is dominated by a homogenous mix of cobble and boulder substrates with patches of gravel. All are substrates suitable for macroinvertebrates. Other less suitable substrates such as silt, sand, and other fines are confined to patches along stream margins and downstream of large object velocity shelters such as boulders. It may therefore be concluded that habitat suitability for macroinvertebrates in the study area is not substrate-limited, and that habitat suitability trends for macroinvertebrates can be approximated by reviewing the wetted width and wetted area calculations presented in these studies.

5.0 CONSULTATION SUMMARY

SCE distributed periodic progress reports on the following schedule:

- Progress Report 1: December 19, 2019
- Progress Report 2: April 14, 2020
- Progress Report 3: July 24, 2020
- Initial Study Report (Progress Report 4): October 30, 2020
- Initial Study Meeting: November 10, 2020
- 2021 Progress Report 1: March 2, 2021
- 2021 Progress Report 2: May 28, 2021
- 2021 Progress Report 3: August 27, 2021
- Updated Study Report (2021 Progress Report 4): November 4, 2021
- Updated Study Report Meeting: November 18, 2021

Eight technical memoranda summarizing the 2019 study implementation were submitted with Progress Report 2 filed with FERC on April 14, 2020. Following that filing, SCE hosted a TWG meeting on May 7, 2020 to discuss the 2019 study season, work completed to date and the technical memoranda. After the meeting, TWG members submitted comments on the technical memoranda and SCE provided a general response to those comments as part of Progress Report 3, filed with FERC July 24, 2020.

In addition, during 2020, SCE consulted by phone and email with Aquatic TWG members (specifically CDFW and USFS) to determine habitat suitability criteria for speckled dace, brook trout and to finalize study details for Birch and McGee creeks.

The ISR was filed with FERC on October 30, 2020 and a virtual ISR meeting was held on November 10, 2020. No additional comments were received from TWG members or stakeholders on the IFIM ISR materials or on the previously provided responses to comments.

Three progress reports were filed in 2021 after the ISR, as identified above. This Final Technical Report was submitted to agencies and stakeholders for a 60-day review period on May 14, 2021. The comment period was extended, at the request of the agencies, and comments received on this report are provided in Table 5.1-1. A meeting was held with CDFW and USFS on October 6, 2021 to discuss those comments received as well as SCE’s draft responses.

SCE held a meeting on October 28, 2021 for all stakeholders and agencies to discuss what Project effects (if any) had been identified through the implementation of each of the approved study plans.

The USR was filed with FERC on November 4, 2021. SCE held a meeting on November 18, 2021 to discuss those studies which were still in progress at the time of the ISR (Water Quality, Sediment and Geomorphology, Operations Model, Recreation Use and Needs, Recreation Facilities Condition Assessment, Project Lands and Boundary, and Cultural and Tribal Studies). The IFIM Assessment was not discussed at the USR, and thus received no comments.

Additional meetings to discuss Protection, Mitigation, and Enhancement (PM&E) measures were held between February and May, after filing of the Draft License Application (DLA) in January 2022. During these meetings, CDFW requested that the PHABSIM model for one reach be run again to include additional species. Table 5.1-1 provides a summary of comments received to date for this study and responses to those comments.

Table 5.1-1 Comment Response Table

<table>
<tr><th>Comment Number</th><th>Study</th><th>Date of Comment</th><th>Entity</th><th>Comments</th><th>SCE Response</th></tr>
<tr><td>21</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>This goal was accomplished as written in the technical memorandum, but it differs from the Goals and Objectives stated in the Volume III Technical Study Plans. The technical memorandum did not address Section 3.1.2.8 Macroinvertebrates in Technical Study Plans: SCE intends to address the potential impacts within the Phase 1 IFIM study, by characterizing the dominant substrates inventoried during the mesohabitat survey and applying literature to discuss how the presence/absence of suitable substrates affect their distribution.</td><td>The October 4, 2019 Mesohabitat Survey memorandum briefly described reach-specific dominant substrates and discussed with the TWG during the related conference call. These were subsequently quantified in greater detail on each PHABSIM transect, each of which was selected in consultation with the CDFW and other TWG participants as representative of habitat conditions within each reach.

These substrates are discussed in the context of macroinvertebrate habitat in Section 5.2.7 of this Final Technical Report and in the Section 8.5 in Exhibit E of the Draft License Application.</td></tr>
<tr><td>22</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>The intended meaning of “optimal habitat suitability” should be defined in the methods section, or possibly replaced by a more appropriate term…. Most of the brown trout weighted usable area (WUA) curves do not reach their peak in the narrow range of flows that were simulated. Therefore, the ‘optimum’ cannot be stated. The study design does not require the determination of optimal, so replacement of the term with a more appropriate term should not be controversial. CDFW recommends replacing the term ‘optimum’ with ‘modelled boundary’ in most cases.</td><td>Optimum habitat as used by SCE refers to the maximum amount of WUA achieved at a flow within the modeled range in cases where the peak occurs at a low or intermediate flow within the range modeled. SCE notes that the CDFW’s general comment that “Most of the brown trout weighted usable area curves (WUA) do not reach their peak in the narrow range of flows that were simulated” is only partially correct, and primarily applies to only the adult life stage within certain reaches. The report confirms that juvenile brown trout WUA peaks at flows within the model range in all except two study reaches, and most commonly at flows at the lower end of the modeled range. In all cases habitat suitability for juvenile trout increased only slightly throughout the higher range of flows. Adult WUA peak in three of the study reaches within the flow range, and the data generally show that of the remaining reaches, incremental gains in adult WUA at flows greater than 25- 50 are very slight up to 100 cfs.

<table>
<tr><th>Reach</th><th>Juv. Trout (peak WUA flow)</th><th>Adult Trout (peak WUA flow)</th></tr>
<tr><td>1</td><td>25 cfs</td><td>Minimal WUA at all flows</td></tr>
<tr><td>2</td><td>50 cfs</td><td>Minimal WUA gains at higher flows</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Comment Number</th><th>Study</th><th>Date of Comment</th><th>Entity</th><th>Comments</th><th>SCE Response</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td><table><tr><td>3</td><td>6 cfs</td><td>20 cfs</td></tr><tr><td>5</td><td>100 cfs</td><td>100 cfs</td></tr><tr><td>8</td><td>50 cfs</td><td>Minimal WUA gains at higher flows</td></tr><tr><td>9</td><td>6 cfs</td><td>Minimal WUA gains at higher flows</td></tr><tr><td>10</td><td>6 cfs</td><td>37 cfs</td></tr></table>
SCE appreciates having the discussion regarding WUA but as noted in the report discussion, does not agree that maximum trout WUA is the goal or metric that should drive the analyses.

WUA analyses is included in the Section 8.5 of Exhibit E of the DLA.</td></tr>
<tr><td>23</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>Page 2-9. The reference to ‘adult suitability’ should be clarified to indicate which species is being characterized.</td><td>SCE clarifies that the “adult suitability” references adult brown trout. Clarification is included throughout Section 8.5 of Exhibit E of the DLA.</td></tr>
<tr><td>24</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>Page 2-10. Use of the word ‘embankments’ to describe habitat in the reach 5 study site should be reconsidered. To the best of our knowledge no embankments have been constructed within the referenced site.</td><td>SCE notes CDFW’s distinction and concurs that no study sites were in the vicinity of constructed embankments. The use of the word embankment is not included in Exhibit E of the DLA.</td></tr>
<tr><td>25</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>Page 3-2. References to the Stillwater report should be ‘in prep,’ not ‘in press.’</td><td>SCE notes CDFW’s distinction and concurs that at the time the report was filed “in prep” would be a more accurate term. Since that time, it can be considered to have been published for purposes of this relicensing procedure.</td></tr>
<tr><td>26</td><td>Instream Flow Incremental Methodology Technical Memorandum</td><td>May 21, 2020</td><td>CDFW</td><td>Page 3-3. The statement ‘Maintaining wild populations [of fish] means that recruitment from younger life stages should be optimized’ is not correct. No evidence suggests the population is recruitment limited. Maintaining wild populations depends on provision of adequate habitat for populations of adults, not maximizing recruitment.</td><td>SCE notes CDFW’s distinction; SCE’s observation was merely to note that the adult fish lifestage must be recruited from younger lifestages such as juveniles and therefore the importance of managing nursery habitat should not be overlooked to maintain a self-sustaining population.</td></tr>
</table>

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
27	Instream Flow Incremental Methodology Technical Memorandum	May 21, 2020	CDFW	Page 3-3. The phrase 'ichthyomechanics in terms of navigating velocities' should be restated using broadly accepted vocabulary. We suspect the intention is to refer to bioenergetics.	SCE notes CDFW's distinction. However, ichthyomechanics refers to the ability of a fish's swimming strength and agility, whereas bioenergetics refers to metabolic processes that support the animal's ability to swim. Based on this definition, SCE feels the term is correctly applied.
1	Instream Flow Needs and Assessment – AQ 1	June 21, 2021, and October 4, 2021	CDFW	The lack of inflection point in Bishop Creek reaches 4 and 6 may be the result of not including a broad enough range of flows. <u>October 14, 2021, CDFW Updated Comment:</u> CDFW previously requested a broader range of study flows in planning meetings, but SCE declined to include them. Brandon Kulick's description of why IFM was deemed unsuitable for reaches 4 and 6 is appropriate.	SCE selected a robust flow spread ranging from one half of the existing flow through double the existing flow. The absence of a sharp inflection point is due to measuring three flow increments (as per USFS and CDFW direction). Additional increments may better express an inflection point, although this was not a goal of the study. Flow increments are discussed in Section 8.5 of Exhibit E of the DLA.
2	Instream Flow Needs and Assessment – AQ 1	June 21, 2021, and October 4, 2021	CDFW	The current flow regime does not provide adequate habitat for adult brown trout (*Salmo trutta*) and adult brook trout (*Salvelinus fontinalis*). Reaches should be identified that have the potential to provide additional adult trout habitat if minimum instream flows are increased. <u>October 14, 2021, CDFW Updated Comment:</u> There are no specific criteria developed for Bishop Creek. The intent of this study was to determine what flows would be improve available habitat for adult BT. The Synthesis report will be useful. CDFW will look to species health and distribution data from fish and BMI monitoring. Then we can use operations modeling and IFIM results to see where we may be able to alter project operations to improve available habitat. The term 'adequate habitat' can be defined somewhat on a case-by-case basis by a combination of the following scientific and measurable characteristics: stream flow, water quality, food sources, physical habitat, and biotic interactions.	The term "adequate" is vague and could be interpreted as any value greater than minimal or less than maximum. SCE understands that CDFW does not have a formal definition of this term. CDFW should advise SCE of their science- based criteria so that this can be better quantified. SCE's definition of habitat suitability and adequate habitat is described in Section 8.5 of Exhibit E of the DLA.

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
3	Instream Flow Needs and Assessment – AQ 1	June 21, 2021, and October 4, 2021	CDFW	Discuss the conflicting habitat needs of the fish species and life stages. Discuss which reaches can currently or could provide for those needs if Project operations are altered. <u>October 14, 2021, CDFW Updated Comment:</u> This is best addressed in a meeting this winter. CDFW fisheries management objectives are to preserve and maintain the current fishery as self-sustaining and to allow a quality sport fishery.	SCE agrees that in certain study reaches and at some flow ranges, WUA curves among species and life stages do conflict. There are numerous techniques for balancing flow recommendations in such cases (Bovee, 1982). SCE recognizes that solutions will vary reach-specifically and is looking for guidance from CDFW prior to discussing alternative flow releases This is likely best handled in a meeting/workshop format after fully understanding the operations model and project hydrology. SCE's discussion of WUA and life stages is found in Section 8.5 of Exhibit E of the DLA.
4	Instream Flow Needs and Assessment – AQ 1	June 21, 2021	CDFW	Analysis of the maximum weighted usable area (WUA) curve is a necessary part of determining flow regimes and is referenced frequently in the literature. CDFW recommends that SCE follow the established methodology for this analysis.	As stated, this is too vague to respond to quantitatively as there are numerous methods for analyzing weighted usable area. SCE requests further clarification. This is likely best handled in a meeting/workshop format after fully understanding the operations model and project hydrology. WUA analyses is included in Section 8.5 of Exhibit E of the DLA.
5	Instream Flow Needs and Assessment – AQ 1	June 21, 2021 and October 4, 2021	CDFW	Several habitat cross-sectional profiles demonstrated scenarios where the minimum instream flow release could result in the creation of isolated pools and potential stranding of fish. The minimum instream flow releases that could results in stranding should be identified and avoided.	SCE appreciates the comment and will review water depths associated with proposed habitat protective flow releases relative to stranding. SCE's discussion of CDFW's comment regarding the potential for fish stranding due to minimum instream flow releases is provided in Section 8.5 of Exhibit E of the DLA.
N/A	PM&E Discussion Meeting	Spring 2022	CDFW	CDFW requested that the PHABSIM model for Reach 3 be re-run to include the Owens sucker and speckled dace.	To address this comment, SCE has included a memo with updated weighted usable area calculations for Reach 3 in Appendix D of this Final Technical Report being filed with the Final License Application.

6.0 REFERENCES

Bovee, K.D. 1982. A guide to stream habitat analysis using the instream flow incremental methodology. (Office of Biol. Service FWS/OBS-82-26). Washington, DC.: USFWS, U.S. Dept. of Interior.

Bovee, K.D., Lamb, B.L., Bartholow, J.M., Stalnaker, C.B., Taylor, J. & Henriksen, J. 1998. Stream habitat analysis using the instream flow incremental methodology. (Biological Resources Division Information and Technology Report USGS/BRD-1998-0004/ viii). U.S. Geological Survey.

EA Engineering, Science, & Technology, Inc. (EA). 1988. Instream flow and fisheries report for the Bishop Creek Hydroelectric Project. EA Engineering, Science, & Technology, Inc. Lafayette, California prepared for Southern California Edison, Rosemead, CA.

Stillwater Sciences. 2009. Lower McCloud River Instream Flow Study (FA-S8) Technical memorandum 56 (TM-56). Habitat Criteria Mapping on the Lower McCloud River. 60 pp.

Southern California Edison (SCE). 2020. Bishop Creek Flow Needs Report, March 2020.

Southern California Edison (SCE). 2019. Bishop Creek Project Aquatic Mesohabitat Survey: Summary of Field Efforts and Data Analysis Memo. September 21, 2019. 19 pp. plus map appendices.

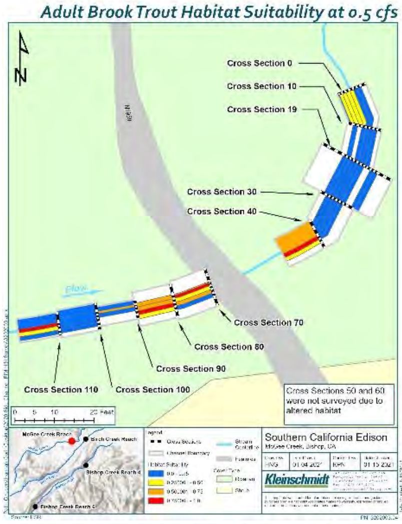
Vermont ANR [unpublished data]. Modified VTANR macroinvertebrate Habitat Suitability Criteria.

APPENDIX A

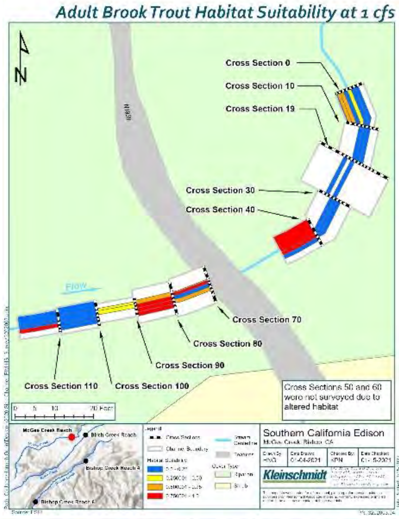
HABITAT SUITABILITY TABLE

McGee Creek

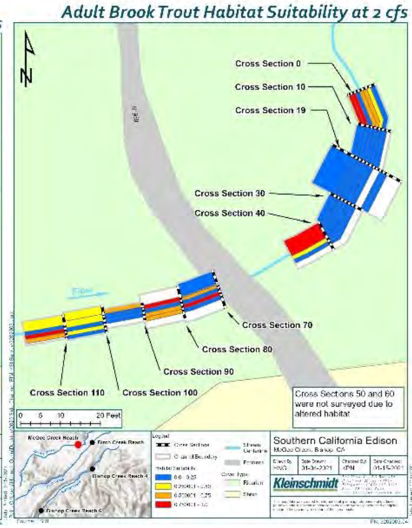
Adult Brook Trout Habitat Suitability at 0.5 cfs



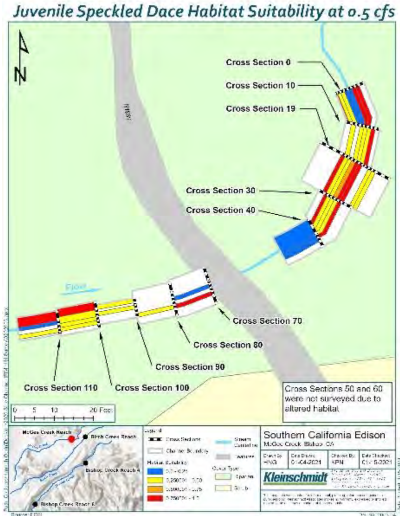
Adult Brook Trout Habitat Suitability at 1 cfs



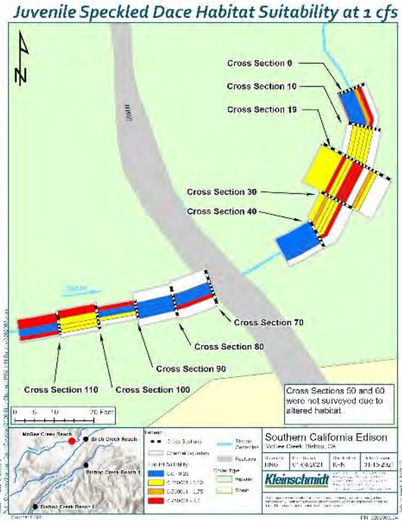
Adult Brook Trout Habitat Suitability at 2 cfs



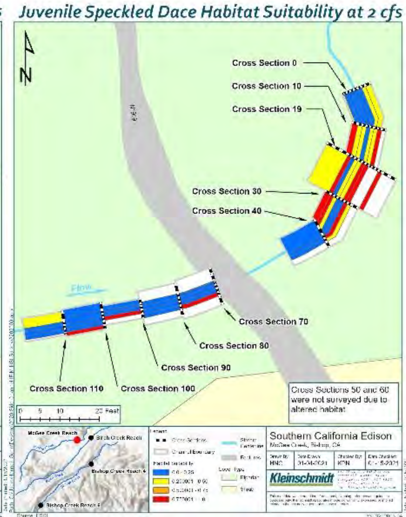
Juvenile Speckled Dace Habitat Suitability at 0.5 cfs



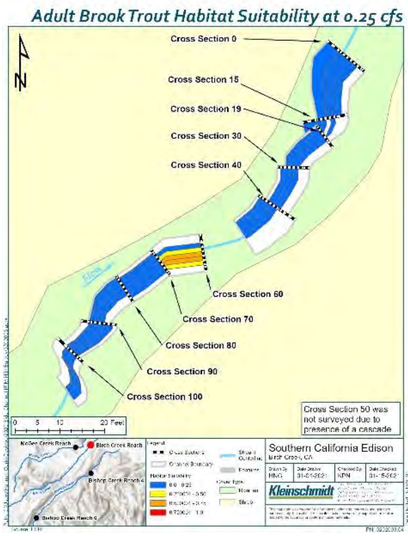
Juvenile Speckled Dace Habitat Suitability at 1 cfs

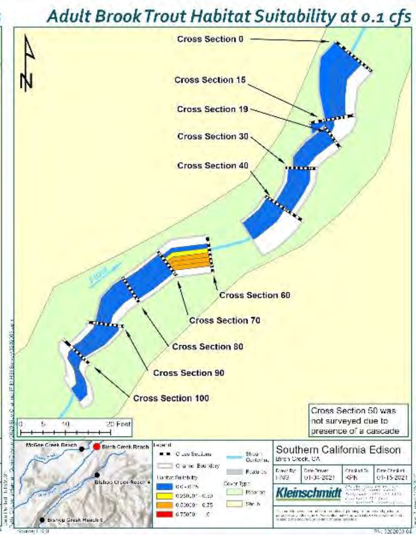


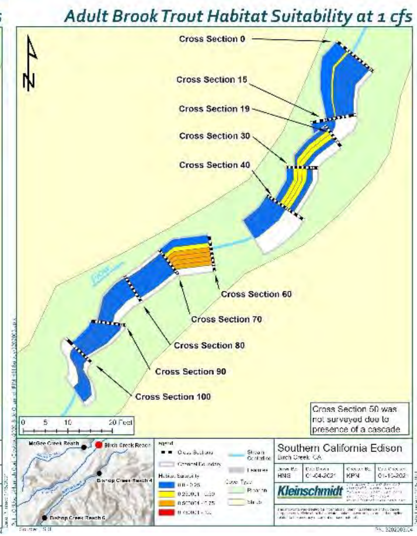
Juvenile Speckled Dace Habitat Suitability at 2 cfs

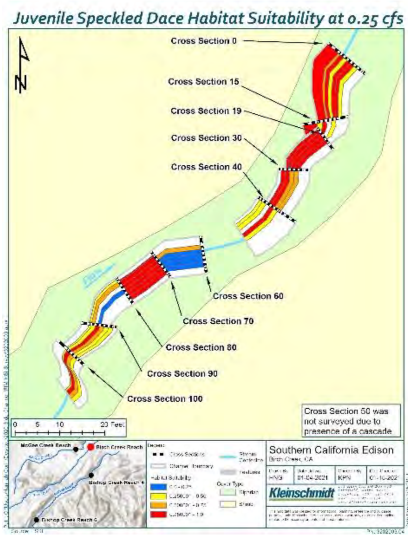


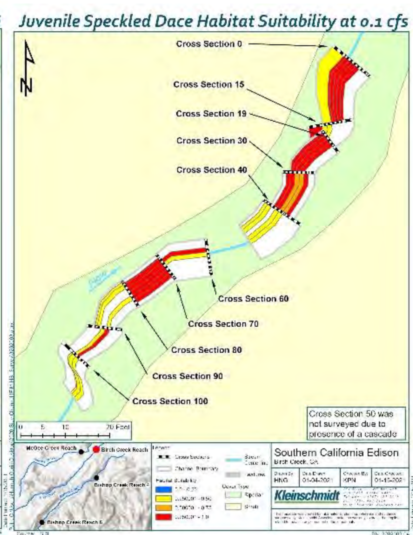
Birch Creek

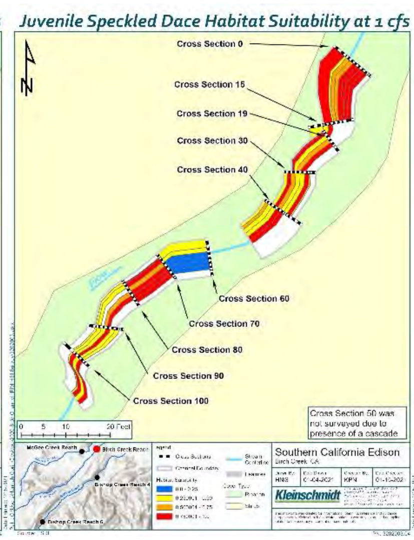

Adult Brook Trout Habitat Suitability at 0.25 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt


Adult Brook Trout Habitat Suitability at 0.1 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt

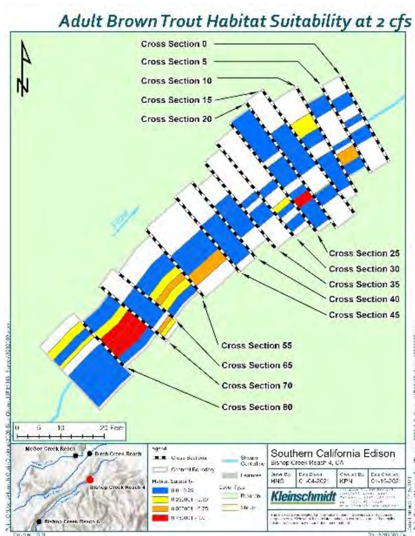

Adult Brook Trout Habitat Suitability at 1 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt

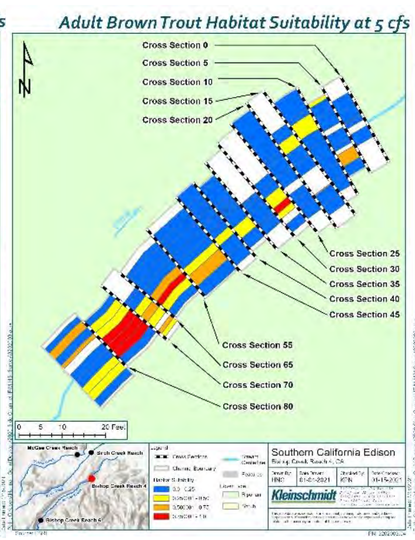

Juvenile Speckled Dace Habitat Suitability at 0.25 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt

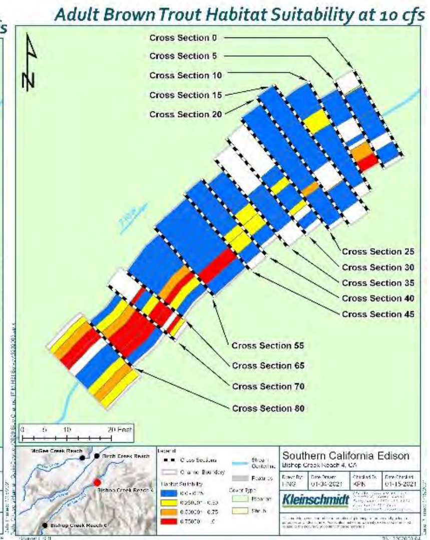

Juvenile Speckled Dace Habitat Suitability at 0.1 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt

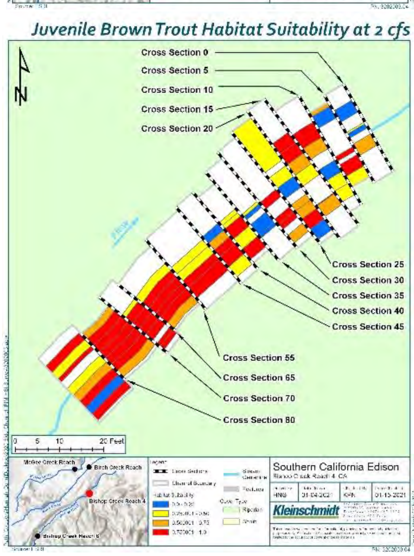

Juvenile Speckled Dace Habitat Suitability at 1 cfs
Cross Section 0
Cross Section 15
Cross Section 19
Cross Section 30
Cross Section 40
Cross Section 60
Cross Section 70
Cross Section 80
Cross Section 90
Cross Section 100
Cross Section 50 was not surveyed due to presence of a cascade
Southern California Edison
Kleinschmidt

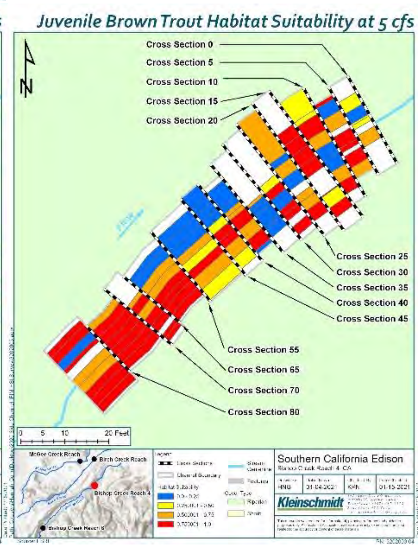
Bishop Creek Reach 4

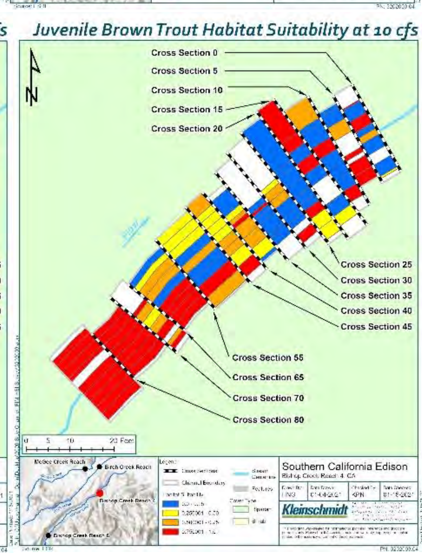






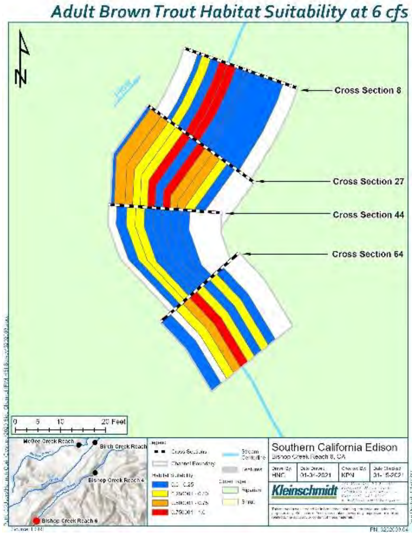




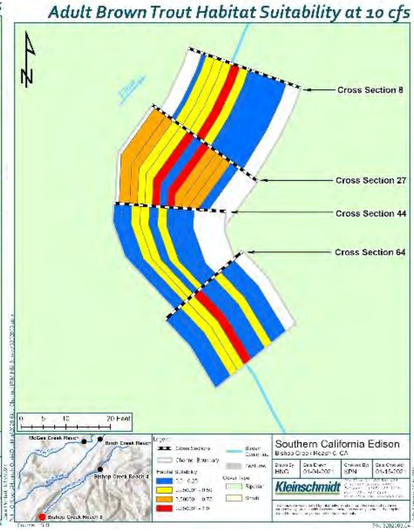


Bishop Creek Reach 6

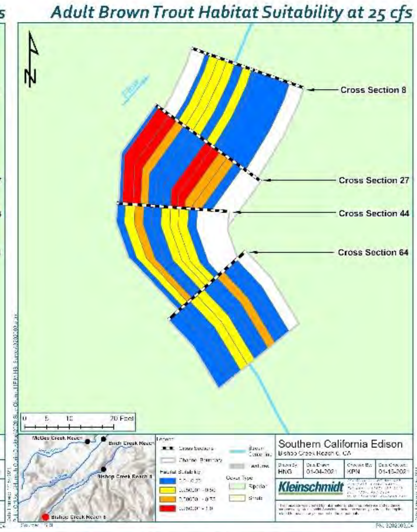
Adult Brown Trout Habitat Suitability at 6 cfs



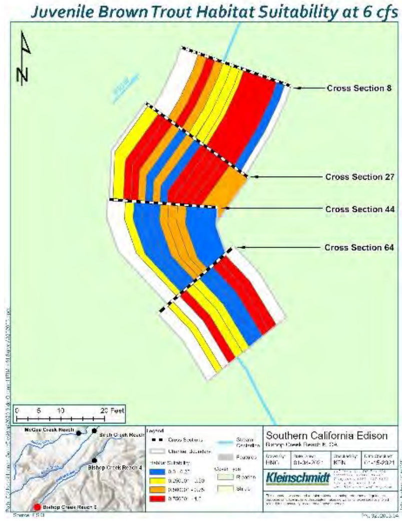
Adult Brown Trout Habitat Suitability at 10 cfs



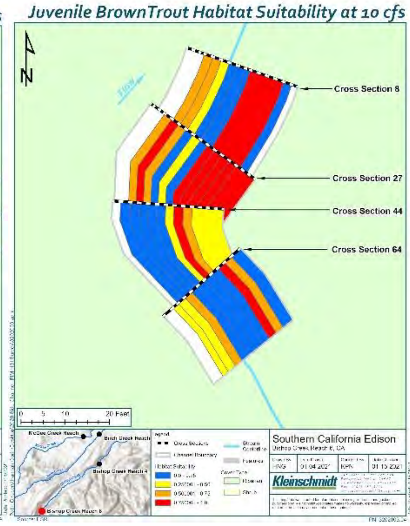
Adult Brown Trout Habitat Suitability at 25 cfs



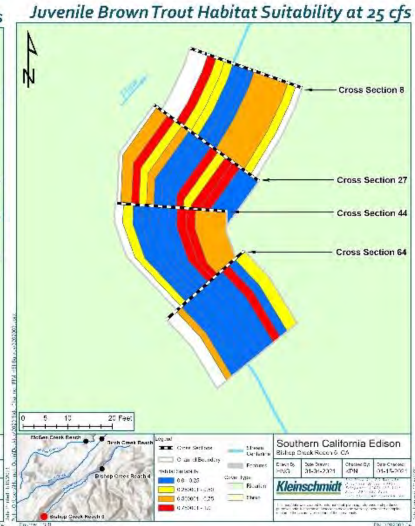
Juvenile Brown Trout Habitat Suitability at 6 cfs



Juvenile Brown Trout Habitat Suitability at 10 cfs



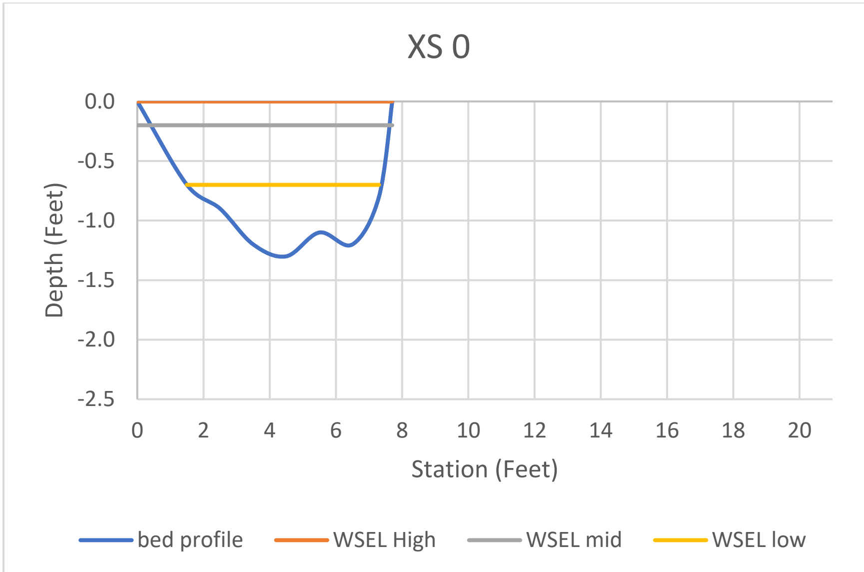
Juvenile Brown Trout Habitat Suitability at 25 cfs



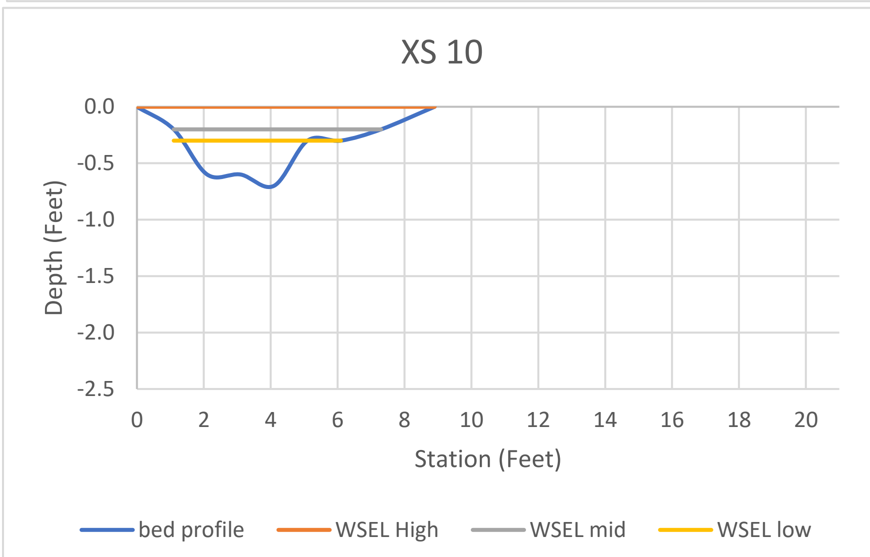
APPENDIX B

HABITAT CROSS-SECTIONAL PROFILES

McGee Creek



XS 0
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
Depth (Feet)
0
2
4
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low



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-1.0
-1.5
-2.0
-2.5
Depth (Feet)
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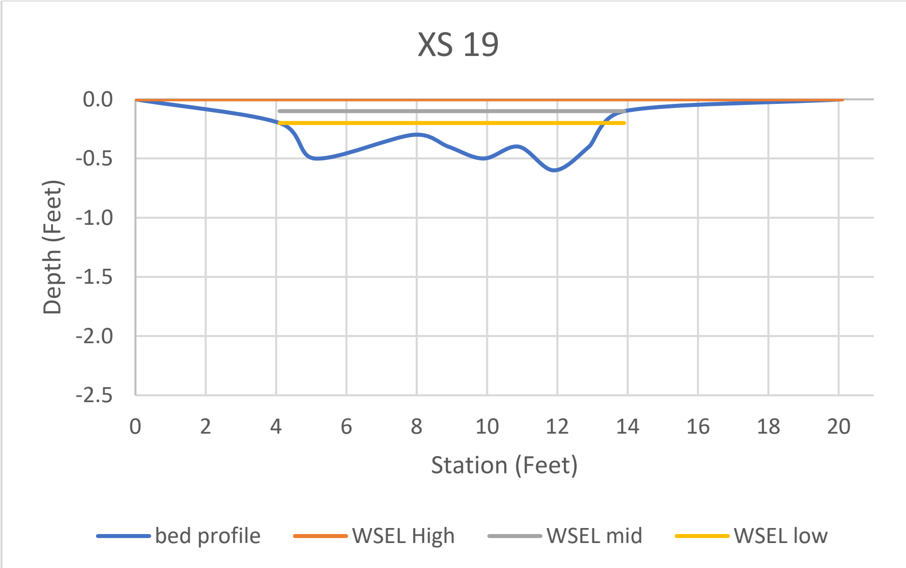
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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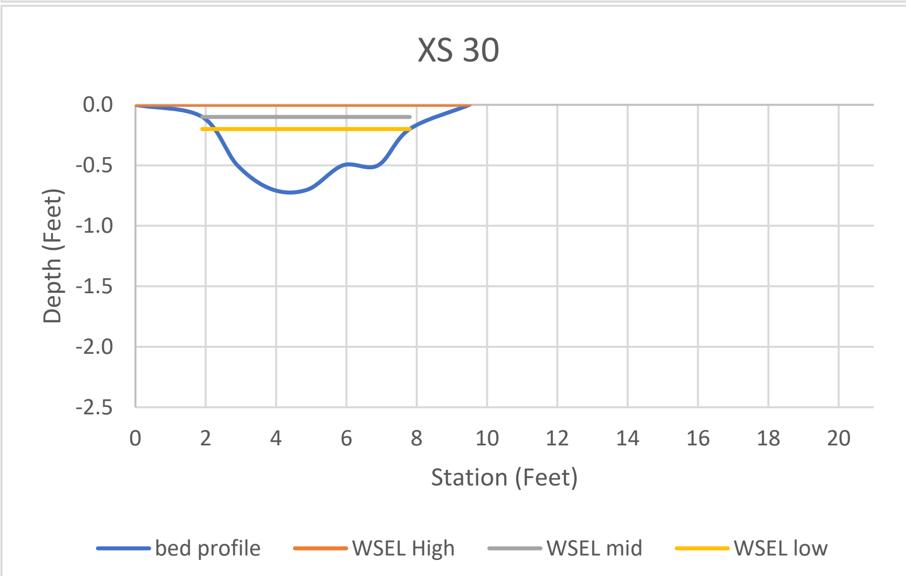
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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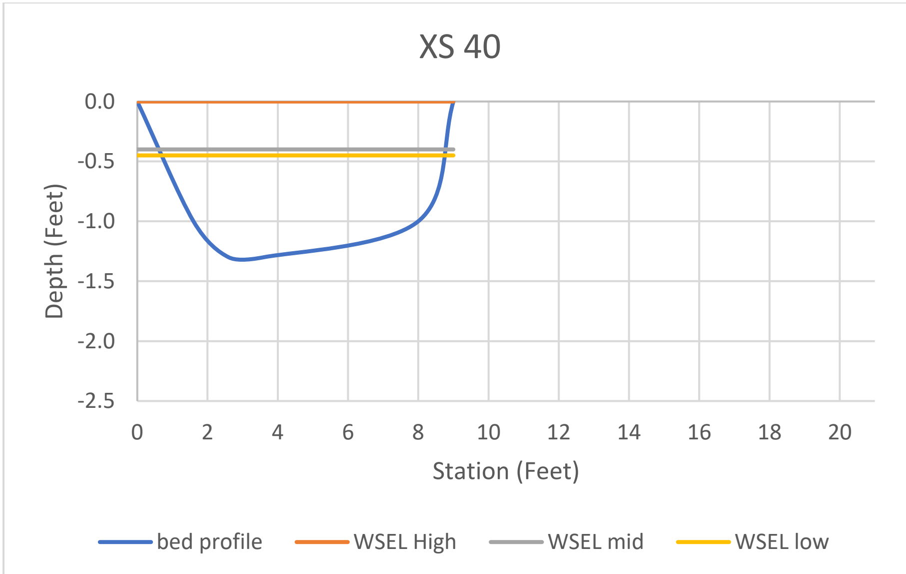
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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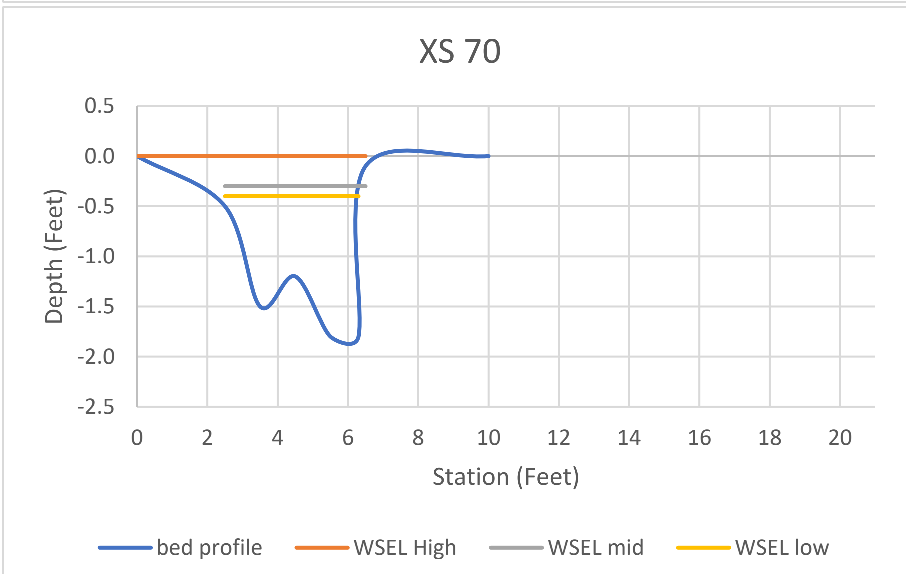
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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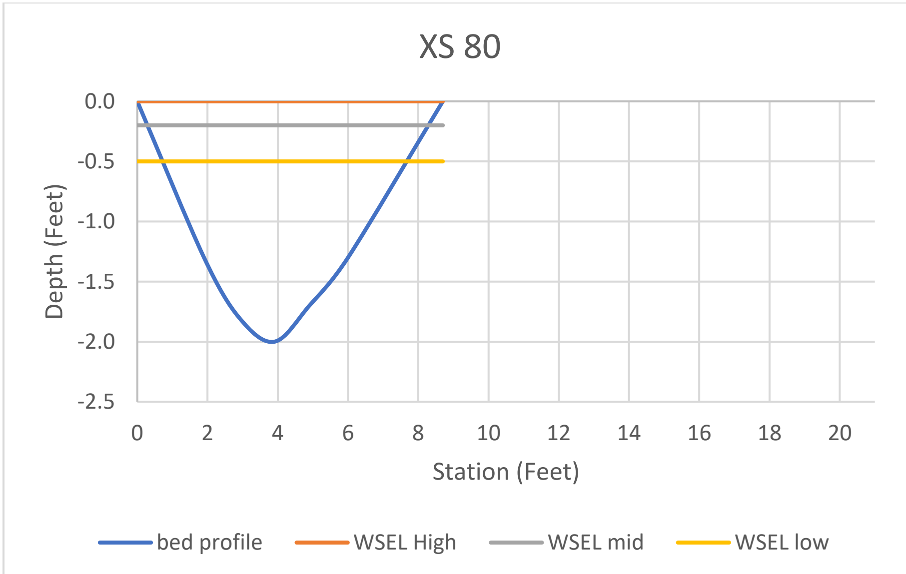
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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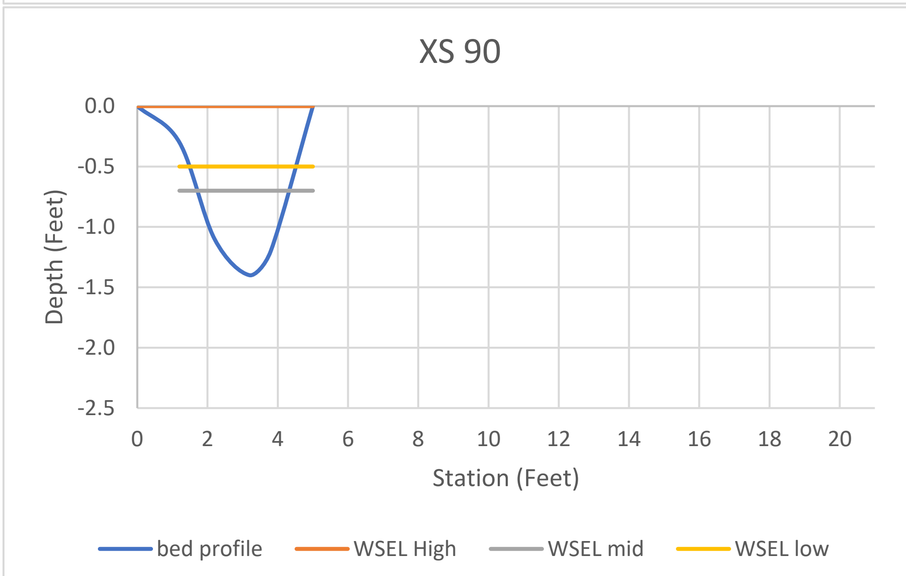
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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-2.5
Depth (Feet)
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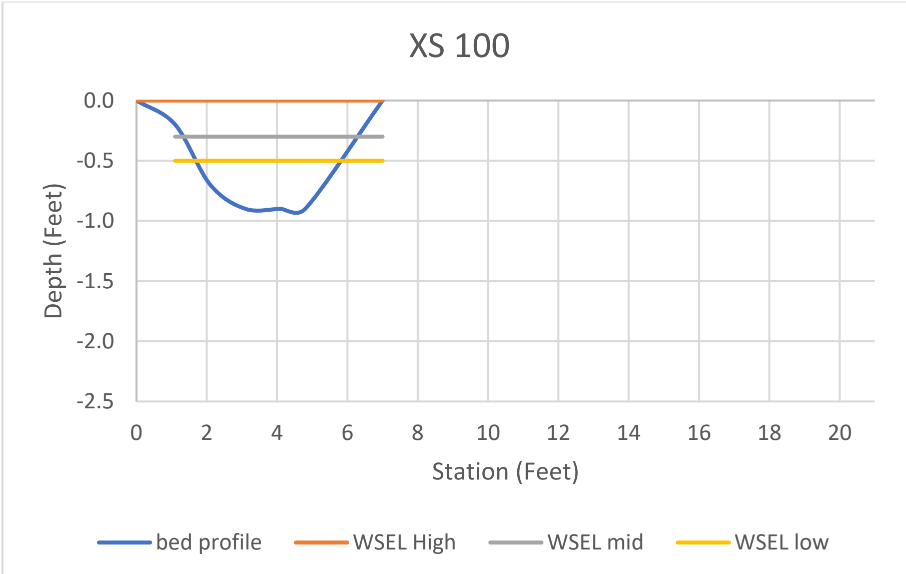
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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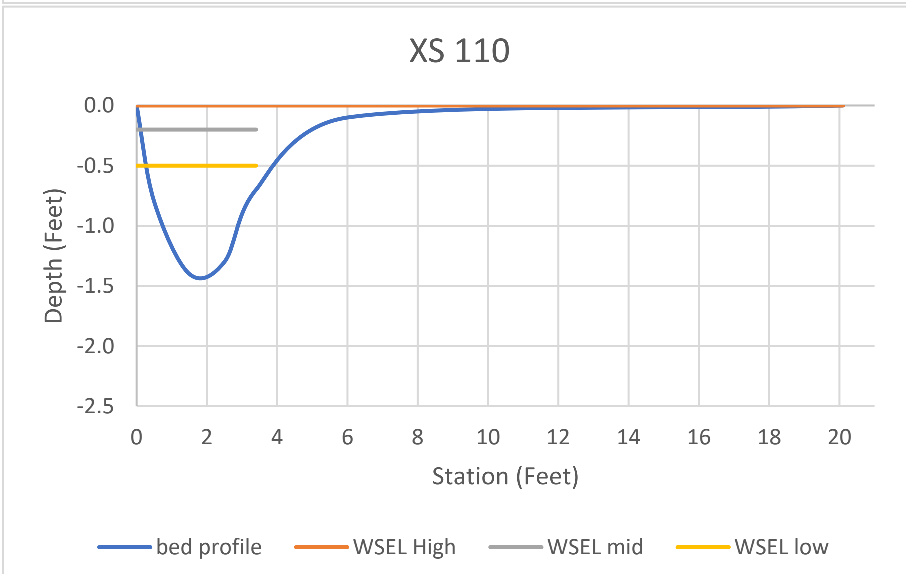
6
8
10
12
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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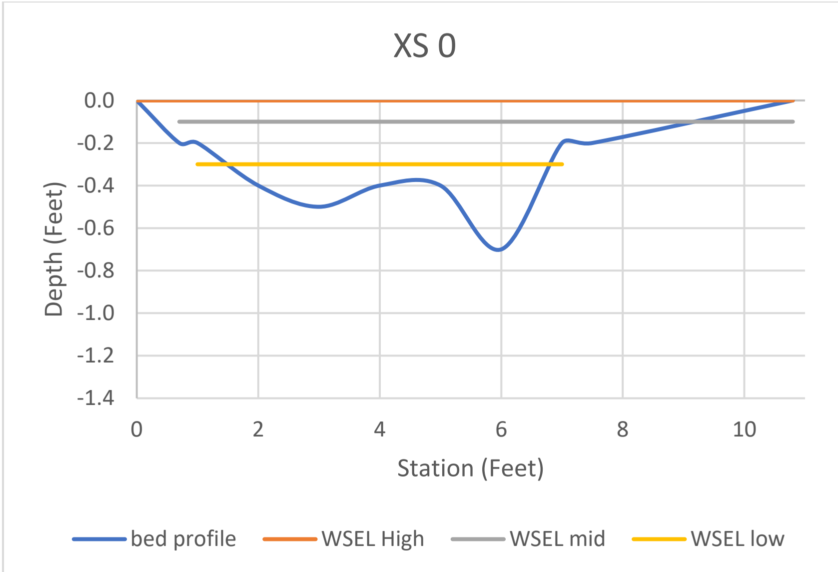
14
16
18
20
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low

Birch Creek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-1.4
Depth (Feet)
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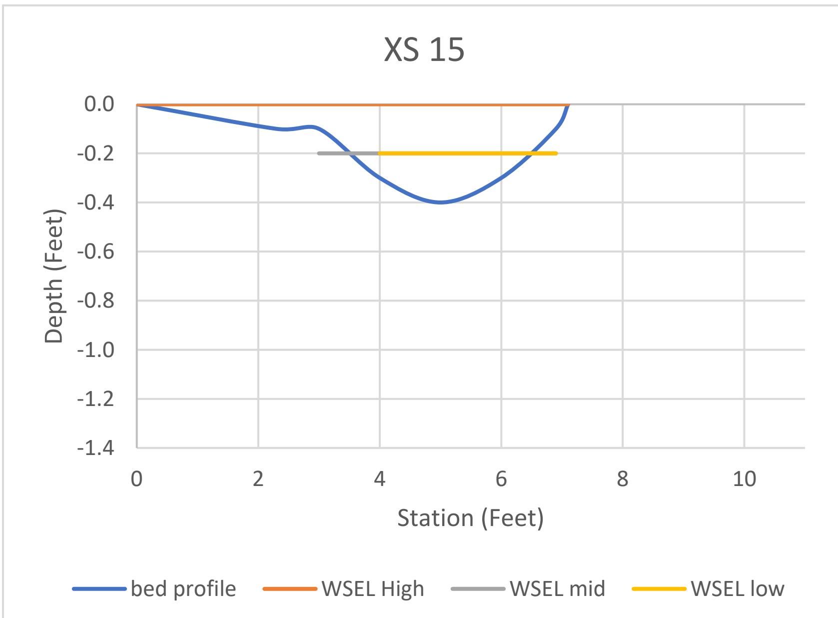
2
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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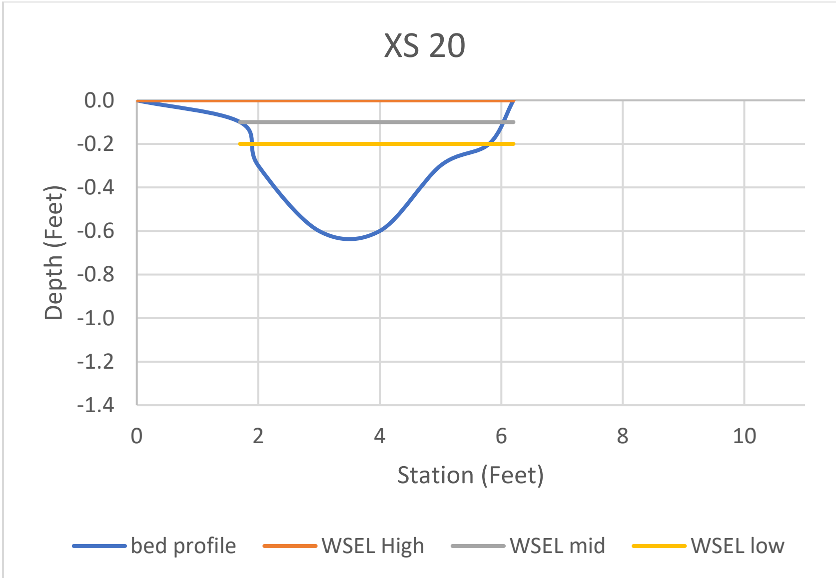
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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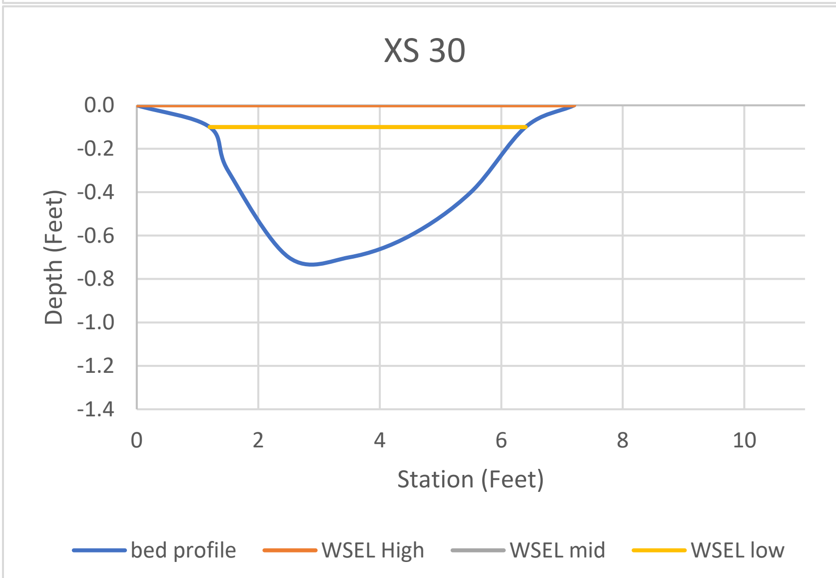
2
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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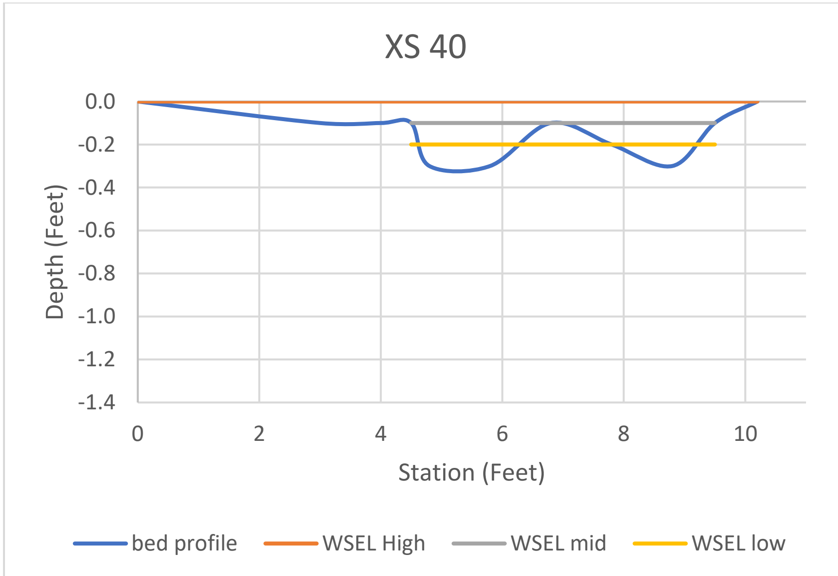
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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0
2
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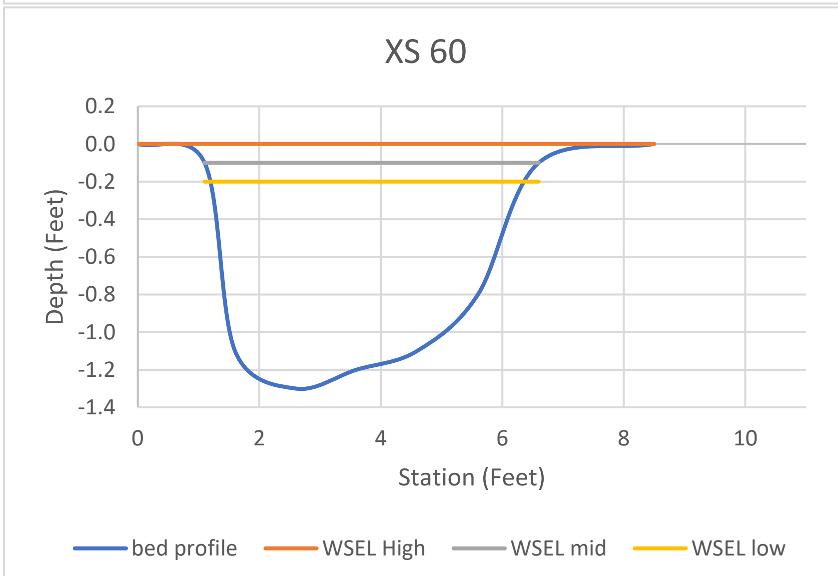
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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2
4
6
8
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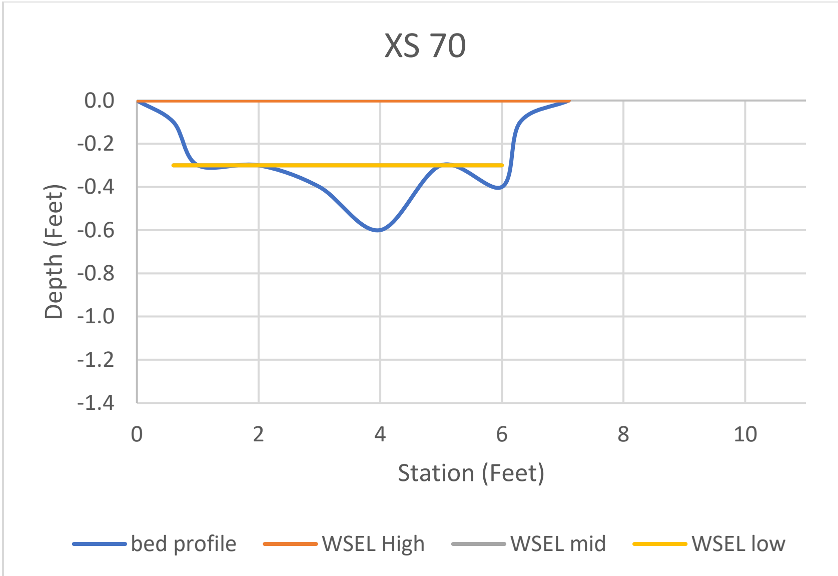
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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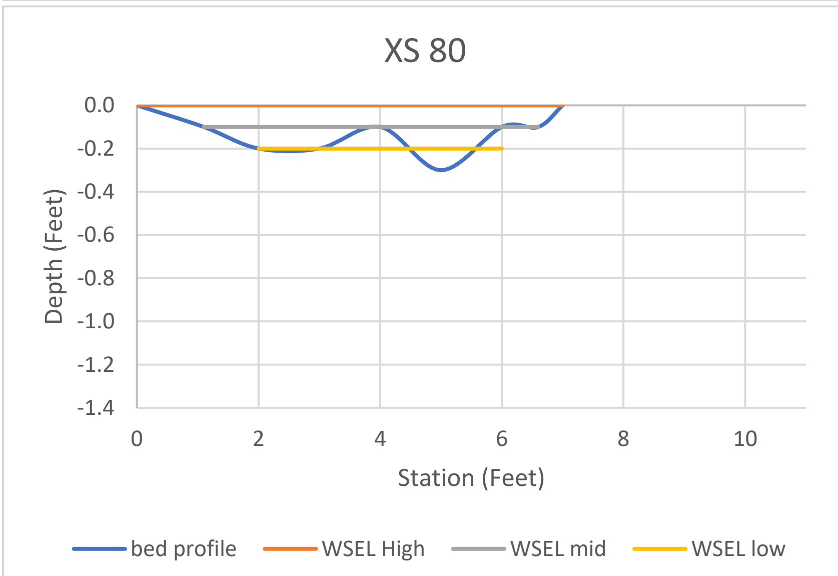
2
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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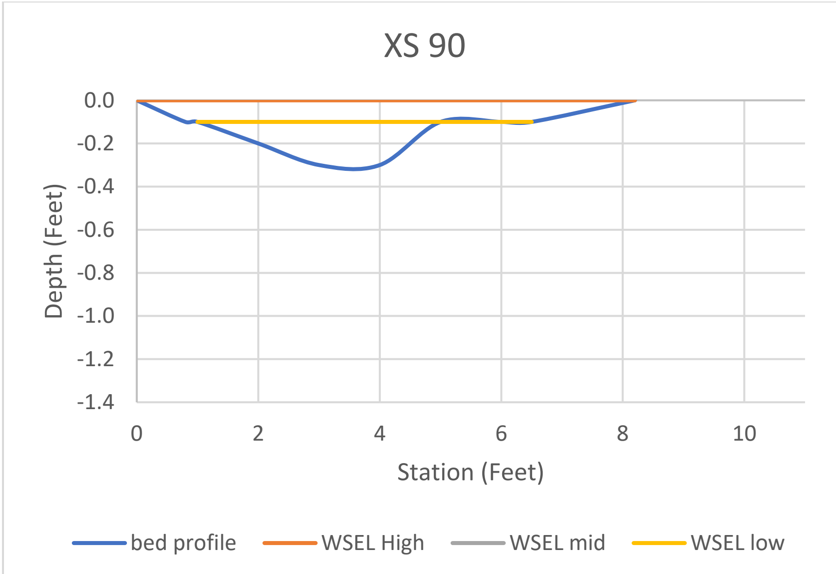
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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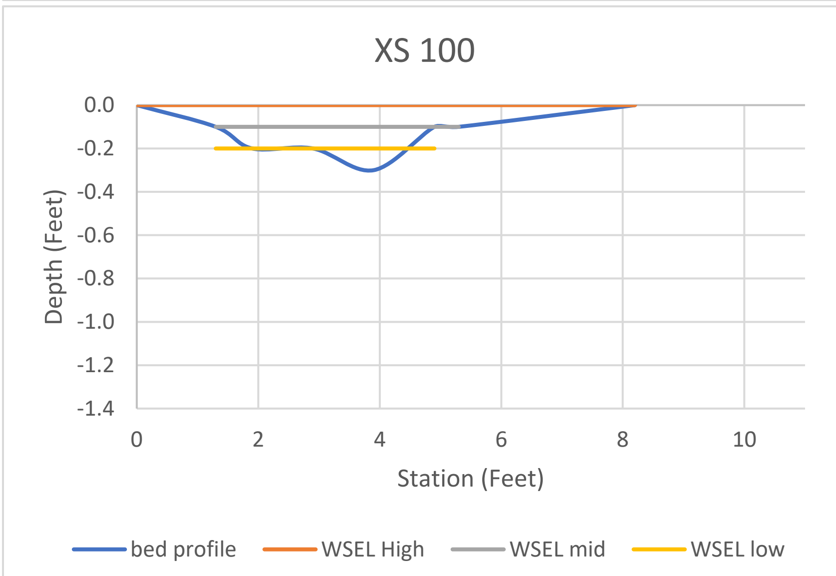
Depth (Feet)
0
2
4
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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-1.2
-1.4
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2
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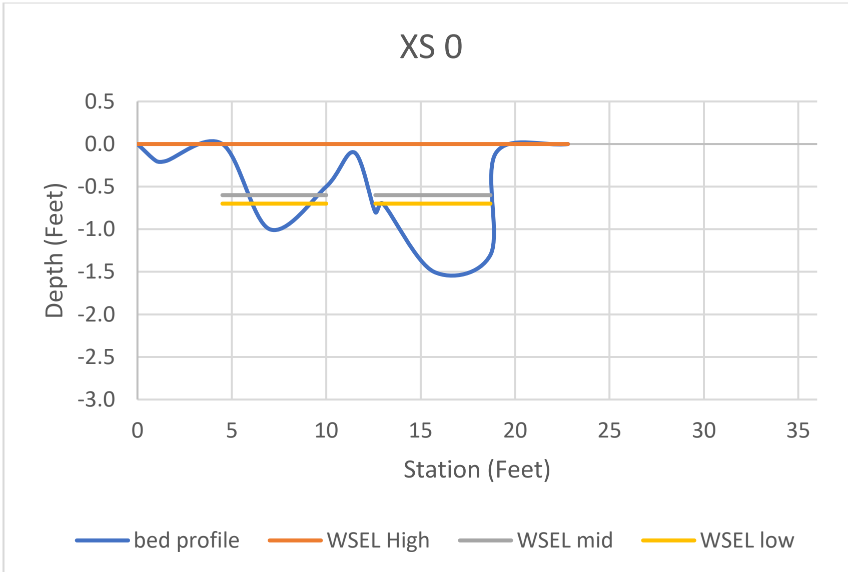
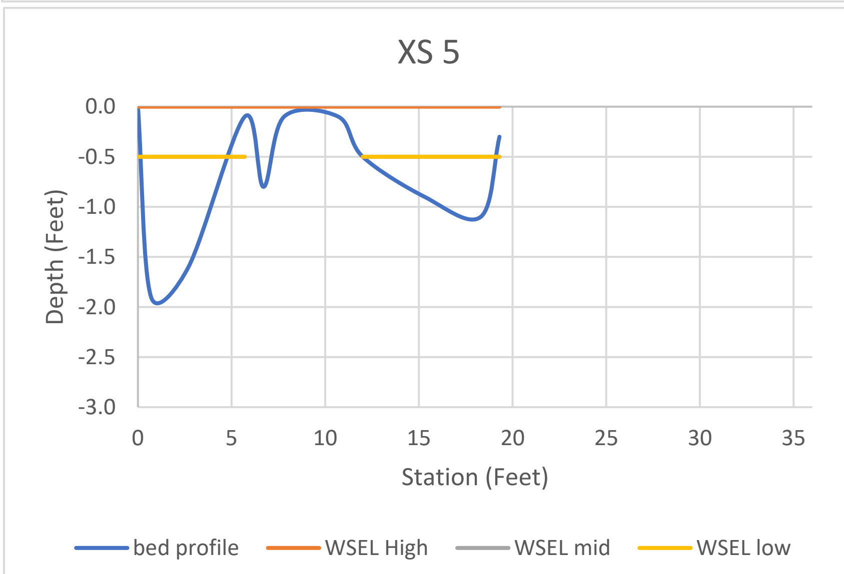
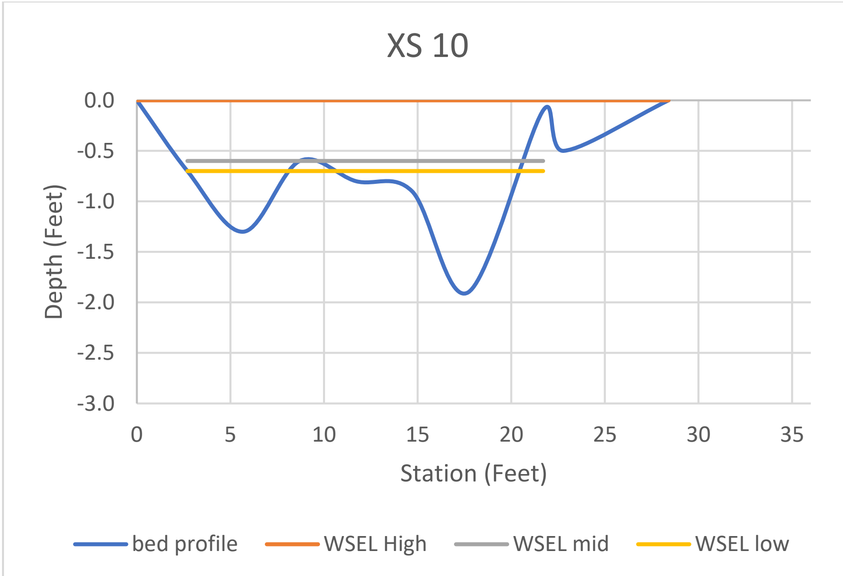
6
8
10
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low

Bishop Creek Reach 4



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-2.0
-2.5
-3.0
Depth (Feet)
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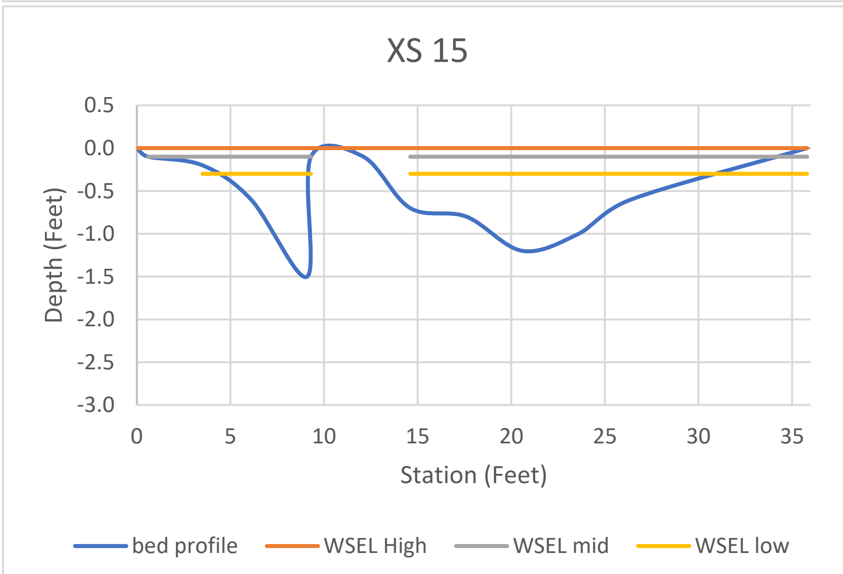
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
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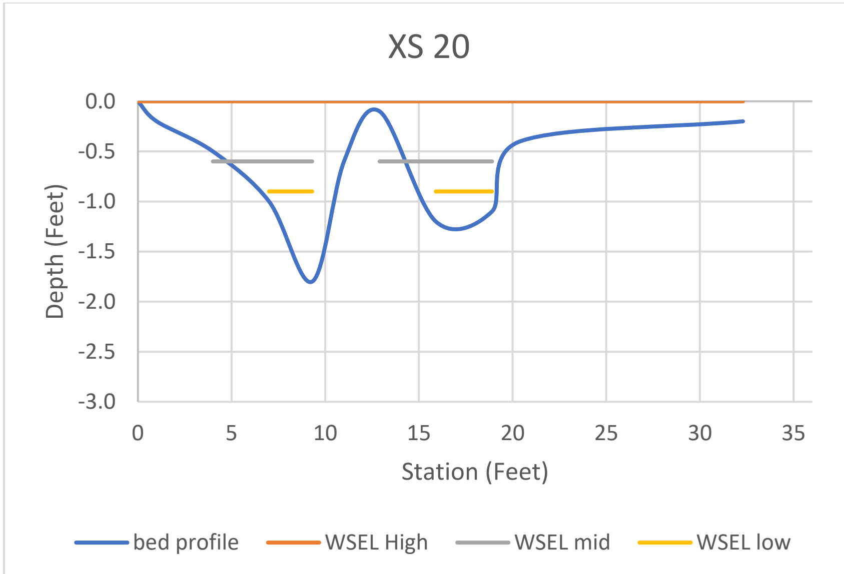
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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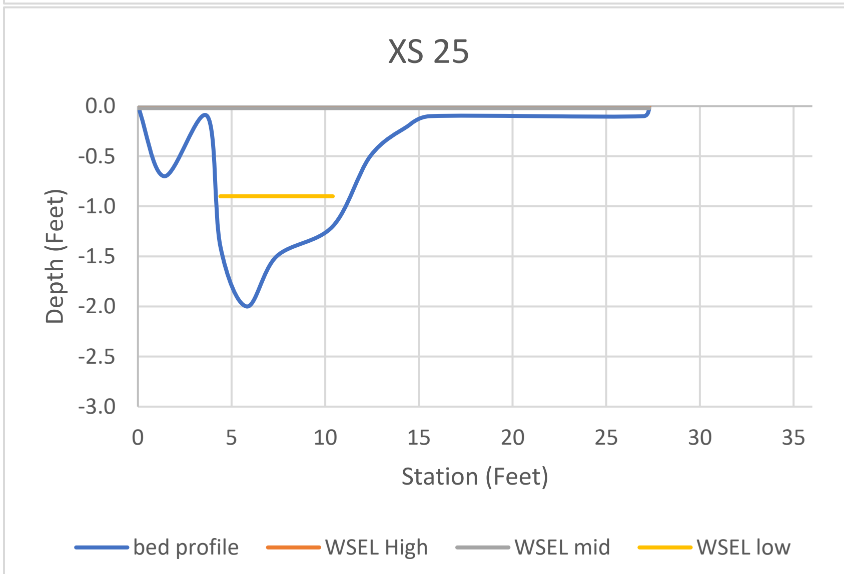
Depth (Feet)
0
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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10
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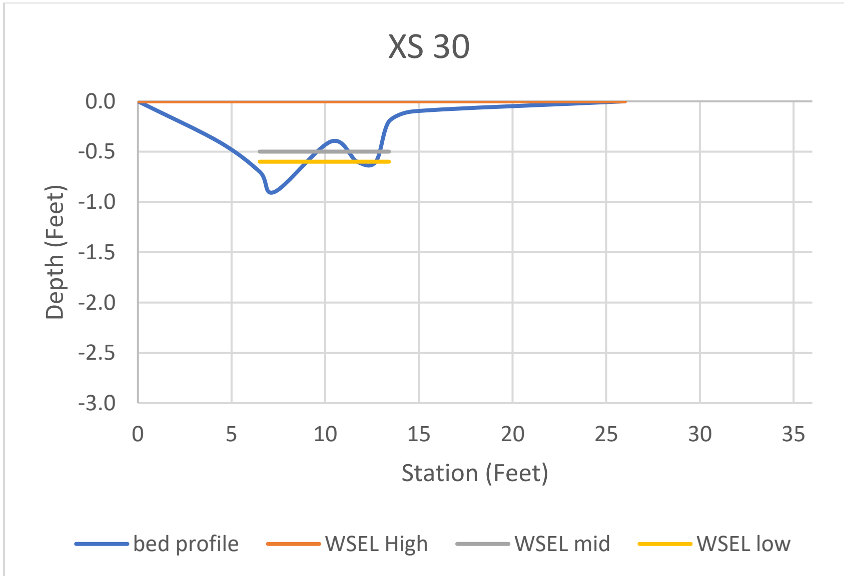
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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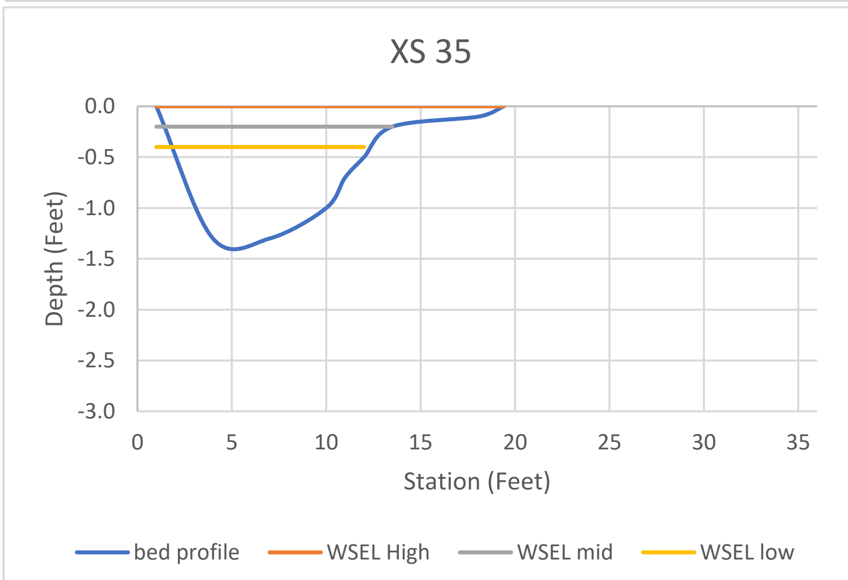
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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10
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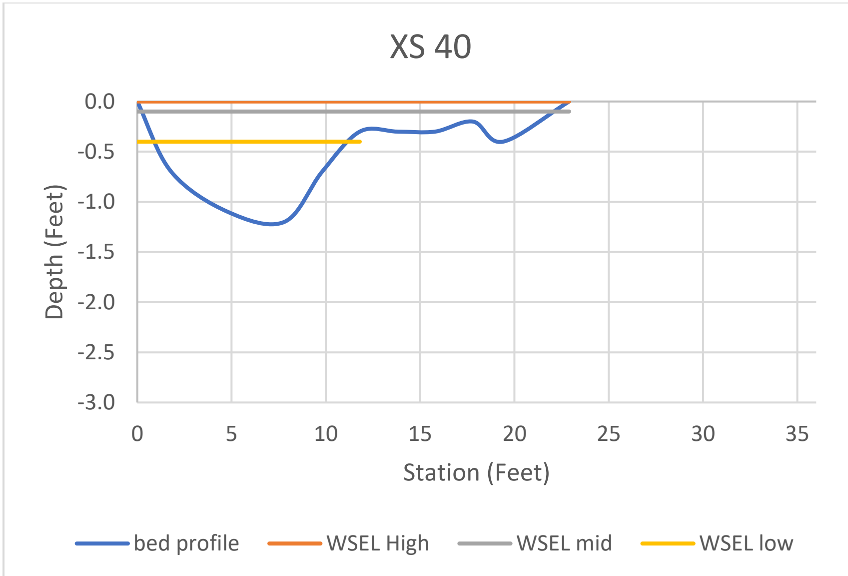
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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-3.0
Depth (Feet)
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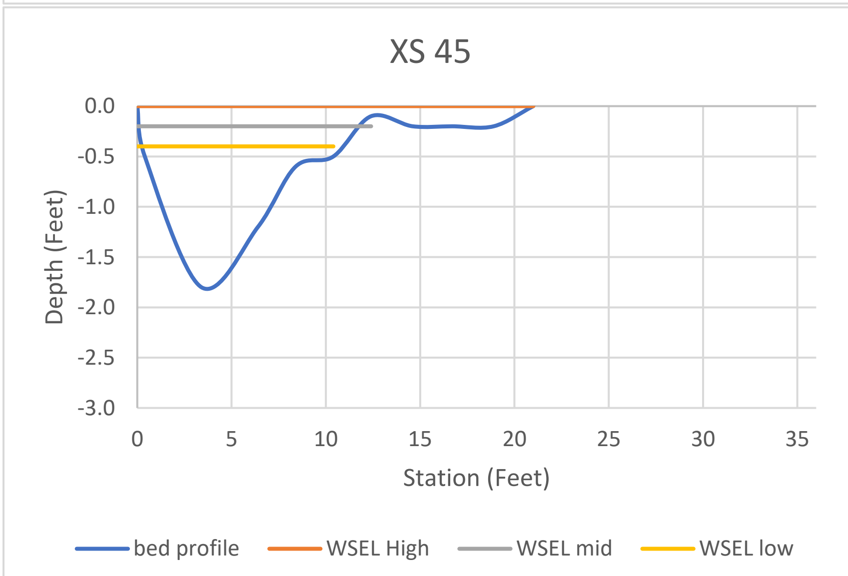
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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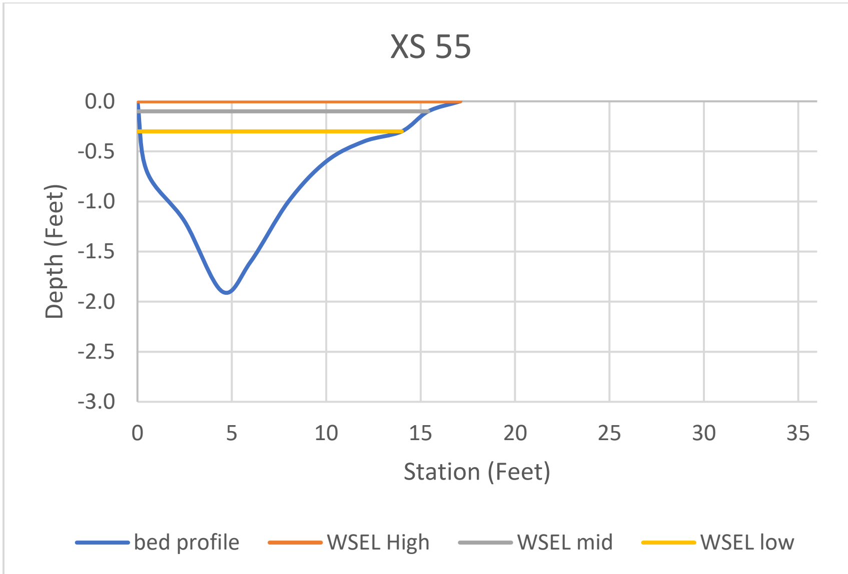
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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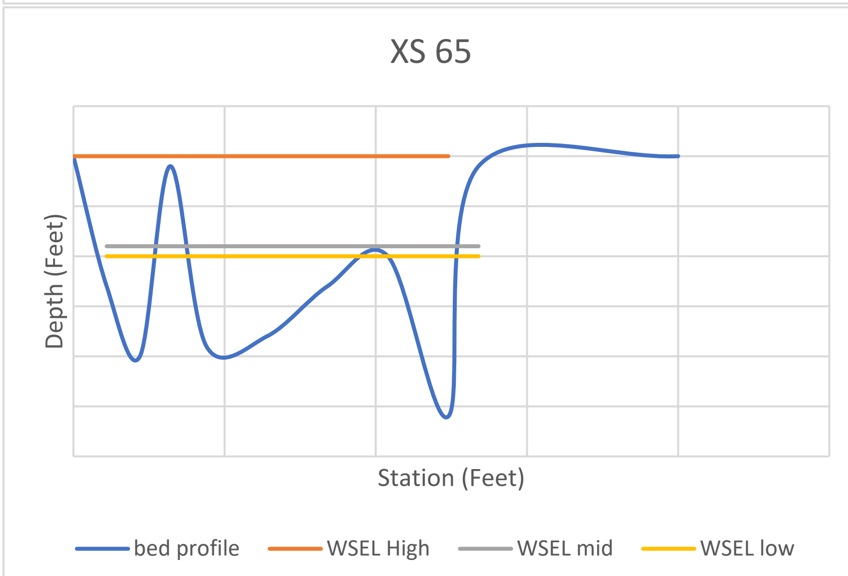
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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Depth (Feet)
Station (Feet)
bed profile
WSEL High
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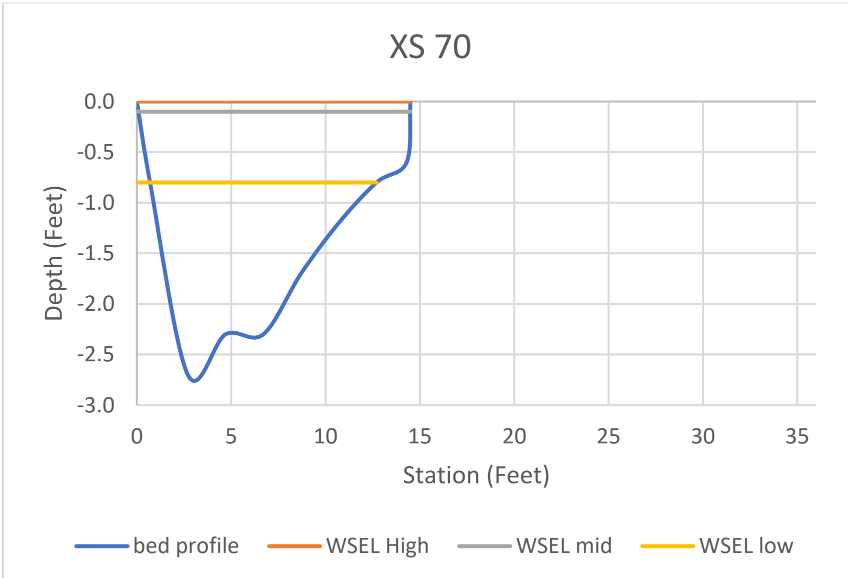
WSEL low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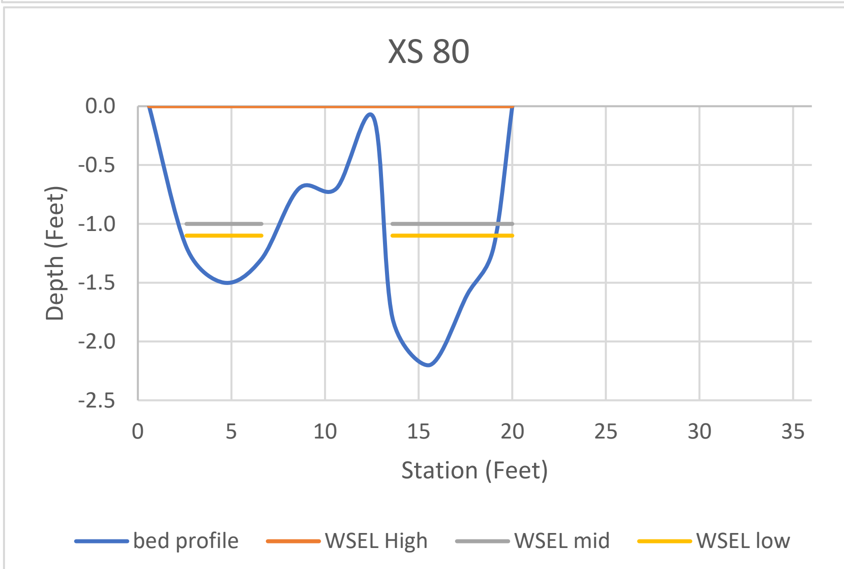
-2.5
-3.0
Depth (Feet)
0
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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-2.5
Depth (Feet)
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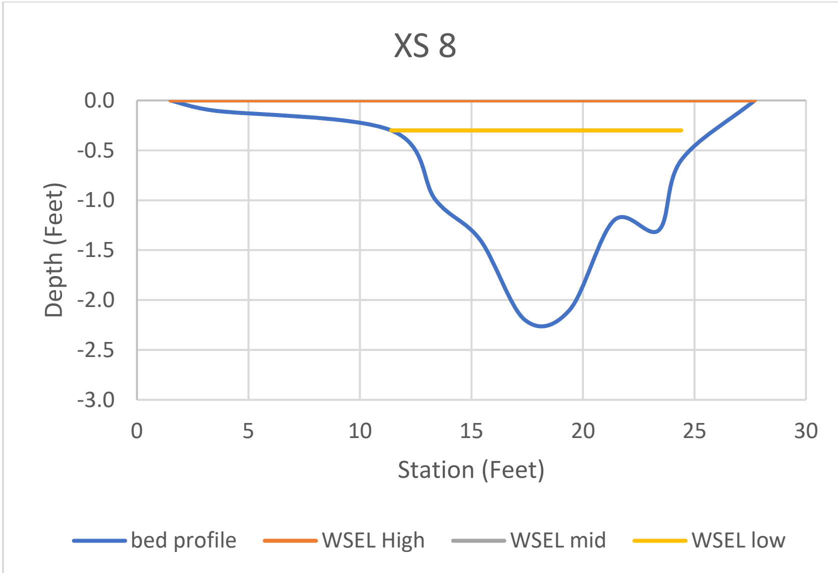
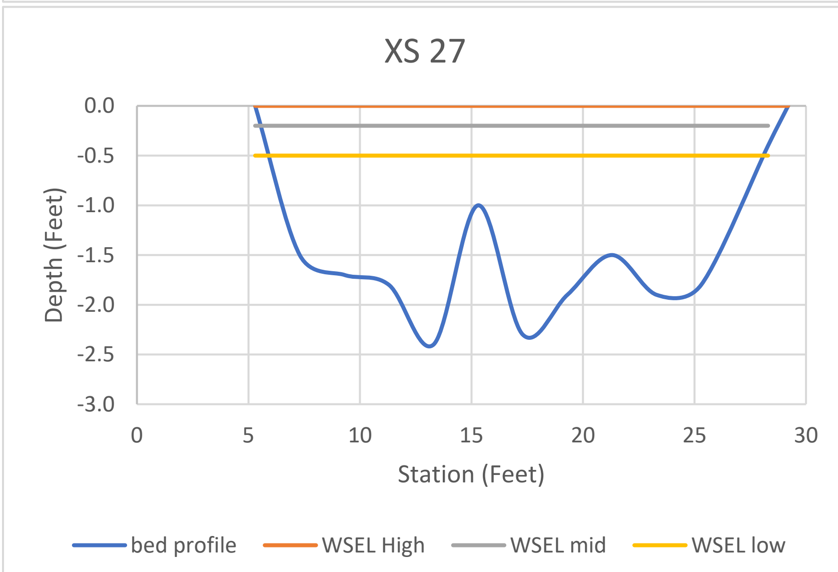
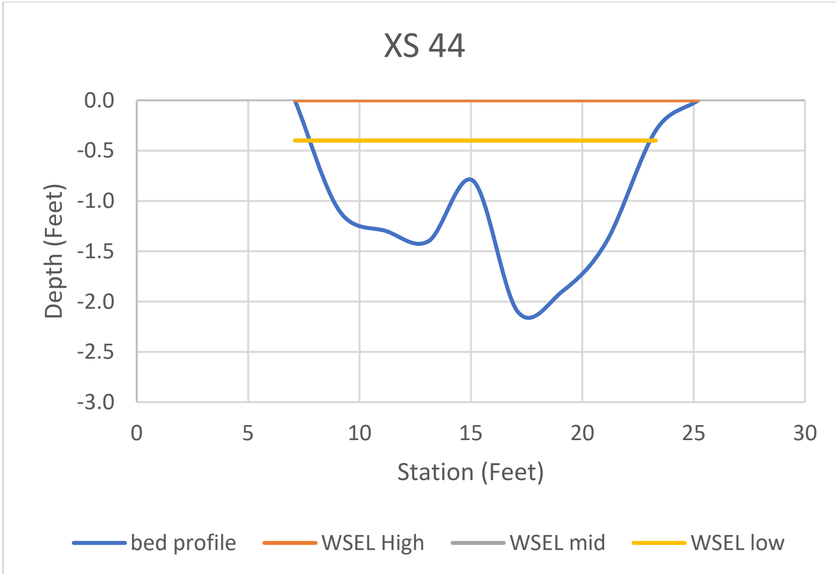
5
10
15
20
25
30
35
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low

Bishop Creek Reach 6



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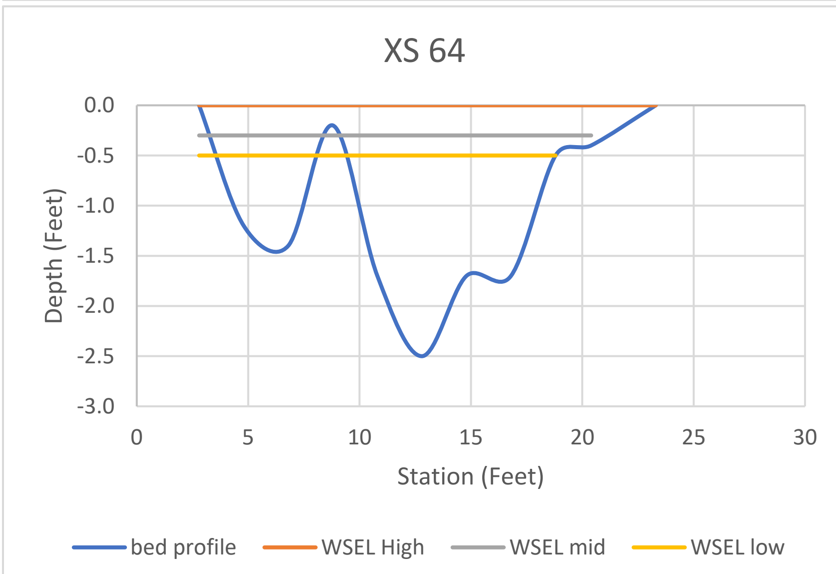
Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low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25
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Station (Feet)
bed profile
WSEL High
WSEL mid
WSEL low

APPENDIX C

HABITAT SUITABILITY CONSULTATION

Memorandum

To: Bishop Creek Fish and Aquatics Technical Working Group

From: Brandon Kulik

Date: June 25, 2020 **Document No.** 3202003.04_ME_001

Re: **INSTREAM FLOW STUDY - HABITAT SUITABILITY CRITERIA**

The Fish and Aquatics Technical Working Group discussed developing a Bishop Creek instream flow study, that included the species and lifestages for which Habitat Suitability Criteria (HSC) would be required (during scoping for the Bishop Creek Project relicensing) in 2018 and 2019). This memorandum updates the discussion between the U.S. Forest Service (USFS), California Department of Fish and Wildlife (CDFW), and SCE/Kleinschmidt Associates for developing HSC for following species and lifestages:

- Adult and juvenile brown trout (*Salma trutta*)
- Adult and juvenile Owens sucker (*Catostomus fumeiventris*)
- Adult speckled dace (*Rhinichthys osculus*)

On March 14, 2020, the USFS and CDFW participated in a conference call with Brandon Kulik, Kleinschmidt, the lead fisheries scientist for the Bishop Creek relicensing, to discuss, review, and finalize HSC for brown trout and Owens sucker. There was concurrence with the proposed criteria, which Kleinschmidt used to complete the PHABSIM model for brown trout and Owens sucker. CDFW subsequently provided raw data for the Owens speckled dace that was used to develop HSC curves for this species. This memorandum provides recommended HSC curves for depth, velocity, and substrate, for Owens speckled dace based on that consultation.

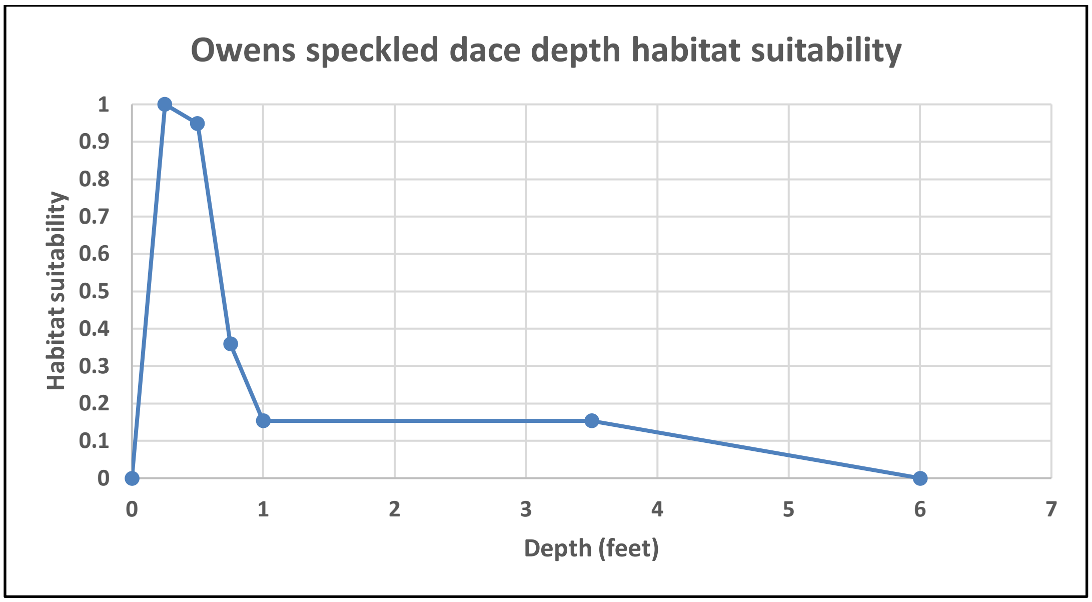
CDFW provided a summary of habitat preference observations for Owens speckled dace on May 20, 2020, collected in Pine Creek (north of Bishop Creek), using point measurements of depth, substrate, cover and width where speckled dace were encountered[1]. CDFW processed the data using a Pearson Chi-Square Goodness of Fit Test based on over 600 individual fish observations. In general, the data showed that

[1] No velocity data were collected by CDFW; after further consultation it was agreed that another dace species with similar overall autecology and available velocity data could be used as a surrogate.

speckled dace do not prefer pools but tend to be positively correlated with run habitat and prefer habitat with more silt. In locations where more than 10 speckled dace were caught, 79 percent of survey locations consisted of 50 percent or more silt with little correlation to other substrates. Most speckled dace were associated with depths of 0.5 meter (approximately 19 inches or less.

The preference data (*i.e.* frequency of occurrence at a particular metric value) for depth was converted to a HSC value on scale of 0.0. to 1.0 by converting to percent and then normalizing on a scale of 0-1. The resulting depth habitat suitability index curve was smoothed as it approached zero. This approach was used to adapt velocity preference data derived from literature into an HSC format.

Depth



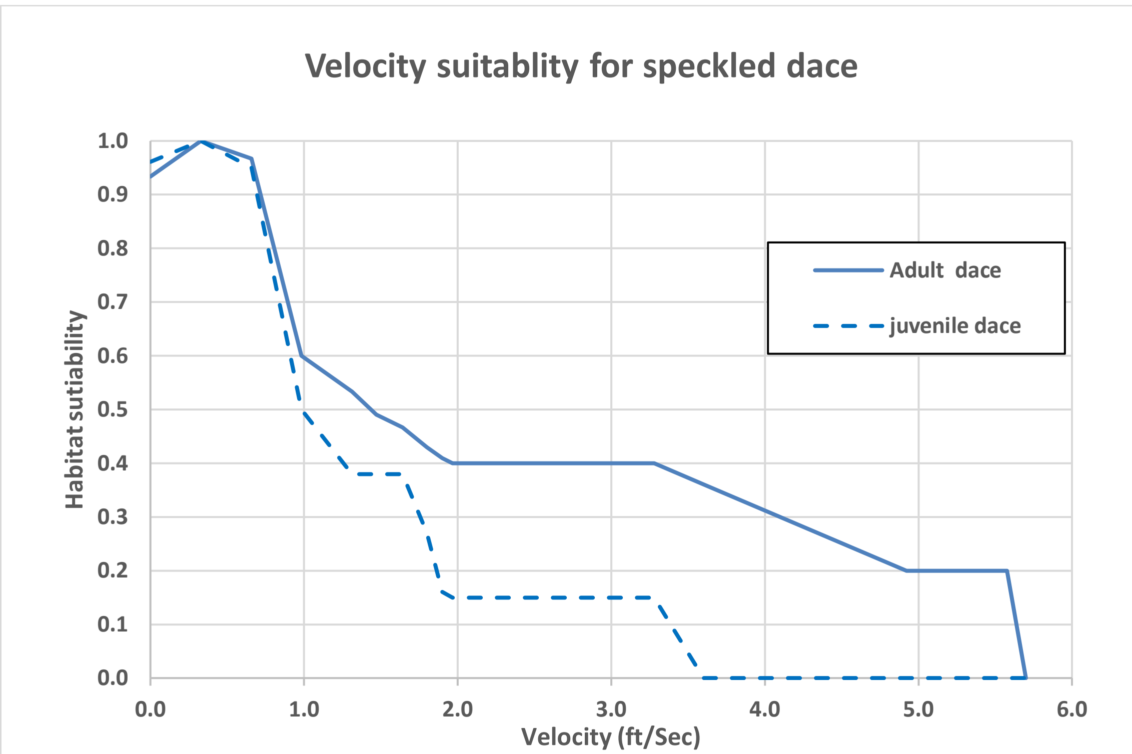
Velocity

Based on a literature review, it appears that the speckled dace (*Rhinichtys oculus*) is a reasonable surrogate candidate for the Owens speckled dace. Speckled dace occur among the larger bottom substrates of riffle habitats where they can hide from predators and feed on aquatic insects.

According to Bonar, *et al.*, 2010,

> *Speckled dace usually live in clear, well-oxygenated water with abundant deep cover and moving water, most often occupying water less than 60.0 cm deep in riffles and runs (Valdez et al. 2001, Moyle 2002). Rinne (1992), Speckled dace are often found among boulders and cobble, although they can also be occasionally found in soft substrates (Gido and Propst 1999). Speckled dace usually inhabit relatively cold waters in desert streams and have been collected at temperatures between 9 and 27°C (Deacon et al. 1987).*

Moyle and Baltz (1985) developed HSC for speckled dace, in Deer Creek, CA, a small stream (9.096 m^3/sec mean annual discharge) including velocity. For purposes of this modeling effort, we adopted their mean column velocity criteria.



Substrate

CDFW data indicated a strong affinity for silt substrates, but no distinct preferences for other substrates. A strict statistical analysis would therefore assign silt a suitability index of 1.0 and consider other substrates as unsuitable. This approach, if unmodified would have the unintentional effect of rendering most if not all of the study reaches as unsuitable at any flow because silt is a very uncommon substrate; most of each study reach is dominated by cobble, gravel, and boulder. Calculated changes in depth, velocity and wetted area would be cancelled out by a suitability rating of 0.0 for most study site cells., To allow the model to function, it was suggested to give partial credit to coarser substrates. Bonar, *et al*. 2010 notes qualitatively that "*Sites preferred by speckled dace were relatively shallow (9.0 – 30.0 cm), with fast flowing waters (2.2 – 26.8 cm. s -1) and relatively coarse substrates (gravel – boulders).*" This suggests that some speckled dace (albeit a different species) have at least some tolerance for coarser substrates. Therefore, the following alternative is proposed:

Substrate Type	**HSC Rating**
fines (*silt, muck*)	1.0
sand	0.75
gravel	0.25
cobble	0.2
boulder	0.1

LITERATURE CITED

Bonar, S.A., N. Mercado-Silva, and D. Rogowski. 2010. Habitat use by the fishes of a southwestern desert stream: Cherry Creek, Arizona. USGS Arizona Cooperative Fish and Wildlife Unit Fisheries Research Report 02-10. 45 pp.

Moyle. P.B. and D. Baltz 1985. Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations. *Trans. Am. Fish Soc.* 114:695-704.

APPENDIX D

UPDATED WEIGHTED USEABLE AREA CALCULATIONS FOR REACH 3

MEMORANDUM

TO: Bishop Creek Fish and Aquatics Technical Working Group (TWG)

FROM: Brandon Kulik

DATE: May 11, 2022

RE: Updated Weighted Usable Area Calculations for Reach 3

During scoping in 2018 and 2019 for the Bishop Creek Project relicensing, the Fish and Aquatics TWG targeted adult and juvenile brown trout (*Salma trutta*) as the evaluation species for the Bishop Creek segment extending downstream from Intake 4 to Plant 4. This segment includes a steep series of Cascades and plunge pools (Reach 4) that discharge into a lower gradient stream channel comprised of riffles and runs (Reach 3). The upstream end of Reach 3 also receives inflow from Coyote Creek[1]. Reach 3 was modeled with a conventional PHABSIM model; however, Reach 4 was not modeled with PHABIM; empirical data were collected using the Habitat Criteria Method, per the recommendation of the USFS), however

CDFW subsequently concluded that these reaches do not provide adequate angling access, and therefore have limited value for brown trout management, but Reach 3 habitat could be managed to expand the potential range of native nongame species (Owens sucker (*Catostomus fumeiventris*) and speckled dace (*Rhinichthys osculus*). During PM&E discussions in Spring 2022 CDFW requested that the PHABSIM model for Reach 3 be re-run to include these species.

Results

Habitat suitability for flows ranging from 4 to 100 cfs were modeled (Table 1 and Figure 1). The greatest WUA responses to flow typically occur in the range between 4 and 12 cfs. In general flows from 4 to 12 cfs all provide 88% to 100% of maximum suitability for all lifestages other than dace spawning, which increases from 62% at 4 cfs to optimal at 8 cfs. However, the net amount of WUA for dace spawning is very low compared to sucker lifestages, indicating that the reach has greater potential to support self-sustaining suckers than for dace. Dace characteristically prefer low velocity areas with fine substrates and vegetation; higher flows tend to increase areas of less suitably high velocities that decrease overall suitability for this species. Therefore, increasing velocities tend to decrease suitability for young of year (YOY) dace at flows higher than 6 cfs and depress suitability overall for spawning. The greatest net amount of WUA for any lifestage is that for sucker spawning, followed by both sucker YOY and juveniles.

[1] Typical summer inflow to Coyote Creek is estimated as 3 cfs.

Table 1 Habitat suitability for Life Stages of Owens Sucker and Owens Speckled Dace in Reach 3

Discharge	Wetted Area	Sucker Adult WUA	Sucker Juvenile WUA		Sucker YOY WUA		Sucker Spawning WUA		Dace YOY WUA		Dace Spawning WUA	
4	13,962	3537	9581	99%	8335	86%	11250	88%	6708	98%	1073	62%
6	14,498	4120	9694	100%	9243	95%	11908	93%	6868	100%	1412	82%
8	15,015	4595	9524	98%	9618	99%	12377	97%	6742	98%	1726	100 %
10	15,500	4776	9420	97%	9721	100%	12522	98%	6678	97%	1715	99%
12	16,157	4952	9332	96%	9721	100%	12589	99%	6579	96%	1685	98%
14	16,443	5231	9121	94%	9627	99%	12657	99%	6348	92%	1683	98%
16	16,660	5451	8856	91%	9496	98%	12765	100%	6159	90%	1650	96%
18	16,968	5697	8305	86%	9003	93%	12519	98%	5742	84%	1523	88%
20	17,222	5795	8069	83%	8770	90%	12316	96%	5580	81%	1460	85%
40	17,643	5900	7840	81%	8461	87%	12175	95%	5412	79%	1469	85%
50	18,821	5921	7644	79%	8173	84%	12004	94%	5233	76%	1430	83%
75	19,099	5698	6425	66%	6630	68%	10367	81%	4313	63%	1142	66%
100	19,667	5563	6112	63%	6278	64%	9870	77%	4150	60%	1236	72%

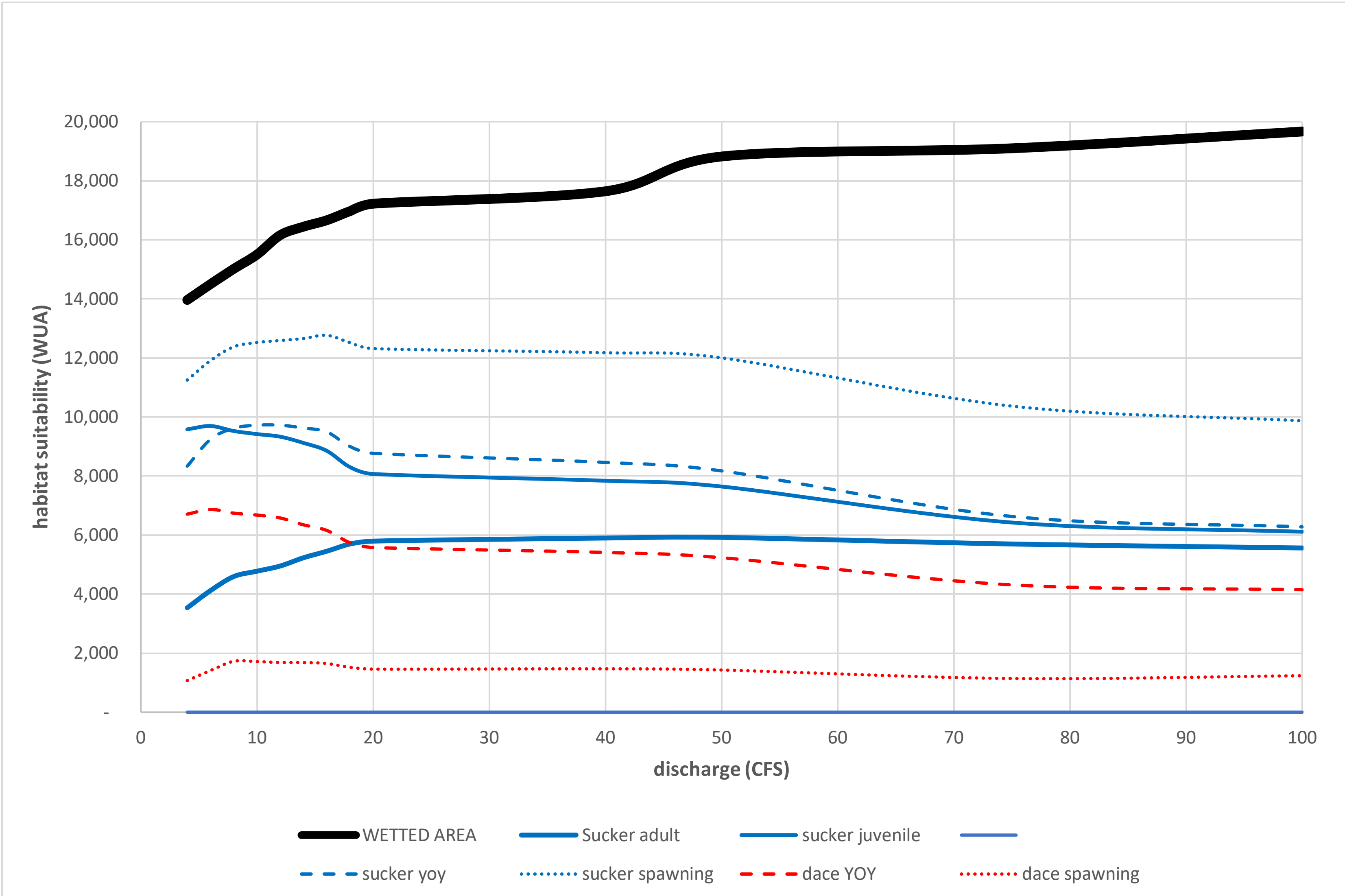


Figure 1 Reach 3 Habitat Suitability for Owens Sucker and Owens Speckled Dace

SOUTHERN CALIFORNIA EDISON
Bishop Creek Hydroelectric Project
(FERC Project No. 1394)

BISHOP CREEK OPERATIONS MODEL FINAL TECHNICAL REPORT (AQ2)

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BISHOP CREEK OPERATIONS MODEL FINAL TECHNICAL REPORT (AQ2)

Southern California Edison
1515 Walnut Grove Ave
Rosemead, CA 91770

June 2022

Support from:

Kleinschmidt

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1.0 INTRODUCTION

During the initial Technical Working Group (TWG) meetings, Southern California Edison (SCE) and stakeholders identified the need to develop a user-friendly Operations Model to assist stakeholders and SCE to identify key hydrologic connections among the components of the Project. This technical report summarizes the development and application of a model created to simulate the Bishop Creek Hydroelectric Project's (Project) operation relative to water resource allocation in support studies conducted on the aquatic and riparian environment. A thorough description of the Project's physical features, flow routing, hydrologic characteristics, regulatory and legal requirements, and powerhouse generating equipment were presented in the Initial Study Report filed on October 30, 2020 and are incorporated by reference. Minor subsequent modifications to the model were incorporated following additional consultation, to include flow contributions from the Birch-McGee nodes, as well as additional hydrograph for results. Overview graphics are provided below for convenience.

2.0 MODEL DESCRIPTION

The operations model was developed as an Excel-based platform to facilitate user accessibility. The purpose of the model is to evaluate impacts from potential changes to the operations within the Bishop Creek system. Using information supplied by SCE, available flow data downloaded from United States Geological Survey (USGS), and snow course measurement data from National Resource Conservation Service (NRCS), logic was developed to allocate hydrologic resources on a daily temporal resolution. The model determines the ability to meet target flows based upon period of record associated with available hydrologic data necessary to represent the system's primary contributions. Storage records for the two primary reservoirs, as well as the flow through Plant 6, were fundamental datasets for constructing can calibrating the model, and result in a start date of 1990.

The file containing the model is divided into tabs for user input and results; hydrologic contributions; and logic for allocation. In addition to the summary graph tab, a more detailed input and summary tab provides more descriptive statistical results of the model and a comparison with a baseline scenario (reflective of current flow targets). Where the majority of the statistics are provided in the input and summary tab, additional post-processing calculations may still be required for alternative flows in lower flow years (described in comment response number 7). Hydrographs and flow exceedance curves are also provided in tabs for select locations. Separate tabs for snowpack and streamflow hydrologic datasets are used as datasets for inflow and determination of year type. Tabs for each of the five powerhouses contain arrays of calculations that represent physical elements of the project, or nodes where logic governs the flow daily at that location within the system.

The summary graph tab with inputs for flow targets at set locations of interest allows user to change flow targets. Results of the ability to meet these targeted daily allocations is displayed next to inputs, and storage graphs for Lake Sabrina and South Lake are also displayed for each year type on the summery graph tab.

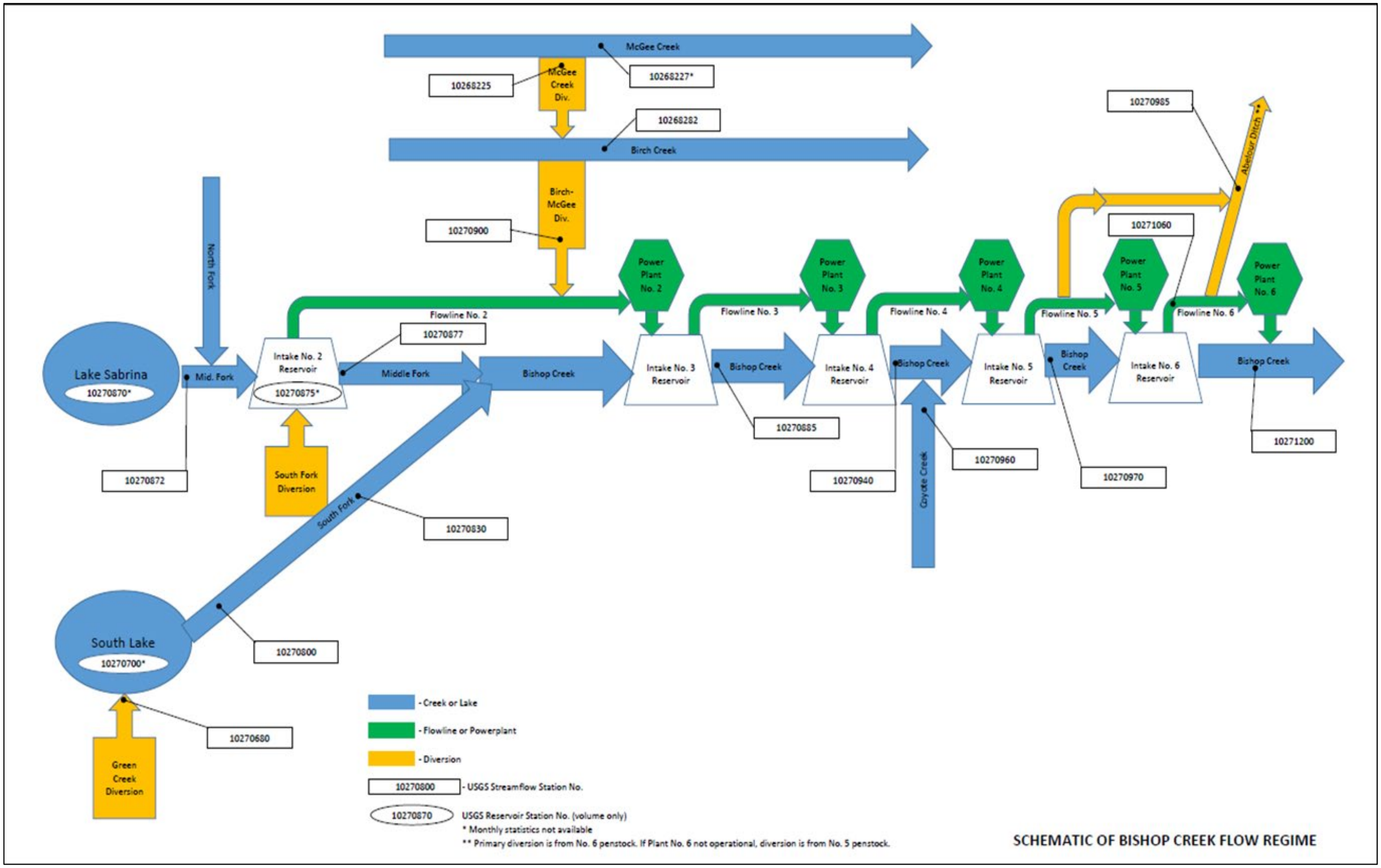


Figure 2.1-1 Bishop Creek Flow Routing

2.1 FLOW AND STORAGE INPUTS

Inflow contributions were calculated for each node within the model on a daily basis. A mass-balance based on storage change and gaged flows was used for nodes where data was available. Ungauged contributions were either prorated from representative gage data based on drainage area ratio or synthesized based on historic records predating the aforementioned period of daily data records. Lake Sabrina and South Lake represent the primary storage reservoirs for the system, while the gaged releases from those reservoirs are used as a mass balance approach to calculating the daily inflow to each of those nodes. North Fork, Coyote Creek, seepage and small springs, and general area runoff constitute the ungauged contributions to the system. Minor contributions from the Longley reservoir are captured via one gage measuring combined flows from McGee and Birch diversions.

Inflow to the system is independent of how water is allocated, and therefore correlates with greater precision. The total daily inflow is calculated as the flows that exit the system plus the increase in storage. Flows that leave the system are measured at the same three locations as the reflective nodes in the model: through the plant 6 powerhouse, in the bypass reach below the intake reservoir for plant 6, and in Abelour Ditch. The historic inflows are calculated using historic data for two gages measuring flow through and bypassing plant 6, and in Abelour Ditch. Daily storage measurements in both Lake Sabrina and South Lake provide the actual increase or decrease, and the model calculates a daily storage based the previous day’s calculated storage, inflow and outflow from each reservoir. These were summed with the model-calculated daily increase in storage in both Lake Sabrina and South Lake. For this historic inflow dataset, two flow gages at plant 6 and one on Abelour Ditch were summed for the historic daily releases.

Table 2.1-1 Acre-Feet of Unregulated Flow in Bishop Creek Drainage

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1988-89	2344	2276	2561	2428	2107	2877	5093	6734	8896	5453	3240	2774	46783
1989-90	2735	2212	2025	2252	2052	2258	4032	6231	8956	7339	3595	2559	46246
1990-91	2264	1887	1761	1780	1551	2675	2381	6090	14240	10072	4214	2975	51890
1991-92	1949	2128	2010	1995	2062	2102	3921	9524	7672	5213	3607	2278	44461
1992-93	2028	2080	2206	2819	2341	2583	3605	11888	17907	18746	8809	3563	78575
1993-94	2162	1818	2032	1804	1829	2176	3640	8509	12265	7245	3889	2920	50289
1994-95	3855	2415	2331	3437	2357	4129	3826	8047	21531	33241	19359	8813	113341
1995-96	4047	2967	3325	3171	3535	3677	5735	13617	21594	17572	10010	4721	93971
1996-97	3192	3678	3799	6110	3220	4116	6572	17619	19068	12843	7886	4680	92783
1997-98	3033	3025	3283	3087	3585	3385	4026	7002	19400	29141	13644	7994	100605
1998-99	3612	3672	2923	2834	2773	3065	3432	11193	15874	10355	5355	3541	68629
1999-00	2568	2058	1973	2306	2619	3024	3811	12227	16161	8353	5302	2929	63331
2000-01	2299	2468	2205	2303	2269	3232	4273	16884	11517	8166	4596	3141	63353
2001-02	2370	1973	2292	2500	2277	2064	3915	7555	12947	7674	3405	2326	51298
2002-03	2203	2736	2585	2428	2057	2426	3030	10681	17567	9512	4837	3023	63085
2003-04	1946	2114	2577	2503	2438	3568	4458	8992	13430	7693	4012	2373	56104
2004-05	2071	2381	2222	2860	2224	2700	3364	13853	18690	23606	9240	3181	86392
2005-06	2529	2363	3187	3079	2077	3225	3967	18152	27528	23814	8202	4238	102361
2006-07	3422	2846	2882	2704	2488	3085	4006	8621	7528	5551	3738	2749	49620
2007-08	2188	1784	2101	2658	2289	2412	3447	8628	12305	8596	3809	2446	52663
2008-09	2221	2454	2252	2294	2339	2633	3858	12375	11533	11686	4177	2613	60435
2009-10	2880	2118	2315	2484	1933	2299	3551	6333	21450	19011	5613	2572	72559
2010-11	3198	2802	4085	2902	2412	3435	5040	9617	20743	23622	12045	5288	95189
2011-12	4136	3079	2498	2571	2236	2574	4248	7446	6409	5325	4775	2697	47994

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2012-13	2444	2147	2512	2259	1847	2282	3484	6513	6907	5132	3423	2113	41063
2013-14	1850	1704	1839	1723	1641	2066	3313	6219	7793	4571	3985	2123	38827
2014-15	1609	1526	1779	1745	1730	1976	2020	4569	6430	4840	2738	1785	32747
2015-16	2390	2057	1989	2128	2075	2554	3861	7848	16580	8205	3557	2005	55249
2016-17	2203	1979	2215	4043	3141	3150	5628	17429	36592	29709	13213	7006	126308
2017-18	3265	2911	2488	2649	2111	2879	6459	10540	14114	13304	7708	3053	71481
2018-19	2731	2341	2456	2686	2892	2331	5466	10251	26724	24997	11010	5547	99432
2019-20	3067	2734	3143	2682	2297	2522	4799	11976	10311	6127	4150	2722	56530
Average	2670	2448	2591	2645	2403	2702	3891	9670	15419	13319	7000	3675	68433

Figure 2.1-2 and Figure 2.1-3 represent the operating rule curve for normal, wet and dry water years. The area-capacity curves that are used by Project operators to manage reservoir elevation and discharge were included in the Operations Model.

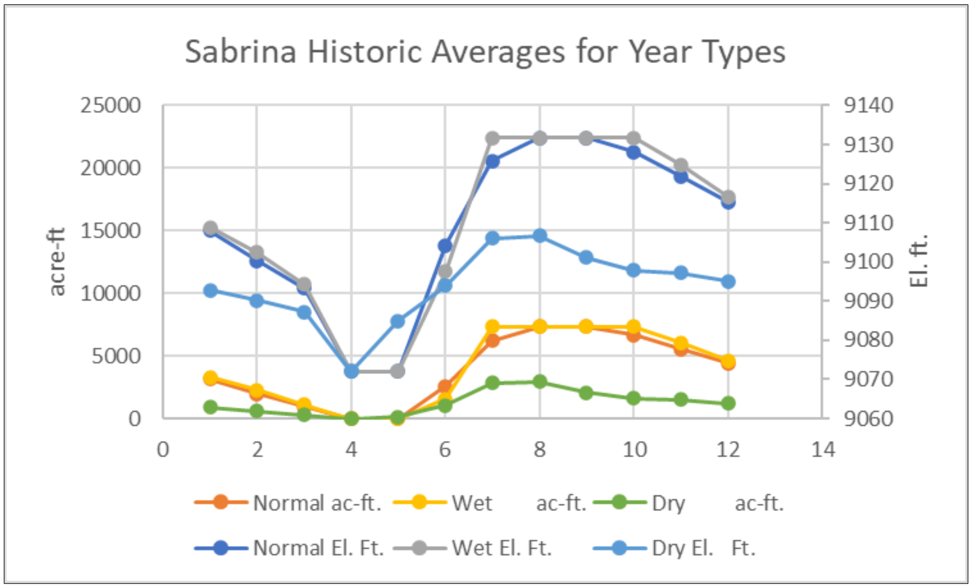


Figure 2.1-2 Sabrina Historic Averages for Year Types

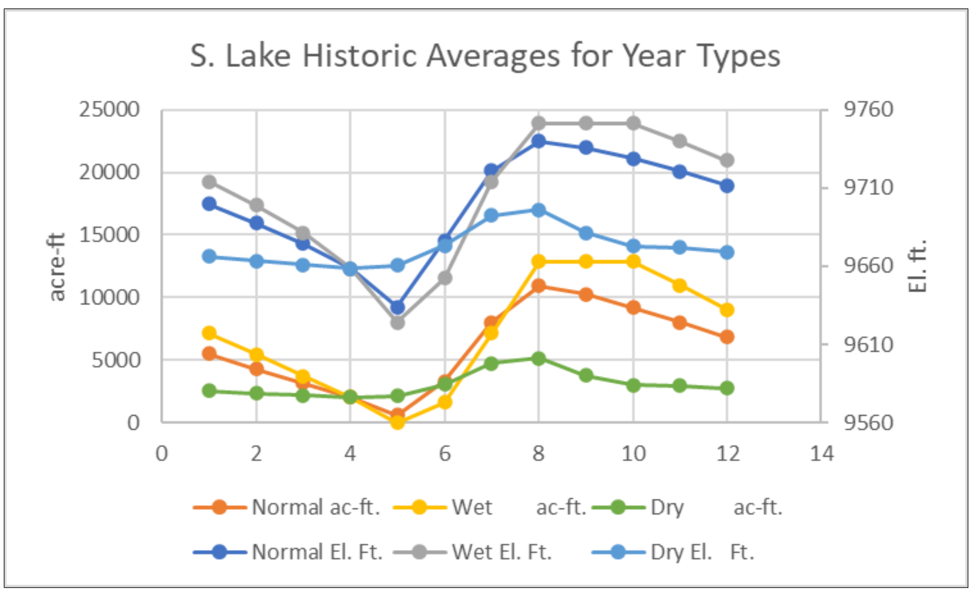


Figure 2.1-3 South Lake Historic Averages for Year Types

2.2 Model Calculation Logic

Physical constraints, then flow allocation priorities, are the basis for logic that drives calculation of daily flow allocation. Physical constraints are represented within the model as the basic structure for hydraulic thresholds. Hydraulic capacity of turbines and flowlines as well as reservoir storage capacities determine upper limits for flows through equipment and triggering spilling from reservoirs and intakes, while lower limits on storage are fixed to trigger “or inflow” releases. These values drive model calculations and limits such as spilling when a storage reservoir reaches a spillway elevation, or when an intake reservoir is full and the powerhouse flow capacity is maximized, or the model resorting to “or inflow” releases when storage is depleted.

Within the physical logic constraints, daily flow allocations are prioritized for water rights and regulatory requirements, including the Chandler Decree requirements and FERC license minimum flow requirements. When these are met, the model logic targets storage elevations based upon historic averages associated with a reflective water year categorization. Flows above required bypassed reaches that are released for storage management are used for generation up to the capacity of each plant’s hydraulic capacity. Water year types are determined based upon spring snow course measurements, and used to categorize each year as wet, normal, or dry. Wet and dry years are calculated as having snow course measurements 25 percent higher or lower than the long-term average. Future planning for resource allocation is also incorporated in the logic, with various forecast durations set on the Input and Summary tab, default set at 90 days to reflect current SCE planning. This prioritizes storage for minimum flow needs to meet the period selected over the daily storage target.

2.3 CALIBRATION

Hydrologic calibration was performed using a mass balance comparison of total daily inflow as calculated by the model versus those measured by gages. Historic flow releases do not necessarily follow the exact logic coded into the model, which is a representation of current requirements and typical operations. Some releases predate the current regulatory targets, and some planning efforts by SCE to conserve flows has occasionally resulted in changes to daily targets. SCE may also use excess storage at any given time to facilitate system load demands as a priority over following a daily storage target. These factors reduce the accuracy of correlating daily outflows between the model-calculated and historic values. A graphic comparison of model versus historic outflows and calculated inflows demonstrates these factors.

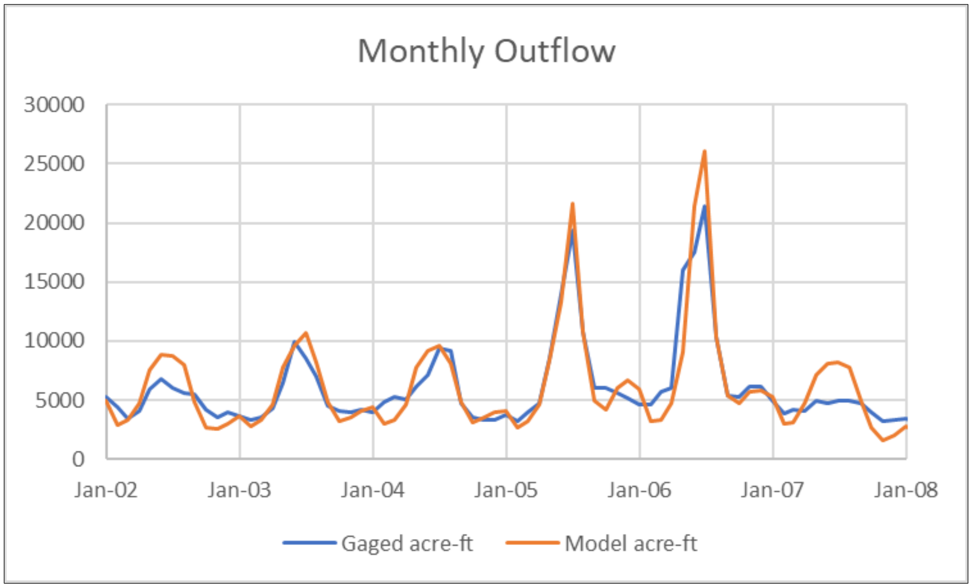


Figure 2.3-4 Monthly Overflow

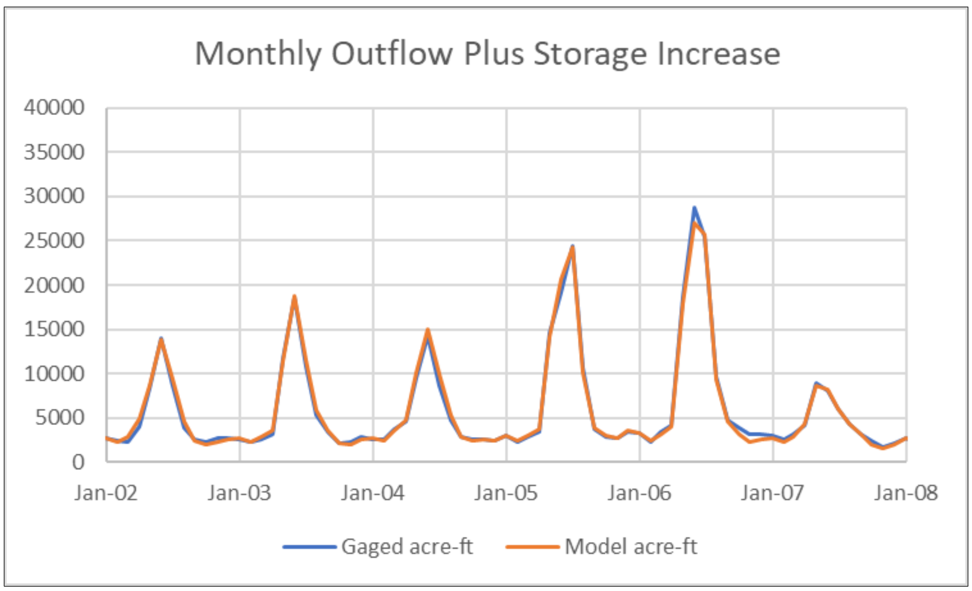


Figure 2.3-5 Monthly Overflow Plus Storage Increase

The two daily inflow datasets were plotted for direct correlation. Because of the distance between the reservoirs and the gages measuring flow exiting the project, the duration between releasing water from upper storage reservoirs and exiting the system is long enough to negatively impact the correlation. The average of concurrent daily inflow totals increases the correlation, with longer averages having better correlation. Single day, three- and five-day average correlations were examined (Figure 2.3-6 through Figure 2.3-8). A nearly two percent increase occurs when changing from single to three-day average correlation. As the incremental benefit of using five-day was less than a half percent, this dataset was deemed acceptable for developing corrective regression formulae.

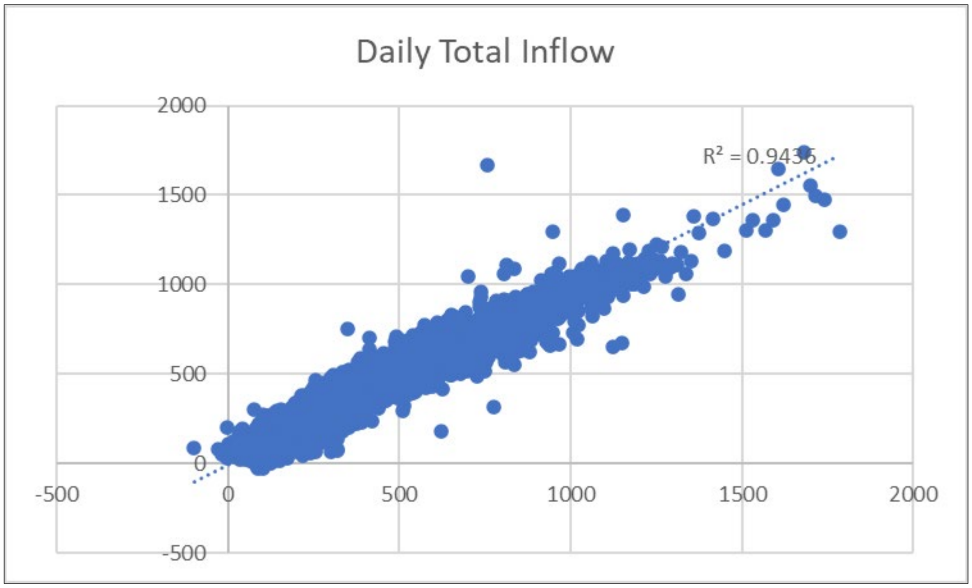


Figure 2.3-6 Daily Total Inflow

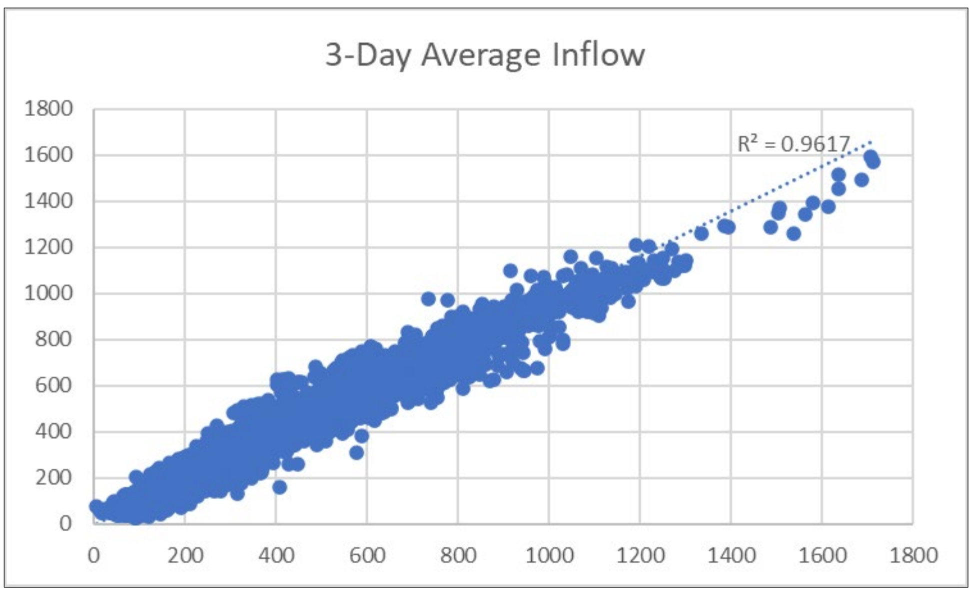


Figure 2.3-7 3-Day Average Inflow

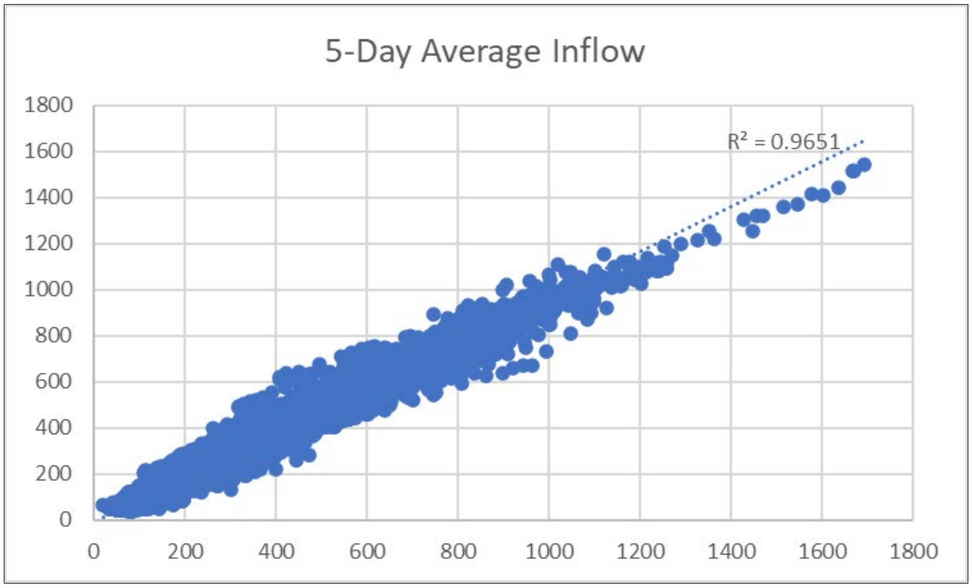


Figure 2.3-8 5-Day Average Inflow

The 5-day average model and gaged inflows were separated into monthly datasets to represent seasonal variability more accurately (Figure 2.3-9). The results of the monthly correlations are included as Appendix A. Using these sorted datasets, equations were developed to apply to monthly calculated inflows and applied at each point of inflow in the model, reflective of that point's contributing drainage area. After this correction was applied to each inflow point, the resulting average value was calculated for each month and compared with the average calculated gage inflow. Additional correction factors were applied to bring the average monthly model-calculated inflow within a tenth of a percent.

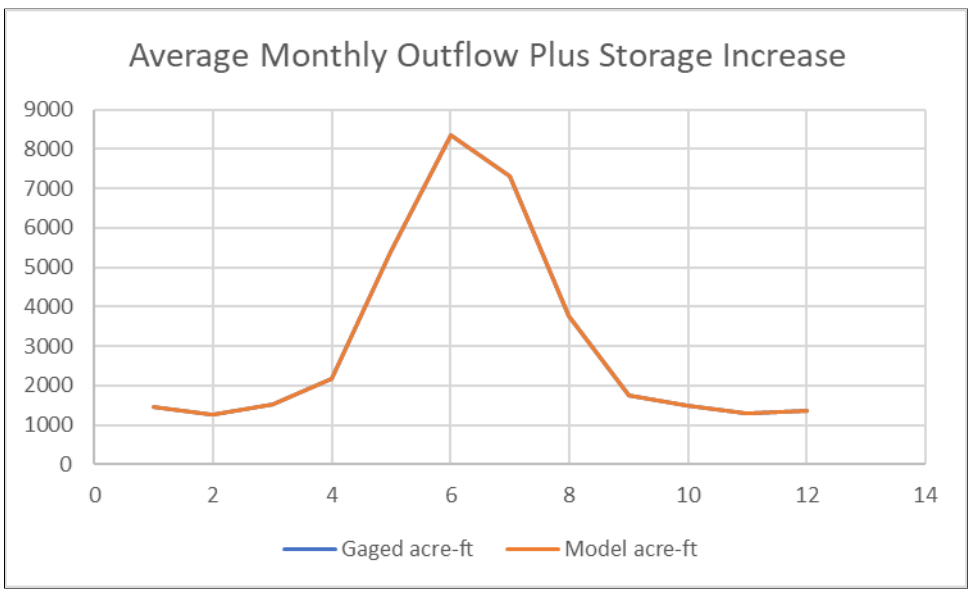


Figure 2.3-9 Average Monthly Outflow Plus Storage Increase

Daily deviations exist, and some seasonal and even annual total calculated values deviate from gauge-measured inflows. While synthesizing or prorating flow contributions from ungauged sources increases overall model accuracy, error exists because not all inflow is measured. Given the availability of data, the model is calibrated and adjusted to the extent possible. The model represents the hydrology of the system and represents the normal operation of the existing features under current regulatory requirements.

2.4 Application and Results

The intent of the model is to measure the ability of the Bishop Creek system to meet flow targets determined beneficial by studies conducted in support of the licensing process. Flow allocations that enhance various reaches can be entered into the model as alternative scenarios to the current baseline conditions. Entering flow targets for cells designated for specific channel reaches on the Summary Graph tab results in the model calculating the percent of successful days when the target flow is missed. The resulting percentage is displayed in a cell adjacent to the flow target; impacts to all other reaches' target flows are calculated, displayed adjacent to their reflective entry cells. The percentage of missed target flows attributable to dry years is also displayed for each location. The model also checks for success in meeting the "or inflow" alternative minimum flow requirement at each location. Using the "Flow Reset" macro changes all flow input values to the current pre-license targets.

Cells displaying the results are color-formatted based on calculated percentages, allowing a quick visual of impacts across the system based on changes made to any target flow. The greater percentage of time a target is missed, the redder the format, while greener format is applied as the target is more consistently met.

On the Input & Summary tab, baseline target flows are listed for comparison to alternative scenario flows, with missed percentage values shown for each. Results for missed target percentages are further categorizing into wet, normal, and dry years for each location. Comparison of relative increases or decreases from the baseline results are calculated for each location.

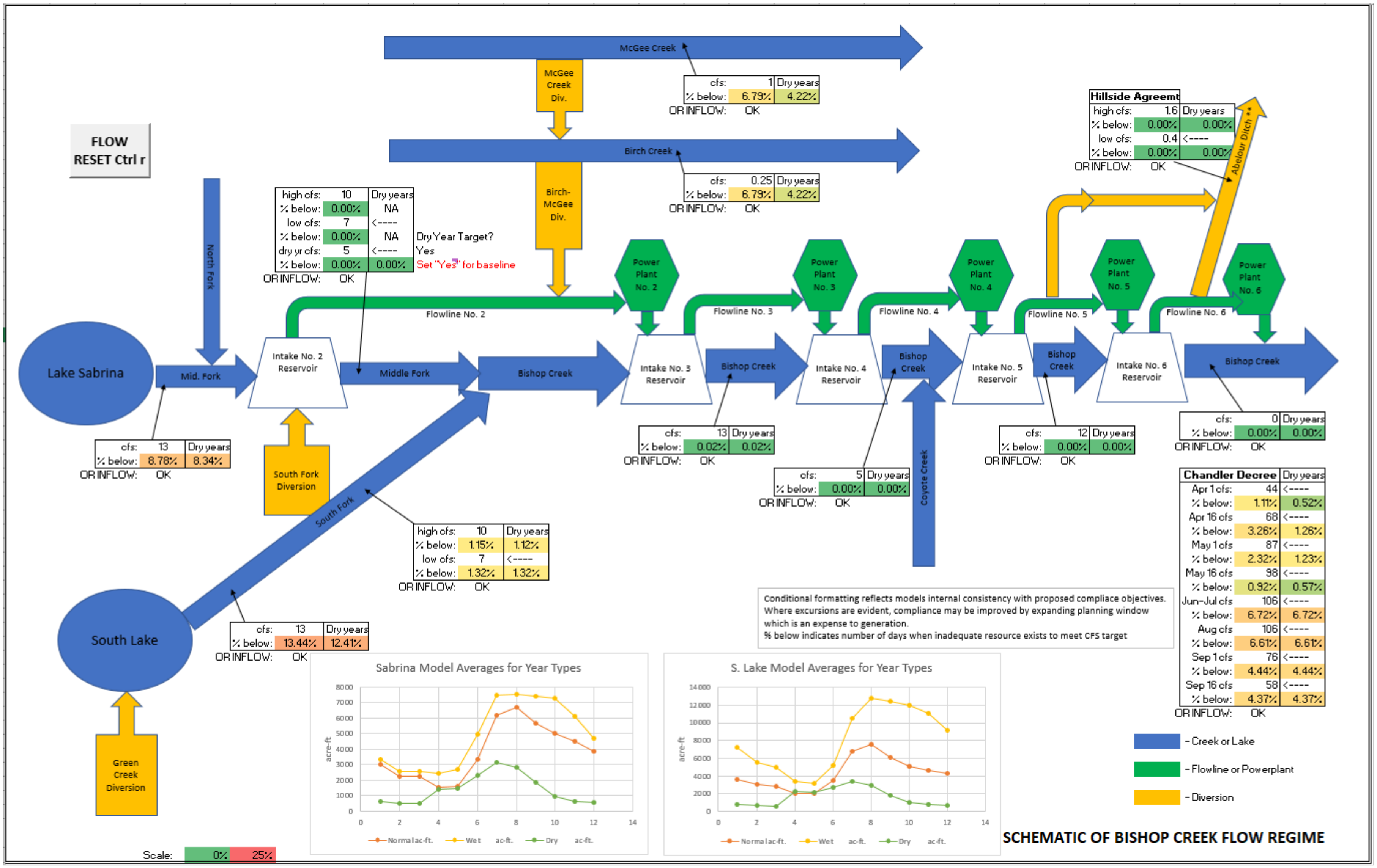


Figure 2.4-10 Baseline Model Summary Graph Input & Result

3.0 CONSULTATION SUMMARY

SCE distributed periodic progress reports on the following schedule:

- Progress Report 1: December 19, 2019
- Progress Report 2: April 14, 2020
- Progress Report 3: July 24, 2020
- Initial Study Report (Progress Report 4): October 30, 2020
- Initial Study Meeting: November 10, 2020
- 2021 Progress Report 1: March 2, 2021
- 2021 Progress Report 2: May 28, 2021
- 2021 Progress Report 3: August 27, 2021
- Updated Study Report: November 4, 2021
- Updated Study Report Meeting: November 18, 2021

Three progress reports were filed in 2021 after the ISR, as identified above. This Final Technical Report was submitted to agencies and stakeholders for a 60-day review period on August 16, 2021. Comments received on this report are shown in Table 3.1-1. Meetings were held with CDFW and USFS on October 13, November 4, and December 8, 2021 to discuss those comments received as well as SCE's draft responses to them.

SCE held a Project Effects meeting on October 28, 2021 for all stakeholders and agencies to discuss what project effects (if any) had been identified through the implementation of each of the approved study plans.

The Updated Study Report (USR) was filed with FERC on November 4, 2021, and a USR Meeting was held on November 18, 2021. At this meeting, SCE only discussed those studies which were still in progress at the time of the ISR (Water Quality, Sediment and Geomorphology, Operations Model, Recreation Use and Needs, Recreation Facilities Condition Assessment, Project Lands and Boundary, and Cultural and Tribal Studies). All comments received to date, including those from the USR, are included in the table below.

Table 3.1-1 Comment Response Table

Comment Number	Report	Location	Comment	Proposed Resolution
1	AQ 2	Figures 2-6 through 2-8	Although the R^2 values for these charts are high, the daily, 3-day and 5-day inflow comparisons have lower accuracy at higher daily inflows. The report should explain in more detail the genesis of this source of error and whether it has been corrected for in the modeling. And if not corrected how does this affect the results of the water balance? The report states in the next paragraph that "Additional correction factors were applied to bring the average monthly model-calculated inflow within a tenth of a percent." Were those additional factors used to make up for ungauged inflow?	This was discussed with CDFW on October 13, 2021, and SCE agreed to provide clarification. **SCE Response:** **Short response**: Identified potential sources of undercalculating higher inflows include: • Prorating gauged inflows to ungauged contributions by direct drainage area ratio that may non-linearly vary under a range of flows and antecedent conditions, • Inaccuracy of storage and streamflow gages, and • Synthesized inflow contributions from North Fork Bishop Creek and Coyote Creek. However, the model accurately reflects the water balance as demonstrated by calculated vs gaged comparisons over the hydrologic record. The high-flow data tail is relatively insignificant as compared to the overall dataset. We did explore changing the polynomial from the 2nd order to a 6th order to see if we could adjust for the bias – the change not result in a meaningful change in the R^2 **Expanded response:** The correction factors were incorporated to more closely align average inflows from all points of contribution, both gaged and ungauged. The correction factor table references appear in formulae where inflows are added in each Power House (PH) tab.

Comment Number	Report	Location	Comment	Proposed Resolution
				The methods of synthesizing contributions were detailed in the Memorandum Re: Bishop Creek Operations Model Structure, December 21, 2018. Bias in all flows has been corrected by applying monthly regression equations at each inflow contribution formula within the model. The 5-day average inflow data subsets were sorted for developing second-order regression equations. The application of these regression equations was applied to all flow contributions throughout the model as a corrective measure, not just ungauged contributions. The additional correction factors were incorporated to closely align average inflows from all points of contribution, but gaged and ungauged. The correction factor is also applied to all inflow contributions throughout the model. Bias in the high end flows shown on the upper portion of the graph represent a very small number of days. Even after corrective measures, the bias exists. The water balance for 30 years has a gaged sum of 2.221 MAF. The unbiased sum is 2.112 MAF, the regression corrected is 2.170 MAF, and the additional factor increases it to 2.222 MAF. On an annual basis, the final total is overpredicted by 50 acre-feet, or 0.007 cfs.

Comment Number	Report	Location	Comment	Proposed Resolution
2	ISR	Page 100	The initial study report states that: *While much of the logic imbedded is complex, formulae are visible and can be traced to determine both inputs (precedents) and effects (dependents) in othercells.* Although the model may be designed this way, only a locked version of the model has been provided to date, and so precedents and dependent cells cannot be easily traced in Excel.	This was discussed with CDFW on October 13, 2021, and SCE has since provided an unlocked version. CDFW agrees that SCE will keep the “master” version for documenting model runs.
3	ISR	Page 90	Can unimpaired hydrologic data sets be provided to the licensing participants in DSS or Excel format? CDFW requested a copy of dataset with regression factors applied so that they can compare unimpaired hydrology (calculated) to regulated flow at any point in the system.	This was discussed with CDFW on October 13, 2021, and SCE agreed to provide clarification. **SCE Response:** SCE believes these data are already available, but stakeholder would benefit from an overview of how to access: The calibration process resulted in second order polynomial values used throughout the model, tabulated in the Hydrology tab under CA35 cell heading “Monthly Adjustments.” Setting the factor input values (next comment) below cell CE50 equal to 1, setting the second and first order coefficients in the Monthly Adjustments table equal to 1, and the zero-order coefficients equal to 0 eliminates all

Comment Number	Report	Location	Comment	Proposed Resolution
				multiplier and regression effects on inflow contributions throughout the model. The net inflow daily gage-calculated and model-predicted values are provided, which was the basis of the calibration. With the Monthly Adjustments and factor inputs changed, these will revert the model-predicted values to the unimpaired dataset.
4	ISR	Page 107	The ISR states that "A simple multiplier was applied to each inflow point, then adjusted until the average monthly inflow matched historical gauge totals." Where arethese multipliers listed?	This was discussed with CDFW on October 13, 2021 Similar to the Monthly Adjustments, these simple multipliers are located on the Hydrology tab under CA50 cell heading "Multiplier Adjustments." The "factor input" values were iteratively adjusted until the average monthly inflow ratio was within 0.1%. SCE agreed to provide clarification in the final AQ 2 report.
5	ISR	Page 108	The ISR states that: "*System outflows were modeled using average reservoir operations for the period reflective of the existing license. Changes tothese operations can be made by adjusting target storage levels in each reservoir at the start of each month, for each year designation (wet, dry, or normal).*" Where can those be modified? Are these supposed to be modified in the "storage" tab? If so, this would	This was discussed with CDFW on October 13, 2021, and SCE agreed to provide input on where those modifications could be made. **SCE Response:** Daily storage target values are interpolated based on historic monthly start storage values. These are tabulated under "Storage Targets at Beginning of Month for Year Type" cell AF2 on the "Storage" tab for year type for both reservoirs. Adjustment to model operations would be performed by adjusting target storage values (in acre-feet) in this table. As the model prioritizes storage for planned allocation, adjusting

Comment Number	Report	Location	Comment	Proposed Resolution
			be good to add to the inputs tab. This would be good to add a description of this option to AQ 2 as well.	these values may not significantly impact results, although no sensitivity on this has been performed.
6	Model	Model Logic	McGee Creek Diversion, Birch McGee Diversion and Green Creek Diversion do not have active modeling. There is no way to operate the diversion differently. If this is something stakeholders may want, that functionality should be added to the operations modeling.	This was discussed with CDFW on October 13, 2021, and SCE agreed to provide input on where those modifications could be made. **SCE Response:** SCE understands that there is new interest in looking at flows in Birch and McGee creeks to address some potential for managing meadows lower in the creek. These management goals were not part of the original scoping of the study program or the operations model. We see difficulties in building this in at this point (as explained below) but believe there is a good workaround to provide agencies with necessary information to understand the system. From a practical standpoint, the physical extent of the model was limited by data adequacy, much like the period of record and the temporal resolution. Where datasets are significantly lacking, simulating flow in abundance introduces error and may curtail or eliminate the calibration. Where daily storage records for Lake Sabrina and South Lake were limiting factors in selecting the start of the model period, the diversions' gage datasets and concerns about limitations in measurement capacity were not adequate for fully extending the model without introducing additional error. Adjustments to these diversions would impact the net flow contributions to the model and increased releases

Comment Number	Report	Location	Comment	Proposed Resolution
				downstream of the diversions would effectively be daily net reductions to the Bishop Creek project. These have not been incorporated into the model due to lack of gage records and limitations on measurements. **As an alternative to incorporating these**, a simple addition to flow allocation could be artificially added to all bypassed reaches in the model. While it would not account for times of excess flow availability, it would provide some relative impact on the results. Trying to accurately incorporate changes to these flow into model as independent adjustable variables would be very difficult given the data limitations, and generally stated, are not significant in magnitude for the system. **Resolution:** SCE met with CDFW again on December 8; at this meeting, it was agreed that inputs for the McGee and Birch Creek bypassed flows would be added as model inputs. The adjustments to those flow targets can be changed as other targets on the summary graph input tab, and the results displayed as percent missed target days as well. Alternative scenarios are calculated as adjustments from the contribution to the model input at flowline to powerhouse 2, which has a net total of both diversion contributions. This dataset is largely complete for the model period of record (93.5 percent), and changes can be quantified with confidence. Conversely, the McGee and Birch downstream gages have just 1.6 and 12.3 percent of the daily data for the model period of record, inadequate for accurately quantifying changes. Because the ability of meeting the flows is measured with a single combined gage, allocations when inadequate flow is

Comment Number	Report	Location	Comment	Proposed Resolution
				available could either be prioritized for one reach over the other, or both could fall short. It was agreed that equally meeting both targets would be an adequate representation at the meeting.
7	Model	Model Logic	The model logic does not allow variation in water year types other than at Intake Number 2. Is it possible to include the ability to have water year types for other release locations in the project?	This was discussed with CDFW on October 13, 2021 – CDFW was interested in storage year types based on different [water] year type classification. SCE agreed to provide input on which of the types of water year types would/could be included, which could allow relicensing participants to decide which year typing would be appropriate for other instream flows, if considered. **SCE Response:** This would require significant additional structural changes to the model, and likely impact schedule, and it's unclear that this type of granularity is needed given what we understand as management objectives for Bishop Creek. As an alternative, we propose putting alternate flows in for locations of interest, then observing results as tabulated for the specific year types on the "Input & Summary" tab, columns O, P and Q below row 5. **Resolution:** SCE met with CDFW again on December 8; at this meeting, it was agreed that the model would remain without additional locations having alternative flows based on year types. Using the Intake Res 2 release location, lower flows were run for year-round requirement and compared with the results of running just for low flow year, and having a default higher flow year-round. After running a wide range of flows in the location, the sensitivity analysis had calculated results of missed target flow being within 0.5 percent. One additional post-processing calculation must be made for this: the results of a lower flow run must be divided

Comment Number	Report	Location	Comment	Proposed Resolution
				by 0.3, as this represents the percent of years modeled that are categorized as low flow.
8	Model	Model output	Hydrograph output for each stream reach as an additional output tab would be helpful toaid stakeholders in using the model to understand how rivers may be affected by project operations.	We need clarification of this request, to understand the output metric of interest. Is it looking at what percent of time specific flows are met at each reach? Flow exceedance curves at each reach? **Resolution:** SCE met with CDFW again on December 8; at this meeting, SCE showed sample graphs and data displays for 3 locations in the system. Hydrographs included are total period of record, last decade of record, select wet, normal and dry years. Percent exceedance graphs are also provided. Graphs depict the scenario input and the baseline, which reflects the current release requirements. Graphs are left adjustable, such that users can change the x-axis to more adequately examine specific durations of interest. CDFW agreed that the visual displayed represented the information sought; however, CDFW may seek to add additional locations for future analysis.
9	Model	Model input	Where are the definitions for"wet", "normal," and "dry" years located?	Discussed during meeting. Under the "Snowpack" tab, comment in cell H5 for "Year Type." Comment reads "set as +/- 25% of average, matches determination from license article 105 for Int. Res. 2 release requirement." The 25 percent matches the dry year release determination, and the wet year was set to match. For the modeled period of record, this resulted in a breakdown of years reflecting wet/normal/dry as 33/37/30 percentages.

Comment Number	Report	Location	Comment	Proposed Resolution
10	Model	Model input	If possible, it would be good to have Chandler Decree and existing FERC required flows listed in some way in the input tab, or a separate tab in the model. Using the model alone, it's hard to reference how much each of the flow variables can be toggled within/compared to the existing requirements.	**SCE Response:** These are provided in the "Input & Summary" tab under K5, "Baseline existing cfs target" for each location and season/year type (when applicable). If this does not address CDFW's need, we can discuss further.
11	Model	Model input	Is there any way to include ramping rates or geomorphic pulse flows below project facilities?	**SCE Response:** Addition of geomorphic pulse flows and ramping rates would be well beyond the scope of this model or any resource questions identified during FERC's scoping process and SCE is not aware of any new information that would warrant expanding this model to include this capability. From a feasibility standpoint, these modifications would not be feasible without significant additional data collection and modeling including bathymetry, measurements of stage-discharge relationships. SCE would like to know if there is a specific need that has been identified that would warrant a discussion about how to develop necessary information. **Clarification from November 4, 2021 meeting:** USFS clarified that their interest was in knowing whether it is feasible to do a sediment pulse in a given year. For instance, what is the water budget for a year and is a pulse flow achievable (at what volume, for how long)? And how many times in the period of record did those opportunities occur **Revised SCE Response**: SCE anticipates implementation of geomorphic flows in wet years, in accordance with meeting downstream minimum flow requirements. Details

Comment Number	Report	Location	Comment	Proposed Resolution
				about the timing and frequency of these flows is provided in PME 1, Appendix B of this FLA.

4.0 REFERENCES

Chandler Decree 1922 (Chandler Decree). Hillside Water Company v. William A. Trickey et.al, U.S. District Court, Southern Division of California (Northern Division), No. B-61 EQ, Final Decree in Equity (Chandler Decree), January 27, 1922 (Unreported).

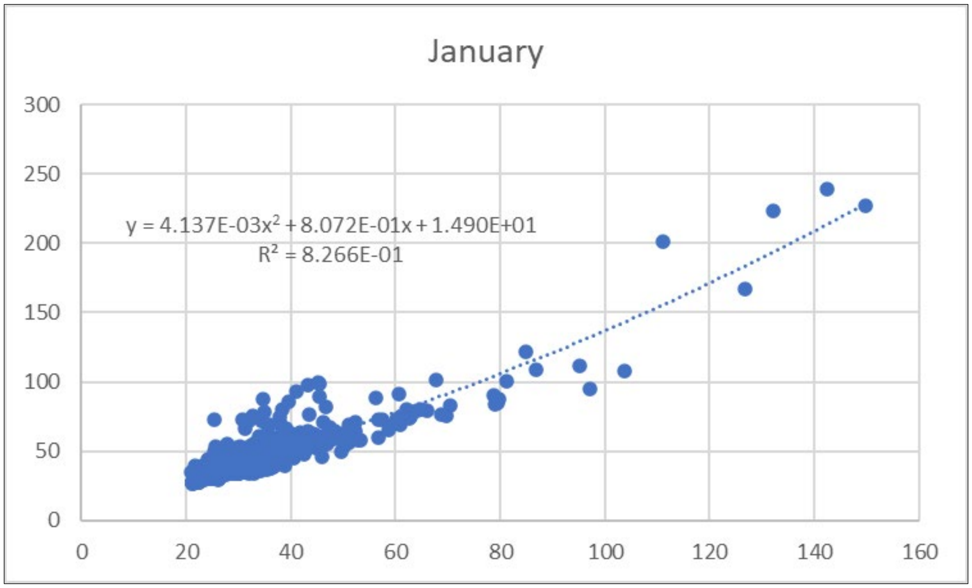
SCE, 2020. Initial Study Report; prepared by Kleinschmidt Associates. Filed October 30, 2020. Portland, Oregon.

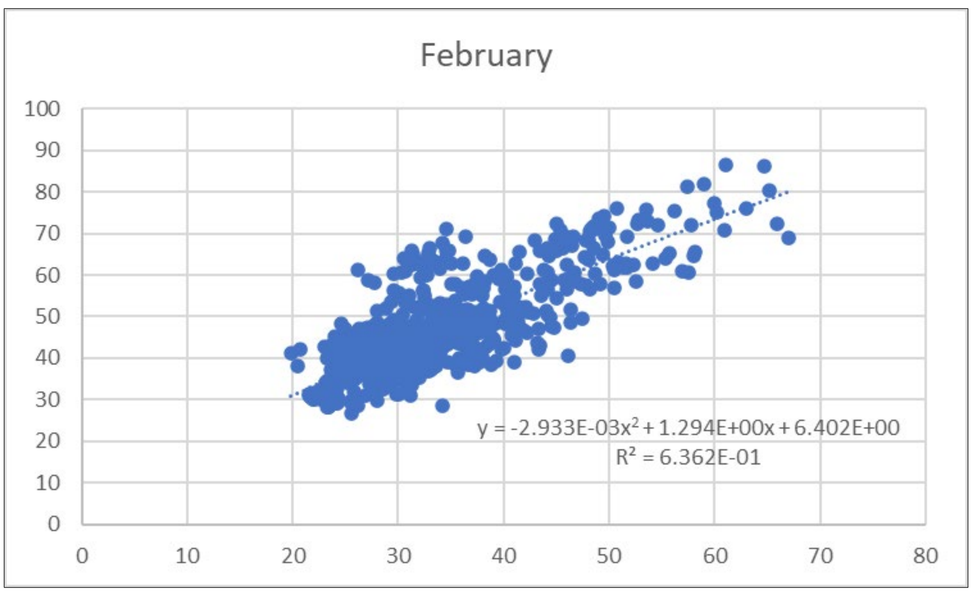
Southern California Edison (SCE). 2002. FERC License Exhibit A document. General Description and Specifications of Mechanical, Electrical, and Transmission Equipment. May, 2002

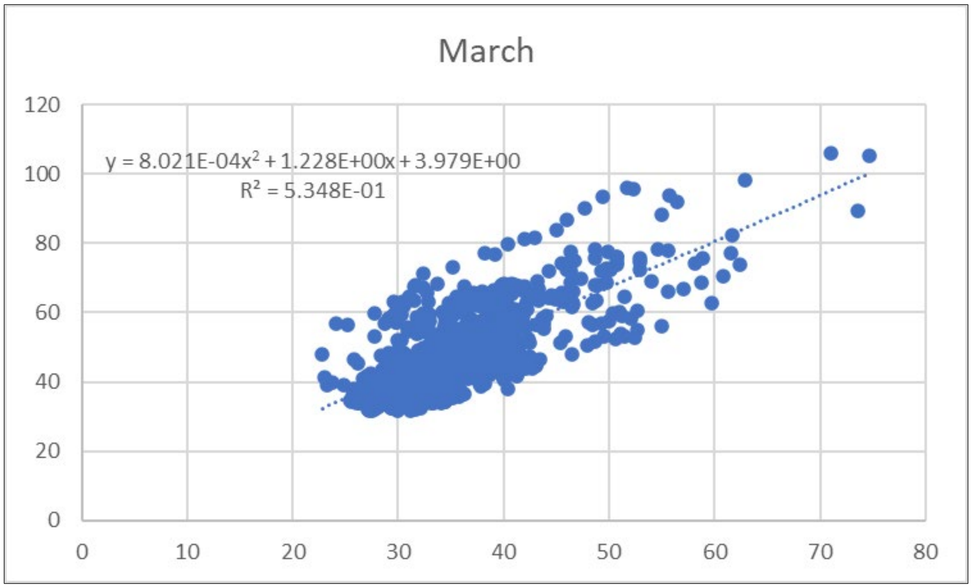
United States Department of Agriculture (USDA). 2019. Land Management Plan for the Inyo National Forest. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd589652.pdf.

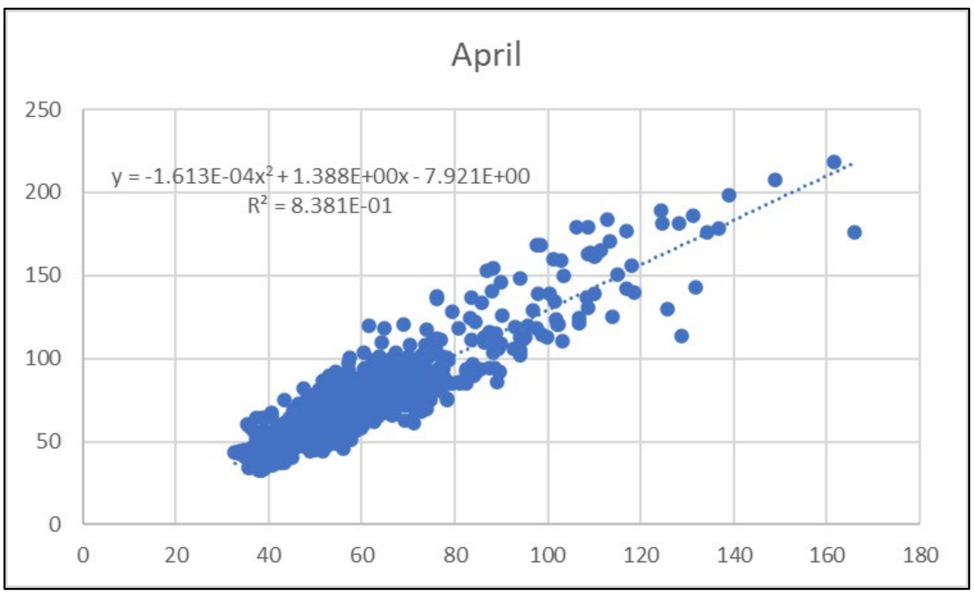
APPENDIX A

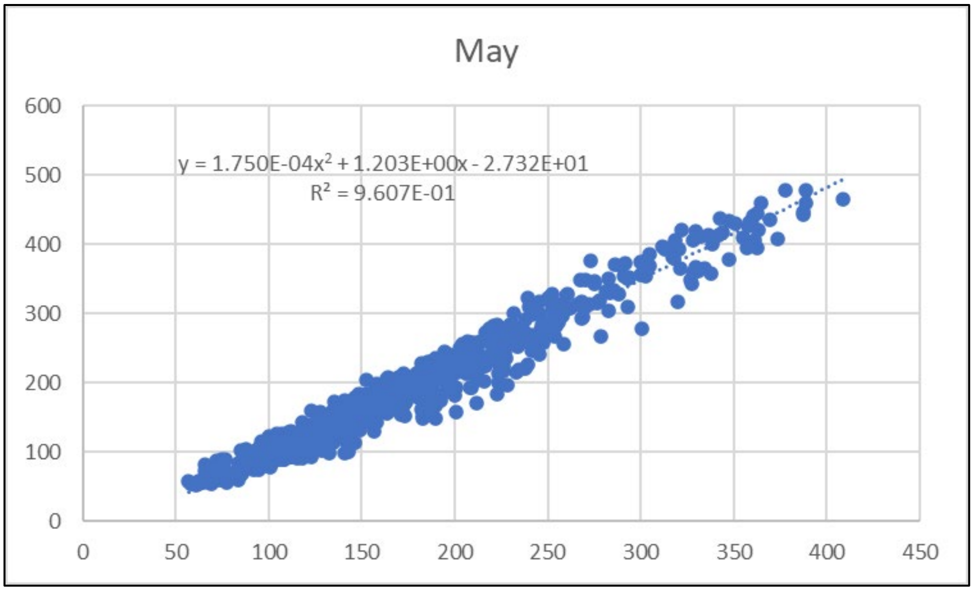
MONTHLY CALIBRATION RESULTS

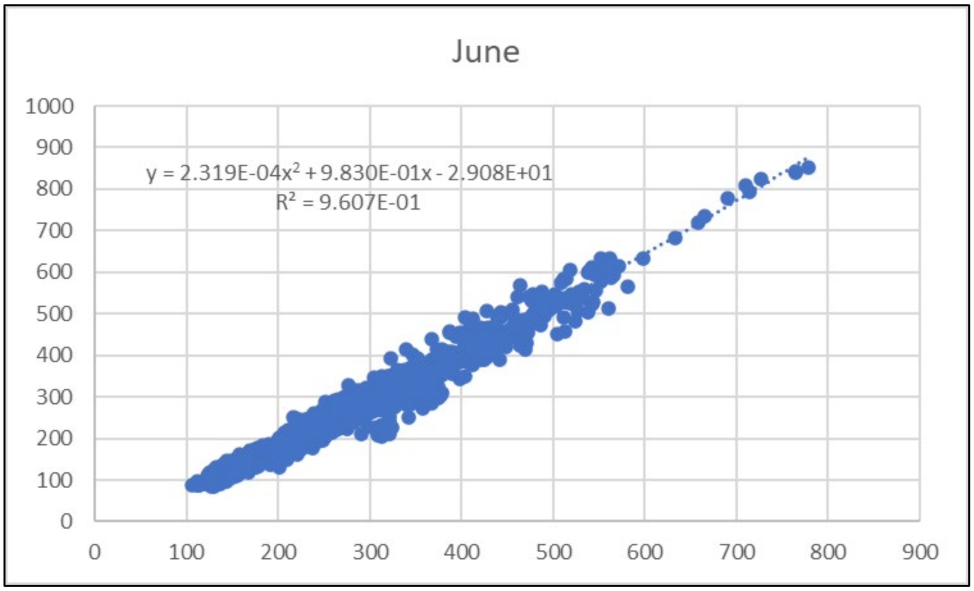

January
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
y = 4.137E-03x² + 8.072E-01x + 1.490E+01
R² = 8.266E-01

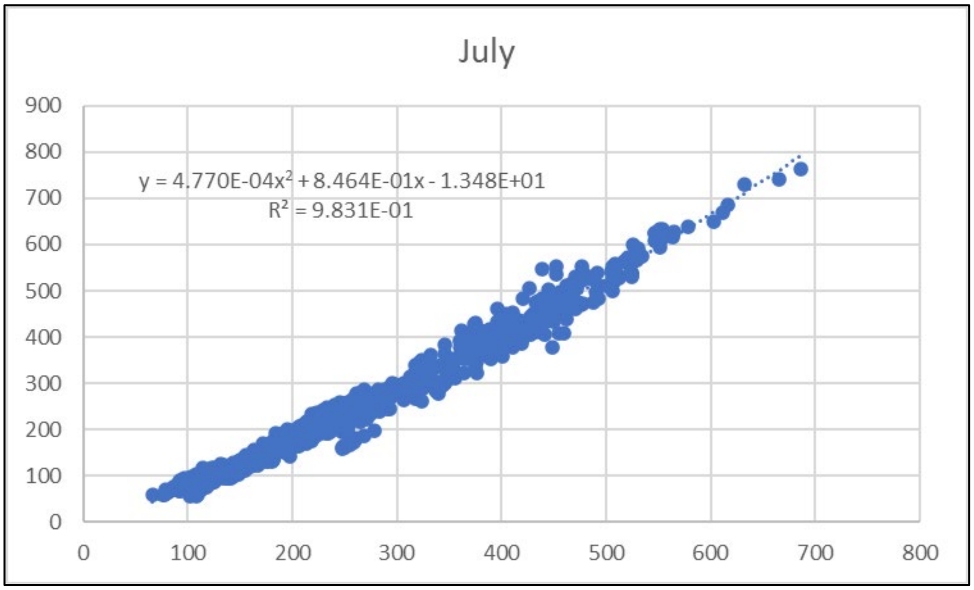

February
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
y = -2.933E-03x² + 1.294E+00x + 6.402E+00
R² = 6.362E-01


March
$y = 8.021E-04x^2 + 1.228E+00x + 3.979E+00$
$R^2 = 5.348E-01$
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80


April
$y = -1.613E-04x^2 + 1.388E+00x - 7.921E+00$
$R^2 = 8.381E-01$
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180


May
y = 1.750E-04x² + 1.203E+00x - 2.732E+01
R² = 9.607E-01
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
450


June
y = 2.319E-04x² + 9.830E-01x - 2.908E+01
R² = 9.607E-01
1000
900
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900


July
y = 4.770E-04x² + 8.464E-01x - 1.348E+01
R² = 9.831E-01
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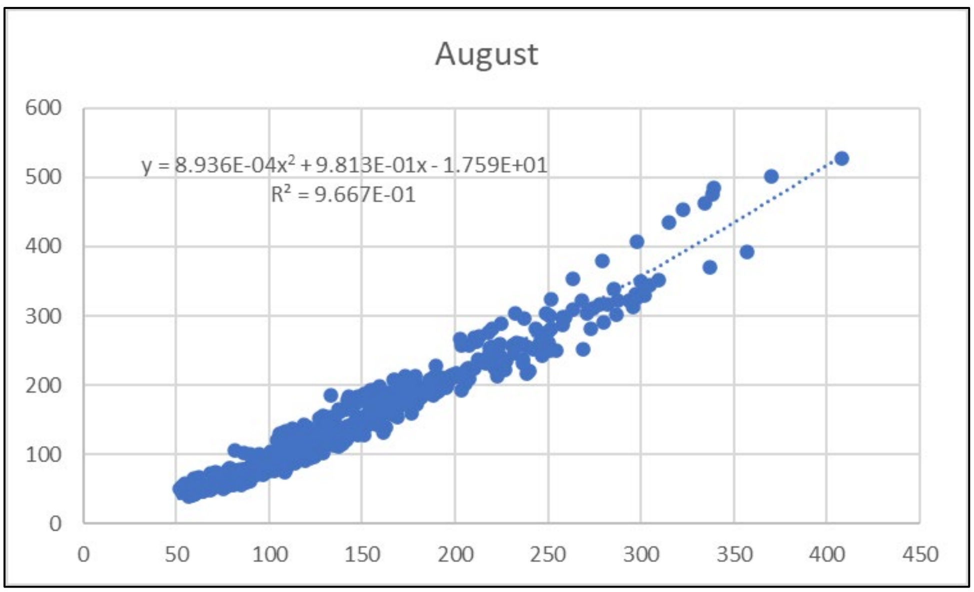
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800


August
y = 8.936E-04x² + 9.813E-01x - 1.759E+01
R² = 9.667E-01
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400
300
200
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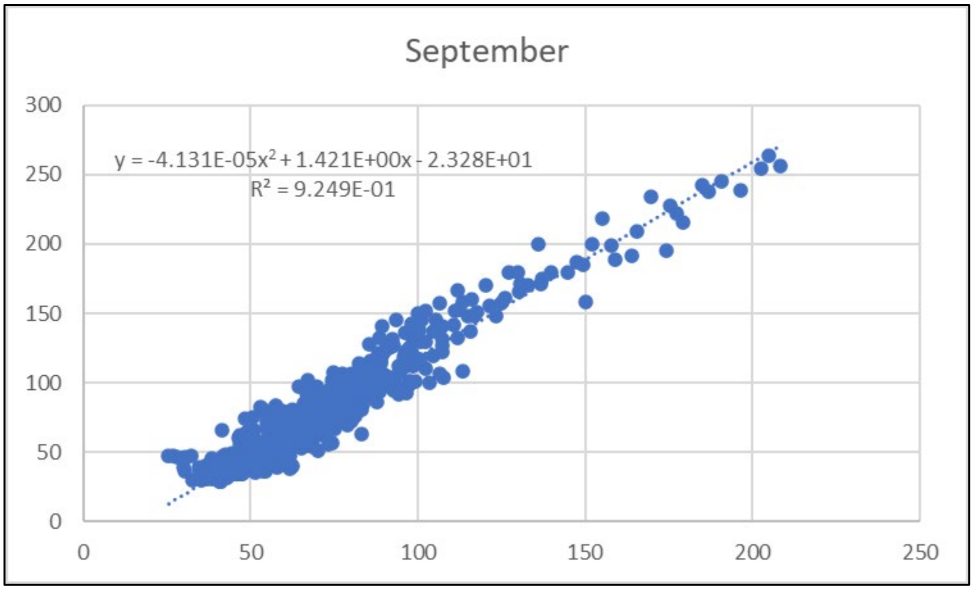
0
0
50
100
150
200
250
300
350
400
450


September
y = -4.131E-05x² + 1.421E+00x - 2.328E+01
R² = 9.249E-01
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250
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150
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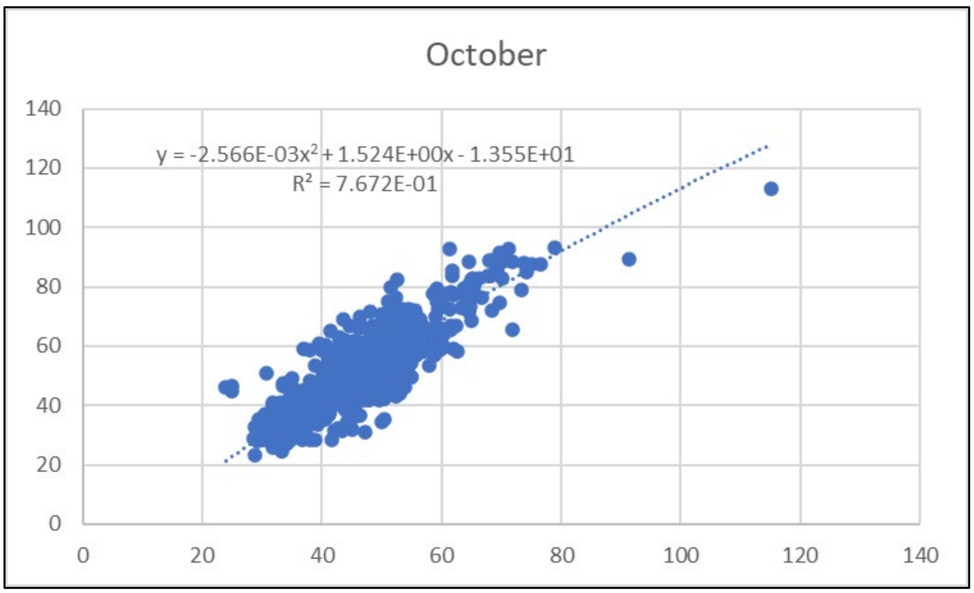
50
100
150
200
250


October
y = -2.566E-03x² + 1.524E+00x - 1.355E+01
R² = 7.672E-01
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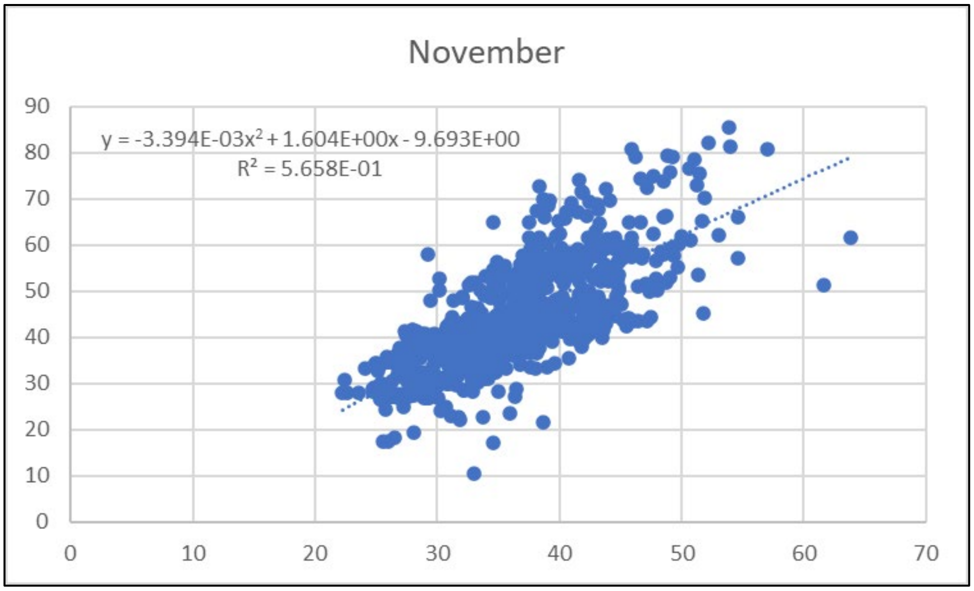
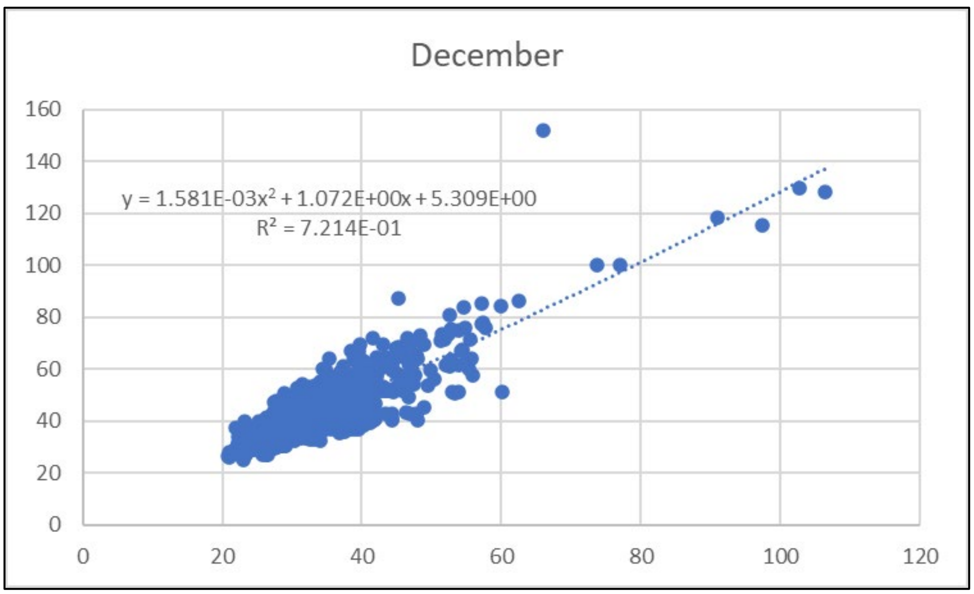
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140


November
y = -3.394E-03x² + 1.604E+00x - 9.693E+00
R² = 5.658E-01
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70


December
y = 1.581E-03x² + 1.072E+00x + 5.309E+00
R² = 7.214E-01
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120

SOUTHERN CALIFORNIA EDISON

Bishop Creek Hydroelectric Project

(FERC Project No. 1394)

FINAL TECHNICAL REPORT
BISHOP CREEK FISH DISTRIBUTION BASELINE STUDY PLAN (AQ 3)

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL® Company

JUNE 2022

SOUTHERN CALIFORNIA EDISON

Bishop Creek Hydroelectric Project

(FERC Project No. 1394)

FINAL TECHNICAL REPORT
BISHOP CREEK FISH DISTRIBUTION (AQ 3)

Southern California Edison
1515 Walnut Grove Ave
Rosemead, CA 91770

June 2022

Support from:

Stillwater Sciences

and

Kleinschmidt

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1.0 INTRODUCTION

Bishop Creek is the largest tributary to the Owens River and enters the river near the City of Bishop in Inyo County, California. When the current license was issued in 1994, the Federal Energy Regulatory Commission (FERC) established minimum flow requirements in Bishop Creek of 18 cubic feet per second (cfs) below Powerhouse No. 4 (Intake 5) and 5 cfs below Powerhouse No. 3 (Intake 4). Baseline fish population monitoring efforts in Bishop Creek began in 1991, and population monitoring efforts continued through 2010 following changes to minimum instream flow releases (Sada and Rosamond 2010; Sada, 2006; Sada and Knapp 1993). The Bishop Creek Stream Fish Distribution Technical Report focuses on identifying the presence and distribution of fish species and characterizing fish populations within the Project area that may be affected by Project operations, as described in the for the Bishop Creek Fish Distribution Baseline Study Plan (AQ 3) approved by FERC on November 4, 2019. This report includes the results of fish population sampling in the Bishop Creek watershed during September 2019. Information on reservoir fish populations is included in the Bishop Creek Reservoirs Fish Distribution Study (AQ 4) Technical Report (SCE 2021).

Data and preliminary results for this survey were previously reviewed with the Bishop Creek Aquatics Technical Working Group (TWG) in May 2020, following distribution of Progress Report No. 2 on April 14, 2020.

This report builds on the April 14, 2020 interim report, but does not draw conclusions about potential Project effects, or consistency with the desired future conditions as described in the Land Management Plan for Inyo National Forest (INF) (USFS 2018). These analyses will be completed in conjunction with the rest of relicensing studies as part of the overall National Environmental Policy Act (NEPA) process and in consultation with the aquatics TWG.

2.0 REVIEW OF EXISTING INFORMATION

Project facilities (13 dams and diversions, 5 powerhouses, and associated intakes) are sited along Bishop Creek and nearby Birch and McGee creeks. Bishop Creek has a total drainage area of approximately 70-square-miles from its headwaters to its confluence with the Owens River. South Lake and Lake Sabrina are the major storage reservoirs in the watershed. Southern California Edison (SCE) manages the releases from the storage reservoirs for purposes of hydro-generation and meeting water allocation requirements in accordance with the Chandler Decree (1922). Water from McGee and Birch creeks (combined drainage area of approximately 25-square-miles) is also diverted to Bishop Creek through the hydroelectric facilities.

This network of creeks and reservoirs supports both stocked and self-sustaining trout fisheries, including brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis)* and rainbow trout (*Oncorhynchus mykiss*), managed by the California Department of Fish and Wildlife (CDFW). CDFW introduced each of these three non-indigenous trout species and manages them to support angling harvest. “Catchable” size rainbow trout (roughly 12 inches) were stocked in South Fork Bishop Creek, Middle Fork Bishop Creek, and Lower Bishop Creek regularly between April and September 2019; no other trout species were stocked in Bishop Creek by CDFW in 2019 (CDFW 2019). Segments of Bishop Creek below Project reservoirs support self-sustaining brown trout populations, and McGee and Birch creeks maintain scattered populations of brook trout.

SCE monitored the Bishop Creek brown trout population at intervals from 1988 through 2010 (Sada and Rosamond 2010). Sada and Rosamond (2010) determined that population parameters such as growth, age, and abundance remained similar to that of other regional Sierra Nevada creeks throughout most of the study period; however, abundance declined during 2010, the last year of monitoring. CDFW noted that growth of adults was limited in recent years but that recruitment from natural reproduction does not appear to be a limiting factor (N. Buckmaster, CDFW, *personal communication*).

Owens sucker (*Catostomus fumeiventris*) are believed to have been informally introduced into Lake Sabrina (N. Buckmaster, CDFW, *personal communication*) where they have established a large and self-sustaining population with the potential to spillover to downstream reaches of Bishop Creek. During an early June 2018 field visit to Lake Sabrina, adult Owens sucker were observed spawning in a shallow arm near the eastern end of the Lake Sabrina dam. EA Engineering (1987) netted an unidentified sucker from Lake Sabrina, which the authors speculated was an Owens sucker.

3.0 LIFE HISTORY INFORMATION

CDFW currently manages waters in the Project area as a popular stocked rainbow trout fishery. Bishop Creek presently supports a self-sustaining brown trout fishery, while McGee and Birch creeks maintain small brook and possibly brown trout populations. Introduced species such as Owens sucker and Owens speckled dace (*Rhinichthys osculus robustus*) also occupy Project waters.

3.1 BROWN TROUT

Brown trout are an introduced species to the Bishop Creek watershed and have established a self-sustaining fishery, supported entirely by natural reproduction. Spawning recruitment to the fishery does not appear to be a limiting factor (N. Buckmaster, CDFW, personal communication). The following summary of brown trout life history is excerpted from Raleigh et al. (1986).

> *Brown trout mature as early as the end of their first year and as late as their eighth year but most mature in their third to fifth year. Brown trout up to 30.0 cm in length feed generally on terrestrial and aquatic insects but, as they exceed 25.0 cm, fish and crustaceans become more important in the diet. Brown trout are fall spawners with apparent latitudinal differences in time of onset. Spawning migrations appear to be triggered by decreasing day length, increased late fall flows, or drops in water temperature to <9 °C though these events are usually concurrent. In California, however, spawning often occurs when stream flows are low. Eggs are buried in unguarded nests (redds) built in well aerated gravels where they incubate throughout the winter. Egg sac larvae live in the gravels prior to emerging as fry in the spring.*
>
> *Optimal brown trout riverine habitat is characterized by clear, cool to cold water; a relatively silt-free rocky substrate in riffle-run areas; a 50% to 70% pool to 30% to 50% riffle-run habitat combination with areas of slow, deep water; well vegetated, stable stream banks; abundant instream cover; and relatively stable annual water flow and temperature regimes. Brown trout tend to occupy the lower reaches of low to moderate gradient areas (~1%) in suitable, high gradient river systems.*

3.2 BROOK TROUT

Brook trout are an introduced species to the Bishop Creek watershed with small populations present in South Lake and Lake Sabrina in the upper watershed. During monitoring efforts conducted between 1991 through 2010 in Bishop Creek below the diversions for Plant 3 and Plant 5, brook trout were only captured during one year (Sada and Knapp 1993; Sada 1997; Sada 2006; Sada and Rosamond 2010). Brook trout are not currently stocked in the Bishop Creek watershed (CDFW 2019) and are expected to be uncommon based on lack of stocking and historically low observations.

Brook trout are native to the northeastern United States and eastern Canada and have been introduced throughout most of California. Although widely introduced throughout California, they have primarily become established in small spring-fed headwater streams and in isolated mountain lakes. Brook trout can tolerate a wide range of water temperatures from 1°C up to 26°C; however, they prefer temperatures of 14–19°C (Moyle 2002). Brook trout feed primarily on insects but will consume whatever prey items are most abundant, including smaller fish. Growth is highly variable, but in most California locations, they rarely exceed 300 mm (millimeters) total length (TL), and individuals over five years old are rare (Moyle 2002).

Spawning can occur by the end of their first summer for males and at the end of the second summer for females when fish are as small as 100 mm fork length (FL) (Moyle 2002). Brook trout typically spawn anytime between September and January at temperatures between 4–11°C (Moyle 2002). Optimal spawning locations are found in water >0.4 meters deep with spring upwelling and gravel substrate ranging from 5–30 mm in diameter; however, suboptimal spawning conditions can still support self-sustaining populations (Moyle 2002).

3.3 RAINBOW TROUT

Rainbow trout are an introduced species to the Bishop Creek watershed. Rainbow trout are frequently stocked in South Fork Bishop Creek, North Fork Bishop Creek, and Lower Bishop Creek near the City of Bishop (CDFW 2019). Various size rainbow trout may be stocked; stocking during the sampling year (2019) included rainbow trout in the "catchable" size range (roughly 12 inches) (CDFW 2019). During monitoring efforts conducted between 1991 through 2010 in Bishop Creek below the diversions for Plant 3 and Plant 5, rainbow trout were only captured during one year (Sada and Knapp 1993; Sada 1997; Sada 2006; Sada and Rosamond 2010).

Rainbow trout historically occupied streams that drain to the Pacific coast, with the exception of a few subpopulations that are occur in isolated locations near the edge of watersheds draining to the Pacific (Moyle 2002). Transplanted rainbow trout have been introduced into coldwater streams throughout the world and are likely the most widely distributed fish in California (Moyle 2002). Rainbow trout can tolerate a wide range of water temperatures from <1°C up to 26°C; however, optimal growth occurs at temperatures around 15–18°C (Baltz et al. 1987).

In streams, rainbow trout feed primarily on drifting aquatic organisms and terrestrial insects but will consume benthic invertebrates. Growth rates for rainbow trout in small high-gradient streams are around 70–75 mm per year during their first years and then decrease to around 40–50 mm per year in their third and fourth year when fish typically reach 235 mm FL (Snider and Linden 1981). Habitat preference changes with life stage, where rainbow trout fry (<50 mm standard length [SL]) are often found in shallow water along stream margins; juveniles (50–120 mm SL) are found in deeper water, usually with rocky substrate or other cover; and larger fish often seek out deeper habitats in slow velocity holding areas adjacent to high velocity water where invertebrate drift is high, such as slow water pockets behind rocks in riffle and run habitat or at the head of pools (Moyle, 2002).

Spawning generally occurs when rainbow trout are in their second or third year and fish are at least 130 mm FL (Moyle 2002). Rainbow trout spawning typically takes place between February and June but low temperatures in high mountain areas can delay spawning as late as August (Moyle 2002). Spawning occurs in coarse gravel ranging from 10–130 mm diameter typically located in the tails of pools or in riffles (Moyle 2002).

3.4 OWENS SUCKER

The Owens sucker was introduced into the Bishop Creek watershed and are known to occupy Lake Sabrina. Historic surveys in Bishop Creek conducted between 1991–2010 did not capture any Owens speckled dace (Sada and Knapp 1993; Sada 1997; Sada 2006; Sada and Rosamond 2010). No Owens suckers were captured during the current study. This species occupies waters specifically in the Owens River Valley but have migrated via the Owens Aqueduct to the Santa Clara River drainage.

This species prefers soft-bottomed runs in cool-water streams and the bottoms of lakes and reservoirs. Owens sucker feed at night on aquatic insects, algae, detritus, and organic matter. They spawn from early May through early July. Larval suckers become juveniles at a TL of 19 mm to 22 mm and hide under cover along stream margins and in backwaters. According to CDFW (n.d.):

> *Owens suckers, in the Owens River … are most common in stream reaches with long runs and few riffles. Habitat in these reaches is characterized by fine substrate…with lesser amounts of gravel and cobble, water temperatures of 7-13°C, and pH of 7.9-8.0. In lakes and reservoirs,… adults are abundant near the bottom, regardless of depth. Adult suckers (> 15 cm) were also commonly found at the bottom of pools in a 10-mile reach of the Owens River Gorge. Recent surveys in the lower Owens River found suckers predominantly in off-channel habitats, such as backwaters.*

3.5 OWENS SPECKLED DACE

Owens speckled dace are native to the Owens River and its tributaries. Historic surveys in Bishop Creek conducted between 1991–2010 did not capture any Owens speckled dace (Sada and Knapp 1993; Sada 1997; Sada 2006; Sada and Rosamond 2010); however, observations have been documented in North Fork Bishop Creek. No Owens speckled dace were captured during the current study. The following summary of Owens speckled dace life history is excerpted from Moyle et al. 1995:

> *In general, speckled dace feed on small aquatic insects and algae (Moyle 1976). They typically live three years and attain a maximum size of 80 mm SL in inland basins (Moyle 1976). Owens speckled dace, however, rarely exceed 50 mm SL in length.*

Speckled dace from the Owens Basin are known to occupy a variety of habitats ranging from small coldwater streams and hot-spring systems, although they are rarely found in water exceeding 29°C. They also have been found in irrigation ditches near Bishop. Despite the large variety of habitats apparently suitable to speckled dace of the Owens Basin, their disappearance from numerous localities since the 1930s and 1940s suggests their vulnerability to habitat modifications or to invasion by exotic fishes.

4.0 STUDY OBJECTIVES

The primary goal of the Bishop Creek Fish Distribution Baseline Study is to acquire information on the current distribution of game and non-game fish species of interest and the growth and density of wild brown trout populations in the Project area. To address this goal, this study was designed with the following objectives:

- Characterize fish populations and distribution in Project-influenced stream reaches:
- Assess if recruitment of Owens sucker has occurred downstream of Lake Sabrina and South Lake in Bishop Creek;
- Assess the distribution of other fish species in Project waters (streams and Project intakes);
- Determine if naturally reproducing brown trout populations are consistent with levels documented from 1991 through 2010 at historical monitoring locations; and
- Evaluate population health and condition of recreationally important trout species (e.g., brown trout, rainbow trout, and brook trout) in lotic habitat affected by Project operations.
- Evaluate select, localized water quality parameters that may affect the growth and distribution of fish species; and
- Determine whether future Project facilities and operations are consistent with the Desired Conditions described in the Land Management Plan for the Inyo National Forest (USDA 2019) as they relate to ecological sustainability and diversity of plant and animal communities.

4.1 STUDY AREA

The study area included the Bishop Creek watershed downstream of Project reservoirs (i.e., South Lake and Lake Sabrina) to Powerhouse No. 5. This section of the watershed ranges in elevation from approximately 4,900 feet to 8,500 feet. Bishop Creek is separated into multiple segments by a series of powerhouses and intakes. Sample sites were selected in six locations within Project-affected reaches of Bishop Creek, Middle Fork Bishop Creek, and South Fork Bishop Creek (Figure 4.1-1). Two of the six sample sites were historical sample locations (Sada 3 and Sada 5) selected for comparison with historical fish monitoring data from Bishop Creek.[1] The remaining four sample sites

[1] The historic Sada 3 site showed clear evidence of having become a frequently visited angling location. To minimize any potential bias resulting from angling exploitation, a site with similar habitat was selected in a more remote area downstream from the original site.

(South Fork, Middle Fork [Cardinal Village], Intake 4, and Intake 5) were selected to assess fish species distribution. The locations of these sample sites specifically targeted suitable habitat for Owens sucker and Owens speckled dace, primarily considering low channel gradients, smaller substrates (i.e., South Fork and Cardinal sites), or availability of large pool habitat (i.e., Intake 4 and Intake 5 sites) (Figure 4.1-1). Sample sites were selected based on habitat characteristics in consultation with CDFW and the U.S. Forest Service (USFS) during study plan development.

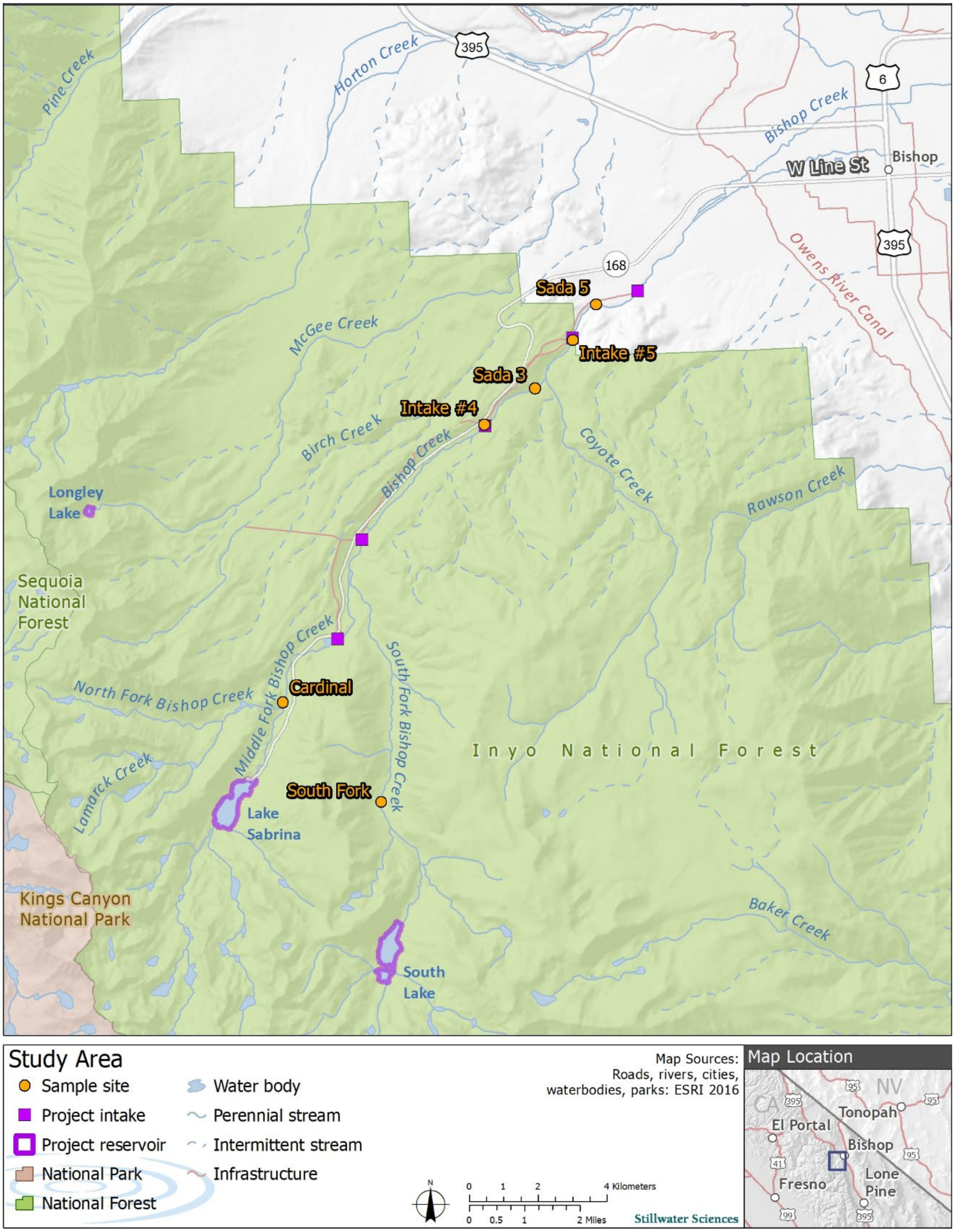


Figure 4.1-1. Stream Fish Distribution Sample Sites

5.0 METHODS

5.1 FISH SAMPLING

Fish surveys were conducted from September 22–26, 2019. Stream sampling methods included multiple-pass depletion backpack electrofishing at the Sada 5 and Sada 3 sample sites, gill netting at Project intakes, and single-pass backpack electrofishing at the South Fork and Cardinal sample sites (Table 5.1-1). All sites were sampled to assess fish species composition, distribution, and fish condition. The Sada 5 and Sada 3 sample sites were also sampled to estimate abundance for comparison with historical monitoring data. Relative abundance was summarized as percent composition using the total count of fish observed at each sample site. Fish age class structure was assessed at stream sample sites using backpack electrofishing. Length-frequency histograms were developed for all fish species captured at each sample site. Breaks or modalities within the histogram for each trout species were evaluated to determine approximate age classes. Fish scales were taken on-site from approximately 50 fish (rainbow trout and/or brown trout) of different age classes and were aged by CDFW staff. Historical fish age data collected from Bishop Creek (Walsh and Williams 1991)[2] were plotted along with length-frequency and scale ages from this study.

Sample methods are summarized by location in Table 5.1-1. Photographs of habitat conditions and block net locations are provided in Appendix A.

[2] The age class system used in Walsh and Williams (1991) did not include young-of-the year YOY fish but considered brown trout ranging from 36 mm to 103 mm as age 1+ fish. To convert the age class system used in Walsh and Williams (1991) to match the age class system in this report the following updates were made: age 1+ fish are referred to as YOY, age 2+ fish are referred to as age 1+, and age 3+ fish are referred to as age 2+.

Table 5.1-1 Sample Site Locations and Sampling Dates during the September 2019 Survey

Sample Site Name	Site Description	Location (UTM NAD 83)[a]		Sample Method	Survey Dates	Sampling Rationale
		Easting	Northing			
Sada 5	Bishop Creek downstream of Intake 5	367749	4132748	Multiple-pass depletion backpack electrofishing	9/22–23/2019	Document species distribution, abundance, fish condition, and age class structure for comparison with historical monitoring data
Sada 3[b]	Bishop Creek upstream of Coyote Creek	365839	4130446	Multiple-pass depletion backpack electrofishing	9/26/2019	Document species distribution, abundance, fish condition, and age class structure for comparison with historical monitoring data
Intake 4	Margin and open water lentic habitat	364306	4129497	Gill netting	9/24/2019	Document species distribution and fish condition
Intake 5	Margin and open water lentic habitat	367006	4131759	Gill netting	9/25/2019	Document species distribution and fish condition
Cardinal	Middle Fork Bishop Creek downstream of Lake Sabrina	357978	4121838	Single-pass backpack electrofishing	9/24/2019	Document species distribution, fish condition, and age class structure
South Fork	South Fork Bishop Creek downstream of South Lake	360580	4118679	Single-pass backpack electrofishing	9/25/2019	Document species distribution, fish condition, and age class structure

[a] UTM is a coordinate system (universal transverse Mercator) NAD83 is the North American Datum 1983 geodetic reference system.

[b] Sample site was relocated from the historical location.

5.1.1 Single-Pass Electrofishing

Single-pass electrofishing was conducted at Middle Fork (Cardinal) and South Fork Bishop Creek (South Fork) sample sites. One representative segment 196-feet-long was sampled at South Fork due to uniform channel conditions, whereas four segments totaling 387 feet were sampled at Cardinal to capture variable channel conditions, including pool, riffle, run, and side-channel habitats.

Block nets were used to section sites and/or stream segments to prevent migration in and out of the sample site and to increase capture probabilities. Two biologists with Smith-Root LR-24 backpack electrofishers and three netters began electrofishing at the downstream block net and proceeded upstream. A single pass through each segment was made by the electrofishing crew. As fish were captured (netted), they were placed in buckets with aerated stream water and periodically transferred to a live-car until the completion of the pass. The captured fish were processed upon completion of each pass. Fish data recorded included species identification, total length, (FL; mm), and weight (grams [g]). At each sample site, scale samples were collected from up to 20 brown trout distributed across each 50 mm size increment greater than 100 mm. Scales were taken from the fish's left side below the dorsal fin and above the lateral line, and then placed in individually labeled envelopes. Using the same methods, scale samples were collected opportunistically from other trout species captured including rainbow trout and brook trout. Scales were later analyzed by CDFW in their Bishop laboratory to characterize age/size class.

5.1.2 Gill Netting

Gill netting was conducted at sample sites in Intake 4 and Intake 5. A single gill net approximately 80-feet-long with variable mesh sizes ranging from 0.75 inch to 2.50 inches was deployed in each intake. The net was deployed perpendicular to the shoreline with one end attached to the shore and the other end anchored in deeper water. The gill net was deployed in Intake 4 for a single 13-hour period spanning from evening until morning. At Intake 5, the gill net was deployed for a 9-hour period from morning until evening; however, because no fish were captured during the initial set, the gill net was redeployed for a 14-hour period from evening through morning. All fish captured were processed as previously described.

5.1.3 Multiple-Pass Electrofishing

Multiple-pass depletion backpack electrofishing, following procedures described by Reynolds (1996), was conducted at two sample sites (Sada 5 and Sada 3) for comparison to historical fish monitoring data from Bishop Creek. Each site was approximately 393-feet-long. To repeat methods used during historical monitoring efforts, each sample site was divided into five segments. Block nets were installed at the upstream and downstream ends of each segment to prevent migration in and out of the sample site and to facilitate an accurate assessment of sample populations.

Two biologists with Smith-Root LR-24 backpack electrofishers and three netters began at the downstream block net and proceeded upstream. As fish were captured (netted), they were placed in buckets with aerated stream water and periodically transferred to a live-car until the completion of the pass. Upon completion of each pass, all captured fish were processed as previously described. After processing, fish were held in a live-car outside the boundary of the segment until the completion of the final pass. Once the fish from the final pass were processed, all fish were returned to the segment. A minimum of three passes were conducted within each segment. If there was poor depletion after three passes, a fourth pass was performed.

Trout abundance, density, and biomass were calculated for sites sampled using multiple-pass electrofishing. Abundance was calculated as the total number of fish captured at each site. Density and biomass estimates were calculated for each segment and then averaged over the entire sample site for brown trout and for all trout species combined. Multiple-pass depletion values were analyzed using the MicroFish V. 3.0 software package (Van Deventer and Platts, 2006) to generate maximum-likelihood population estimates. Biomass was calculated by multiplying the average fish weight per segment by the calculated segment density and then adding all the segment values to get the total site biomass.

5.1.4 Trout Condition

Trout condition was evaluated for all trout captured. The weight-to-length relationship of individual trout was assessed as a method of identifying the nutritional state or health of the fish related to size and growth. A fish condition factor (Ricker, 1975), a measure of this nutritional state, was calculated for each trout. Individual condition factors (k) were calculated by the following formula:

$$\mathrm{k} = \frac{\text{wet weight (g)} \times 10^5}{[\text{fork length (mm)}]^3}$$

The mean condition of trout was calculated by averaging individual condition factors for each trout species at each sample site.

5.1.5 Current and Historical Brown Trout Population Data Comparison

Brown trout population data collected from the Sada 5 and Sada 3 sample sites in 2019 were compared to population data from historical monitoring sites collected between 1991 and 2010 (Sada and Rosamond 2010; Sada 2006; Sada and Knapp 1993). Brown trout density estimates from 2019 were compared to previous monitoring results using a two-tailed t-test with unequal variance to determine if 2019 density is significantly different. Biomass values from previous studies are reported as the site mean biomass and upper and lower range of values which do not allow for comparison using t-tests.

5.2 Habitat Conditions

Habitat descriptors and physical habitat measurements were recorded at each sample site. Each segment was characterized by habitat type (e.g., pool, run, or riffle). The length of each segment was measured along the thalweg to the nearest tenth of a meter, and the mean width of each sampling segment was calculated by measuring the width of the wetted channel to the nearest tenth of a meter at six or more evenly spaced transects. The area of each sampling segment was calculated by multiplying the site length by mean width. The approximate maximum depth and the estimated discharge of the sample site were recorded. Substrates and fish cover were visually estimated at each sample site. Water temperature, dissolved oxygen (DO), pH, electrical conductivity, and specific conductance were measured using a YSI™ Pro Plus multi-parameter meter at the time of sampling.

5.3 MODIFICATIONS TO METHODS

As noted above, the historic Sada 3 site showed clear evidence of having become a frequently visited angling location. To minimize any potential bias resulting from angling exploitation, a site with similar habitat was selected in a more remote area downstream from the original site. No other modifications were made to this study.

6.0 RESULTS

6.1 COMPOSITION AND DISTRIBUTION

Three fish species were observed in the Bishop Creek watershed: brown trout, rainbow trout, and brook trout. No Owens suckers were observed, indicating no recruitment of this species in Bishop Creek downstream of Lake Sabrina and South Lake (Table 6.1-1). No Owens speckled dace were observed. Composition and distribution patterns appeared similar throughout the Bishop Creek watershed with brown trout being the most abundant species at all locations, and while rainbow trout were observed at all sample sites, they only accounted for a small percentage of the fish captured (Figure 6.1-1). A single brook trout was captured at Intake 5. Rainbow trout represented a larger portion of the fish species captured in Project intakes compared to the stream sample sites, but overall fish capture numbers were relatively low in the intakes, likely due to the different sampling methods (i.e., gill net versus single-pass and multiple-pass electrofishing). During 2019, rainbow trout in the “catchable” size range (roughly 12 inches) were stocked throughout the study area, including in Bishop Creek, Middle Fork Bishop Creek, and South Fork Bishop Creek (CDFW 2019).

Table 6.1-1 Fish Species Capture Totals by Sample Site during the September 2019 Survey

Fish species (common name)	Sada 5	Sada 3	South Fork	Cardinal	Intake 4	Intake 5
Brown trout	186	103	45	145	2	7
Rainbow trout	8	10	3	1	1	4
Brook trout	0	0	0	0	0	1
Total	**194**	**113**	**48**	**146**	**3**	**12**

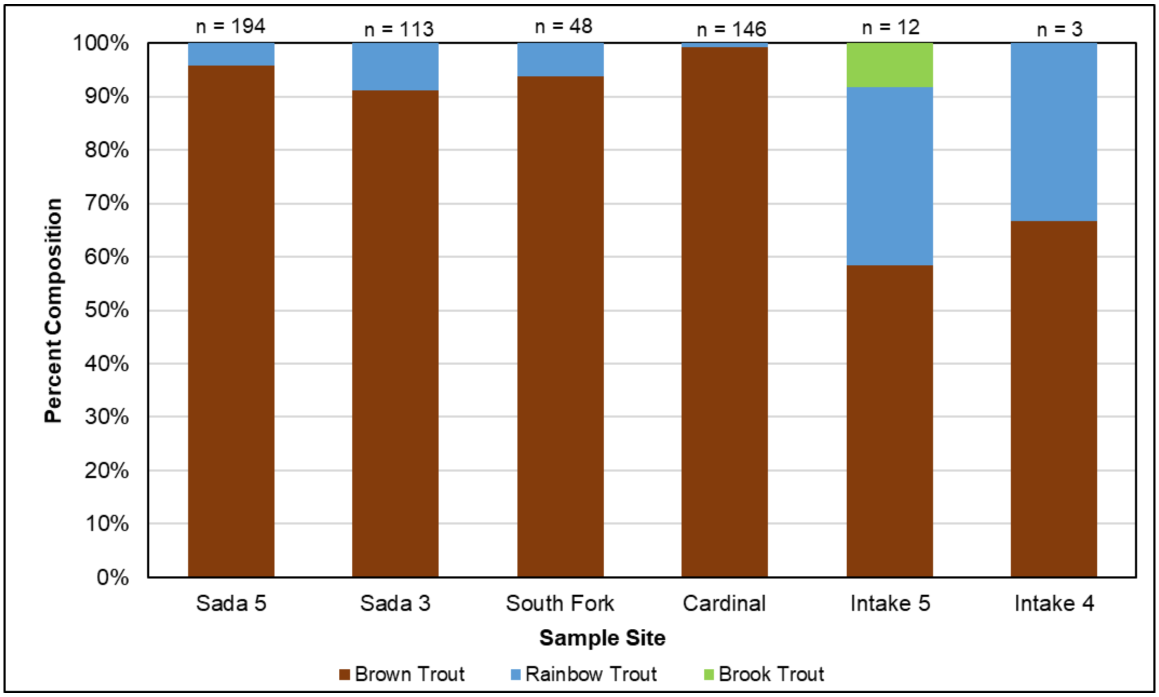


Figure 6.1-1. Fish Species Composition Observed in the Bishop Creek Watershed during September 2019 Survey

6.2 Abundance, Density, and Biomass

Of the two sites sampled using multiple-pass electrofishing, trout abundance was higher at the Sada 5 sample site; however, biomass was greater at the Sada 3 sample site. Brown trout, the most abundant species at both sites, were the primary driver of the population estimates. Trout abundance, density, and biomass in Bishop Creek at the Sada 5 and Sada 3 sample sites are summarized by site in Table 6.2-1 and Figure 6.2-1. Trout abundance and biomass are presented by segment in Appendix C, and individual fish data are provided in Appendix D.

Table 6.2-1 Trout Population Abundance, Estimated Density, and Estimated Biomass at the Sada 5 and Sada 3 Sample Sites, September 2019

Sample site	Site length (m)	Average width (m)	Trout species	Number captured	Biomass (g/m^2)			Density (Trout per mile)		
					Est.	Lower 95% C.I.	Upper 95% C.I.	Est.	Lower 95% C.I.	Upper 95% C.I.
Sada 5	122	6.3	Rainbow	8	0.13	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	186	5.72	3.89	7.55	2,889	2,032	3,745
			All Trout	194	5.85	5.06	6.65	2,983	2,220	3,747
Sada 3	123	5.1	Rainbow	10	1.58	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	103	9.08	2.46	15.70	1,354	1,222	1,485
			All Trout	113	10.58	4.00	17.16	1,486	1,334	1,637

CI= Confidence Interval

[a] Depletion pattern and low capture numbers for rainbow trout did not allow for density estimates.

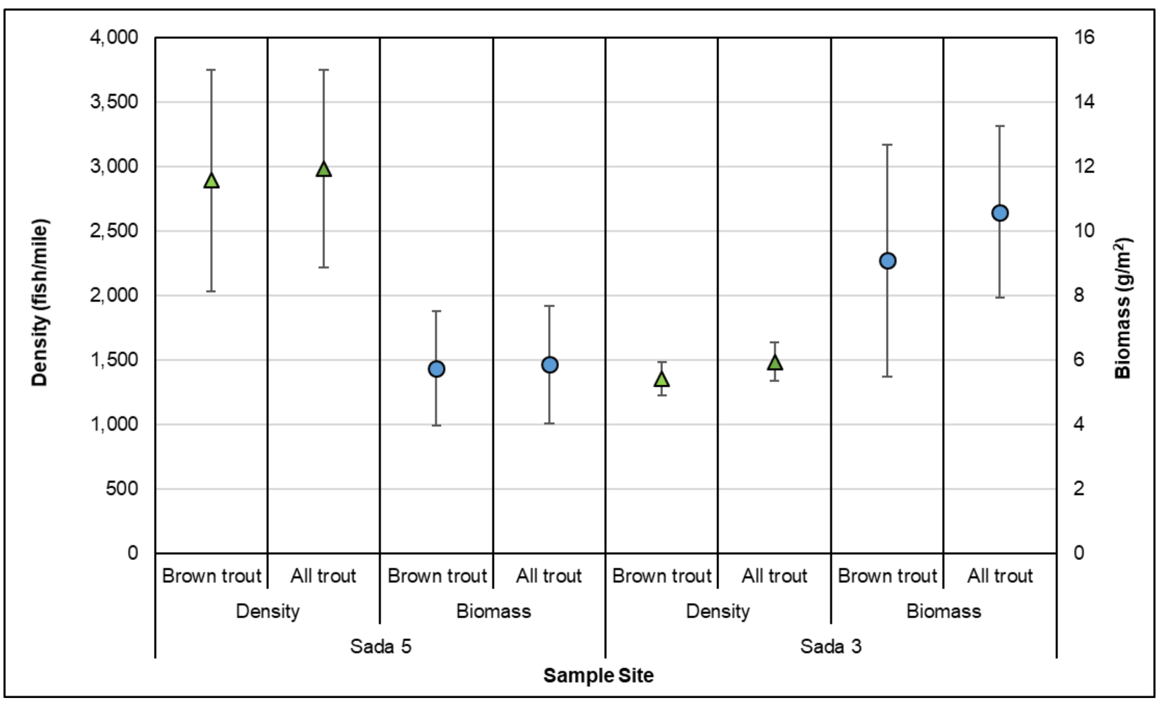


Figure 6.2-1. Estimated Density and Biomass (with 95% confidence intervals) for Brown Trout and All Trout at the Sada 5 and Sada 3 Sample Sites, September 2019

6.3 Age Class Distribution

During the 2019 sampling effort, brown trout were observed at each sampling location with most fish ranging from young-of-year (YOY) up to age 3+ with a few older fish observed. Both sites had fish as old as 4+; the Sada 3 sample site had brown trout as old as 7+. Length-at-age size ranges based on scale analysis, length frequency distribution, and previously reported values are presented in Table 6.3-1. Ranges of fish lengths for each age class during this study were narrower than the values provided in Walsh and Williams (1991) (Table 6.3-1 and Figure 6.3-1 through Figure 6.3-5).

Table 6.3-1 Trout Age Based on Length Frequency Histograms and Scale Analysis

Fish Species	Age	Fork Length Range Based on 2019 Scale Analysis (mm)[a]			Fork Length Range Based on Length-Frequency Nodes (mm)[b]	Fork Length Range Reported in Walsh and Williams (1991) (mm)[c]
		Sada 5	Sada 3	Cardinal		
Brown Trout	YOY	--[d]	100	--[d]	< 120	36–103
	1+	100–112	97–100	107–149	90–170	87–219
	2+	178–248	140–172	137–236	130–220	136–327
	3+	250	150–204	167–182	180–250	--
	4+	240	199	--[d]	210–290	--
	5+	--[d]	198–270	--[d]	>290	--
	6+	--[d]	--[d]	--[d]	--	--
	7+	--[d]	289	--[d]	--	--
Rainbow Trout	YOY	--[d]	--[d]	--[d]	--	--
	1+	--[d]	--[d]	--[d]	--	--
	2+	--[d]	170–176	--[d]	--	--
	3+	--[d]	147–174	--[d]	--	--
	4+	--[d]	--[d]	--[d]	--	--
	5+	--[d]	233	--[d]	--	--
	6+	--[d]	--[d]	--[d]	--	--
	7+	--[d]	--[d]	--[d]	--	--
	8+	--[d]	--[d]	285	--	--

[a] Fish were not aged from scales collected at the South Fork, Intake 4, or Intake 5 sample sites.

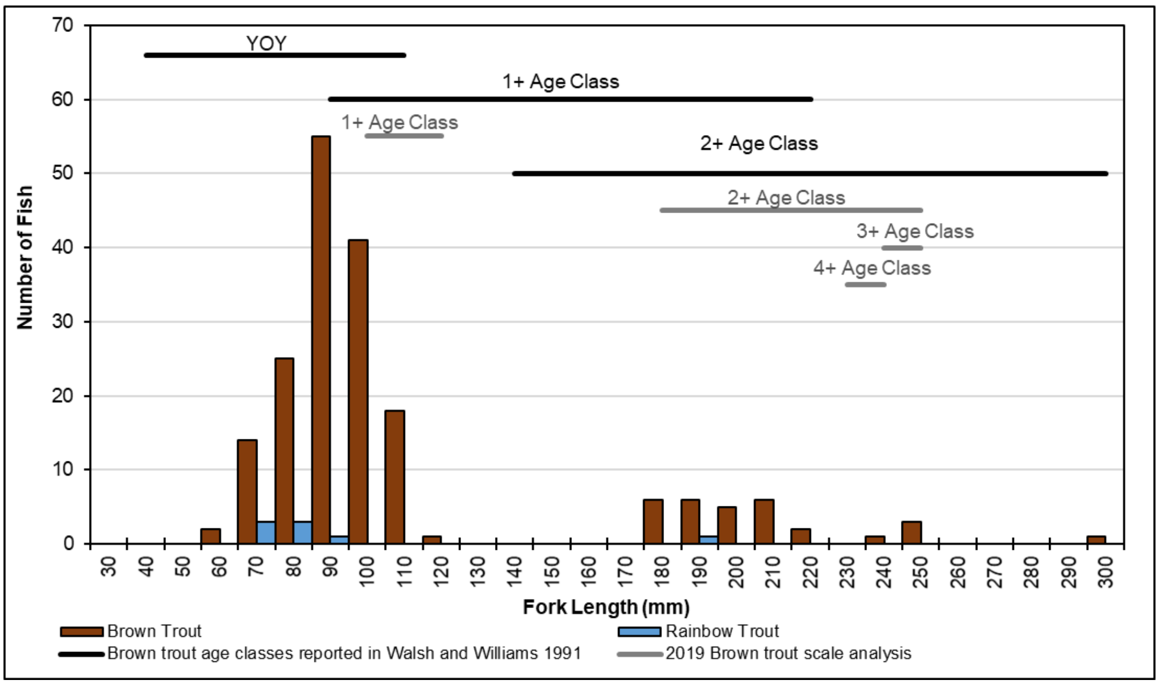
[b] Distinct nodes were not apparent on the length frequency distribution for brown trout longer than 290 mm FL or for rainbow trout of any size due to low numbers captured.

[c] Brown trout age class data in Walsh and Williams (1991) included YOY, age 1+ and age 2+; no rainbow trout ages were reported.

[d] Scales were not aged from fish in this size class (N. Buckmaster, CDFW, *personal communication*).

Brown trout captured at the Sada 5 sample site were predominately smaller fish, less than 110 mm FL. Although no scales were aged from brown trout less than 100 mm FL at the Sada 5 sample site, they are expected to fall within the YOY age class based on the length-frequency distribution and scale age data reported in Walsh and Williams (1991). Brown trout within the age 1+ and age 2+ age classes were common but in lower numbers than the YOY age class. A few brown trout longer than 220 mm FL were captured and likely fall within the age 2+ through age 4+ range. The overlap in fish lengths at specific age classes is typically due to variability in individual fish growth rates and is fairly common, especially for older age classes. The greater fish length assigned to age 3+

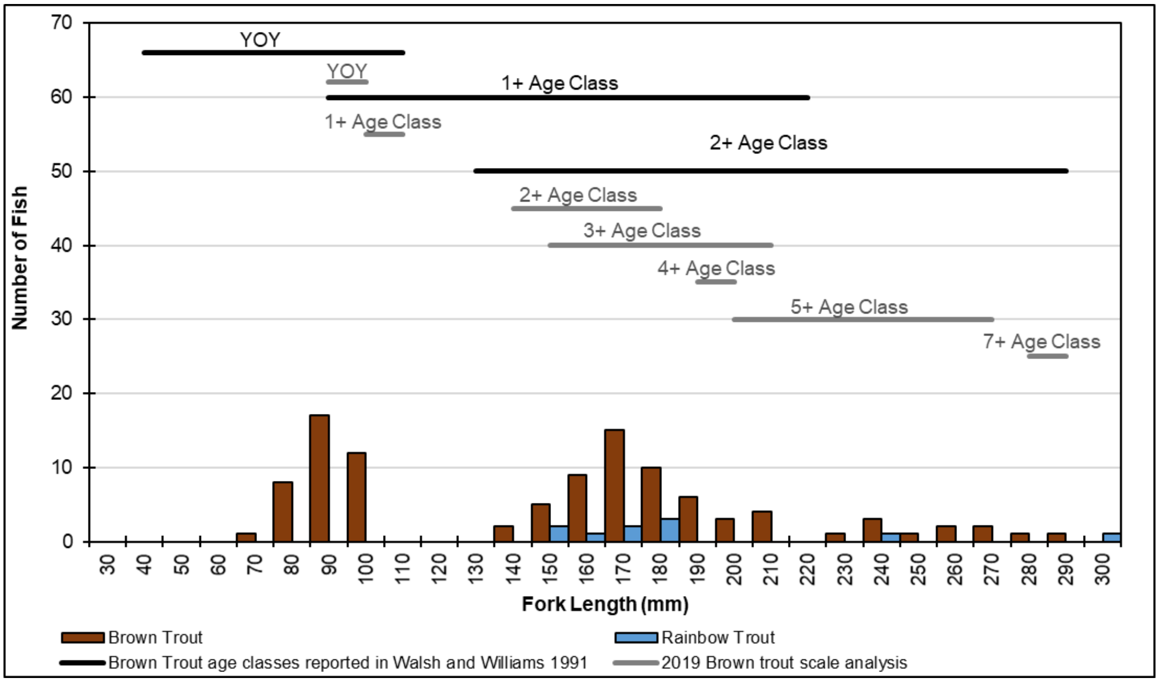
brown trout compared to age 4+ brown trout is likely due to age-class size overlap and the small sample size of scales analyzed from fish in both age classes (n = 1). The largest brown trout captured at the Sada 5 sample site was 299 mm FL and was likely age 5+ or older. The gap in sizes of brown trout observed between 120 mm and 180 mm at the Sada 5 sample site (Figure 6.3-1) may indicate unfavorable 2018 environmental conditions that limited fish survival or growth or delayed the spawning season. Multiple age classes of brown trout and a high abundance of young fish suggest that brown trout are successfully reproducing within this segment of Bishop Creek. The low number of rainbow trout captured at the Sada 5 sample site did not allow for identification of specific age classes; however, the large range in sizes observed suggest at least two age groups were observed (Figure 6.3-1). Rainbow trout less than 100 mm FL observed at the Sada 5 sample site suggest that a small population of rainbow trout is reproducing in this section of Bishop Creek.



Source: Walsh and Williams 1991

Figure 6.3-1. Length-frequency and Age Class Structure of Trout Species Captured at the Sada 5 Sample Site by Electrofishing in September 2019 Compared to Brown Trout Age Classes Identified in 1991

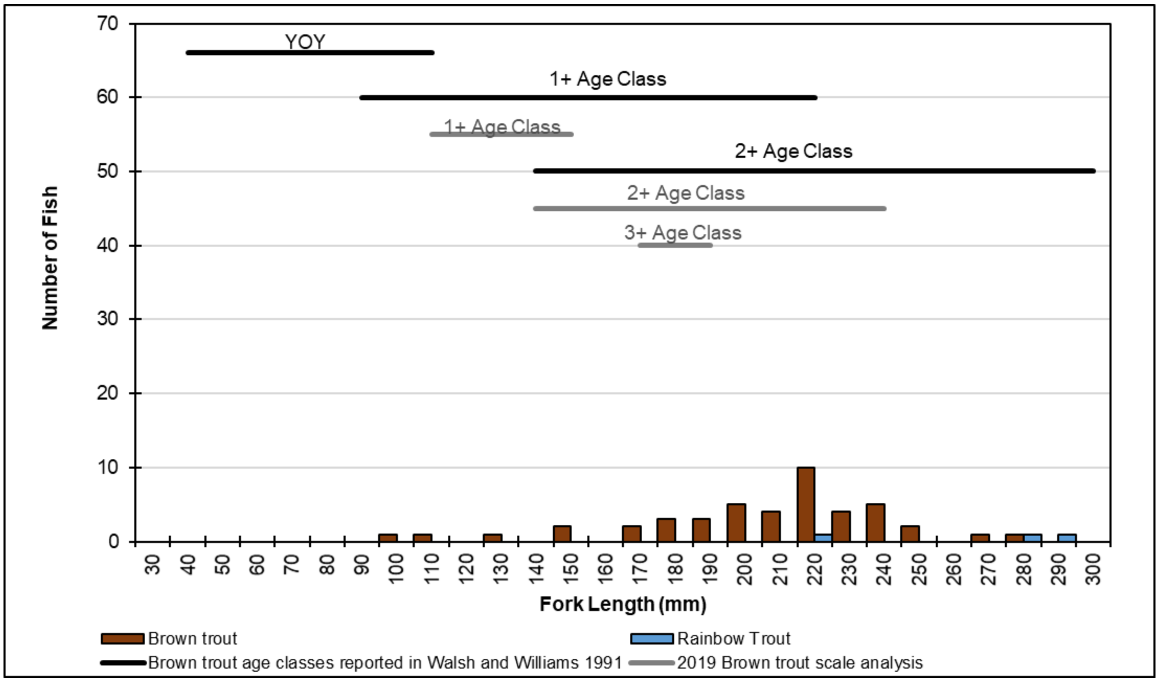
At the Sada 3 sample site, brown trout were fairly evenly distributed within the YOY through age 3+ age classes with lower abundance of larger fish from age 4+ and 5+ (Figure 6.3-2). A single fish was estimated to be age 7+ based on scale analysis suggesting that brown trout older than age 5+ are rare within this section of Bishop Creek (Figure 6.3-2). As previously discussed, the overlap in fish lengths at specific age-classes is typically due to variability in individual fish growth rates and becomes more apparent for older age classes. Rainbow trout captured at the Sada 3 sample site were between the 2+ and 6+ (or older) age classes (Figure 6.3-2).



Source: Walsh and Williams 1991

Figure 6.3-2. Length-frequency and Age Class Structure of Trout Species Captured at the Sada 3 Sample Site by Electrofishing in September 2019 Compared to Brown Trout Age Classes Identified in 1991

Scales collected from fish at the South Fork sample site revealed signs of regeneration and/or damage and were therefore considered unreliable for aging. The length-frequency distribution for the South Fork sample site shows very few brown trout in the presumptive YOY and 1+ age classes relative to older age classes, which is atypical for trout populations (Figure 6.3-3). The skewed age-class distribution is likely an artifact of the unique habitat conditions (i.e., slow, deep water with sand and gravel substrate) that are more suitable for adult brown trout but less suitable for YOY brown trout, which are typically associated with shallow water and rocky substrate (Raleigh et al. 1986). Based on scale analyses from the Cardinal sample site, most brown trout at the South Fork sample site were likely within the age 2+ to age 3+ range. The narrow range of lengths assigned to age 3+ brown trout that falls within the length range for age 2+ brown trout is likely due to the small sample size of scales analyzed from age 3+ brown trout (n = 2) and the potential for variable growth between age-classes.

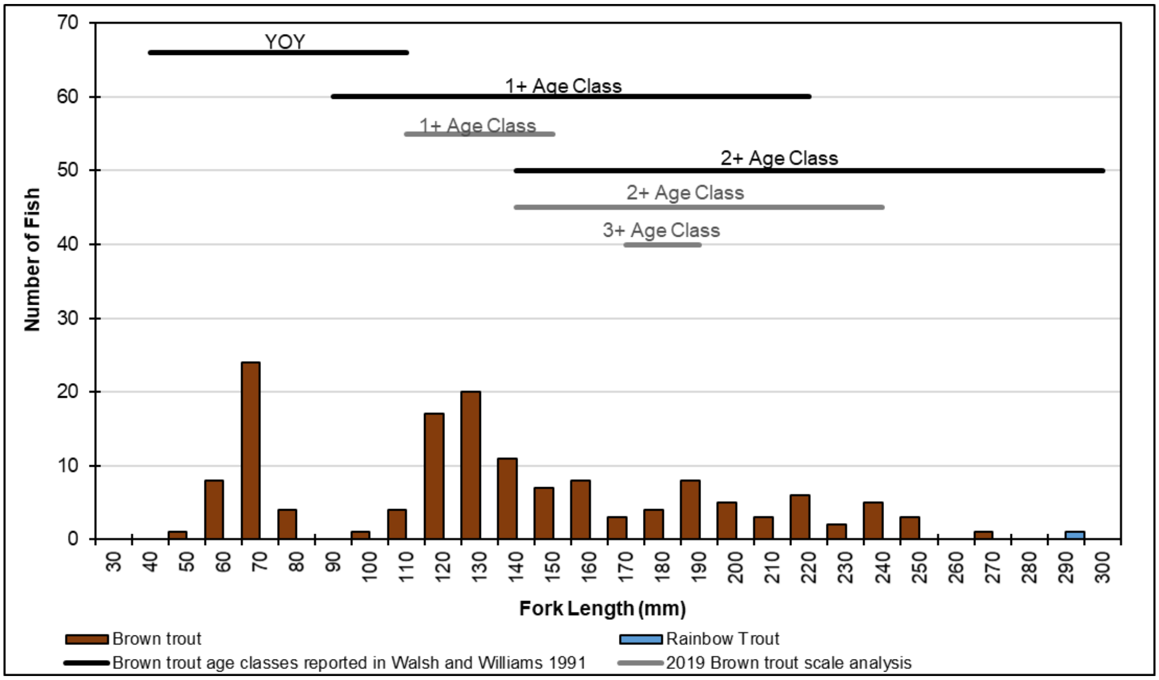


Source: Walsh and Williams 1991

Notes: Scales were not aged from fish at the South Fork sample site; scale analyses shown are based on ages from fish captured at the Cardinal sample site.

Figure 6.3-3. Length-frequency and Age-class Structure of Trout Species Captured at the South Fork Sample Site by Electrofishing in September 2019 Compared to Brown Trout Age Classes Identified in 1991

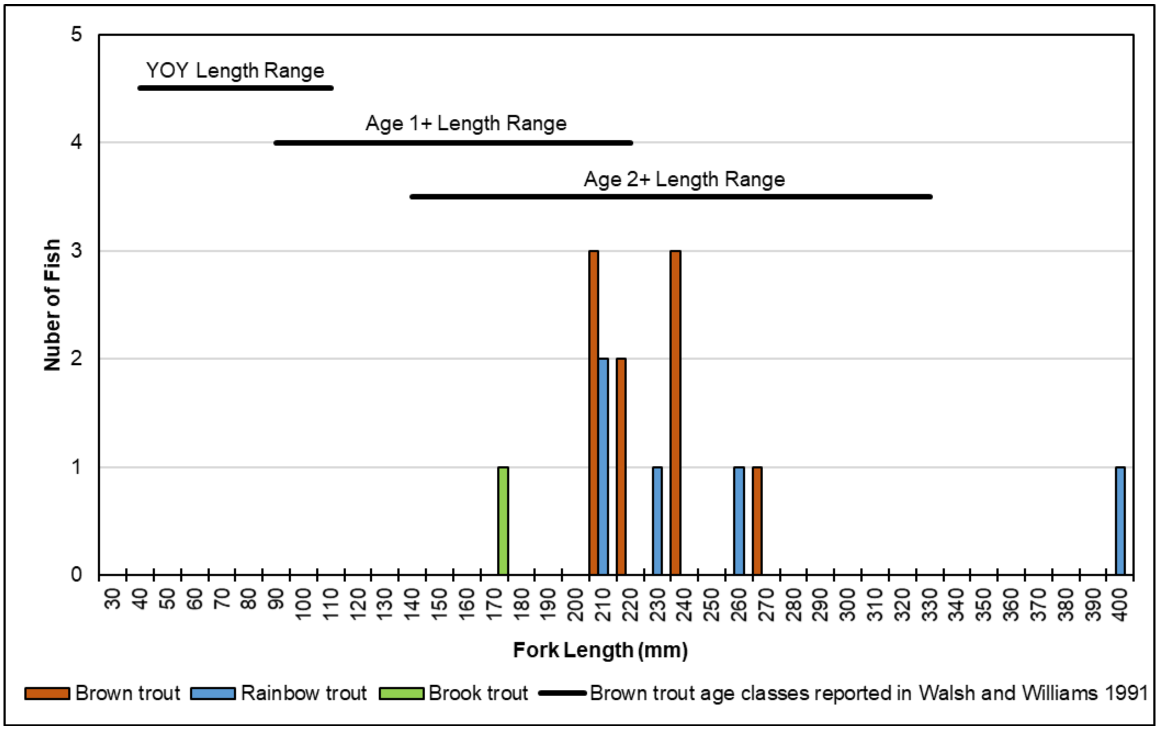
At the Cardinal sample site, brown trout estimated to fall within the YOY age class were observed in relatively high numbers, with lower numbers of brown trout through age 4+ (Figure 6.3-4). The single rainbow trout captured at the Cardinal sample site was estimated to be age 8+. The overall length distribution for brown trout at the Cardinal sample site suggests multiple age classes indicative of a self-supporting population of brown trout.



Source: Walsh and Williams 1991

Figure 6.3-4. Length-frequency and Age-class Structure of Trout Species Captured at the Cardinal Sample Site by Electrofishing in September 2019 Compared to Brown Trout Age Classes Identified in 1991

Lengths of brown trout captured in Project intakes ranged from approximately 160 mm FL to 400 mm FL. Scales collected from fish in Intake 4 and Intake 5 revealed signs of regeneration and/or damage and were therefore considered unreliable for aging. Based on ages observed from other locations in the Bishop Creek watershed, fish captured in Project intakes likely ranged from age 1+ up to age 5+ or older (Figure 6.3-5). Gill netting was selective for fish longer than approximately 100 mm; therefore, the fish lengths observed may not be representative of the true fish size and age distribution in these locations and cannot be compared to creek sites where samples were obtained by electrofishing.



Source: Walsh and Williams 1991

Figure 6.3-5. Length-frequency and Age-class Structure of Fish Species Captured by Gill Netting in Project Intakes in September 2019, Compared to Brown Trout Age Classes Identified in 1991

6.4 Fish Condition

Site-specific mean condition factors (k-values) of trout sampled at all sites in 2019 ranged from 0.92 to 1.21[3], indicating that trout were generally in good condition (Table 6.4-1).

[3] Condition factors in western Sierra Nevada streams typically range from 0.8 to 2.0, with a mean condition factor generally 1.2 or below (Beak 1991; EA 1987; Ebasco Environmental 1993; Wilcox 1994; Hanson Environmental 2005), while Rabe (1967) reported the condition factor to be between 0.9 and 1.1 for rainbow trout in Alpine lakes. Arismendi et al. (2011) cites broader ranges (0.5 to 2.0); however, condition is dependent on the sampling season, species, strain of trout, state of sexual maturity, and the way fish length is defined (e.g., fork length, total length, or standard length), which is not often documented with the results.

Table 6.4-1 Trout Condition (k-value) Calculated for Fish Captured September 2019

Stream	Sample site	Trout species	(n)	Mean k-value	k-value range
Bishop Creek	Sada 5	Rainbow	8	1.10	0.83–1.30
		Brown	186	1.08	0.78–1.31
	Sada 3	Rainbow	10	1.03	0.93–1.10
		Brown	103	0.97	0.79–1.13
	Intake 5	Brook	1	0.95	0.95
		Rainbow	4	0.98	0.92–1.05
		Brown	7	1.00	0.92–1.08
	Intake 4	Rainbow	1	1.21	1.21
		Brown	2	1.12	1.09–1.16
Middle Fork Bishop Creek	Cardinal	Rainbow	1	0.94	0.94
		Brown	145	0.92	0.65–1.14
South Fork Bishop Creek	South Fork	Rainbow	3	1.09	1.01–1.21
		Brown	45	0.96	0.75–1.70

6.5 Current and Historical Brown Trout Population Data Comparison

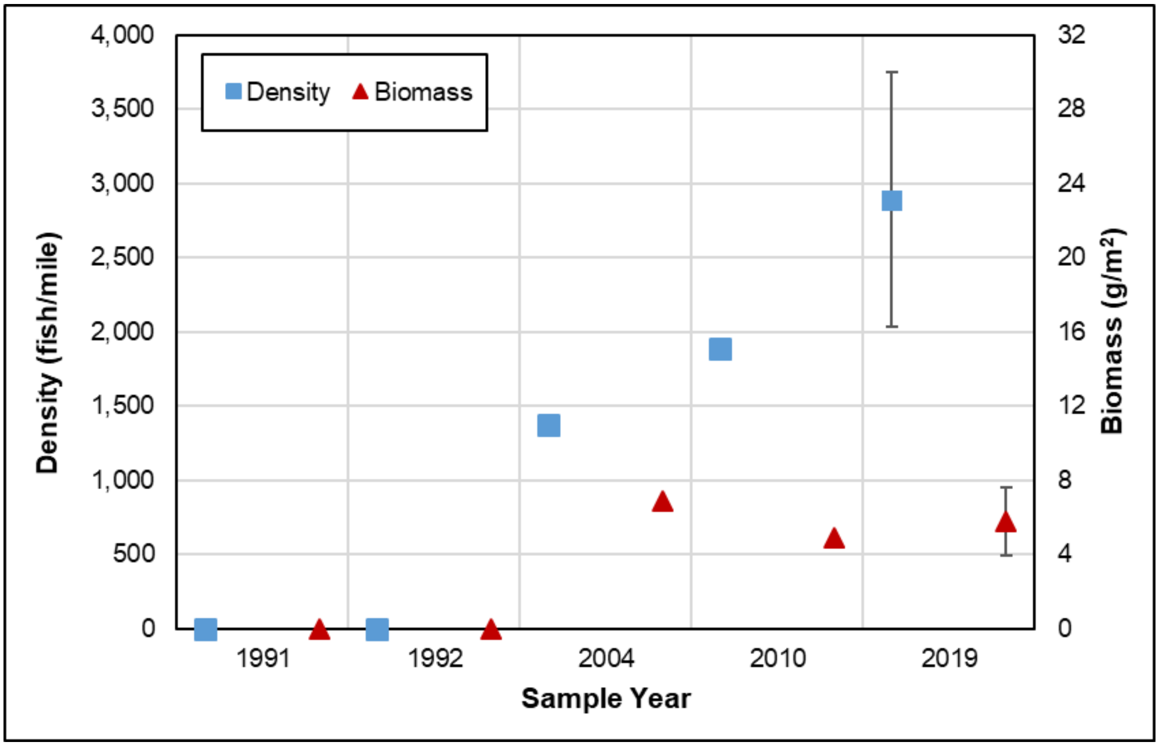
6.5.1 Abundance and Biomass

The estimated density for brown trout in Bishop Creek at the Sada 5 sample site during 2019 was significantly higher (P=0.045) than in all previous years, while biomass was within the range of prior years (Table 6.5-1 , Figure 6.5-1). The Sada 5 site was dry during 1991 and 1992 monitoring efforts, so no fish were captured (Sada 2006). At the Sada 3 sample site, the estimated density and biomass for brown trout during 2019 were higher than in 2010 but lower than in previous years (Figure 6.5-2); however, no significant difference was detected between any of the estimated densities at this site during these sample years (Table 6.5-1).

Table 6.5-1 Results from Two-tailed T-tests with Unequal Variances Comparing Density Estimates at Sada 5 and Sada 3 for 2019 and Previous Monitoring Efforts

Sample years	P-values	
	Sada 5	Sada 3
2019 and 2010	0.015	0.221
2019 and 2004	0.045	0.504
2019 and 1992	n/a [a]	0.265
2019 and 1991	n/a [a]	0.275

[a] This location was dry during 1991 and 1992, so no fish were captured during those years.
Note: Light grey highlight indicates significant differences at α = 0.05.



Note: This location was dry during 1991 and 1992, so no fish were captured during those years

Figure 6.5-1. Brown Trout Estimated Density and Biomass (with 95% confidence intervals) at the Sada 5 Sample Site during 2019 and Previous Studies

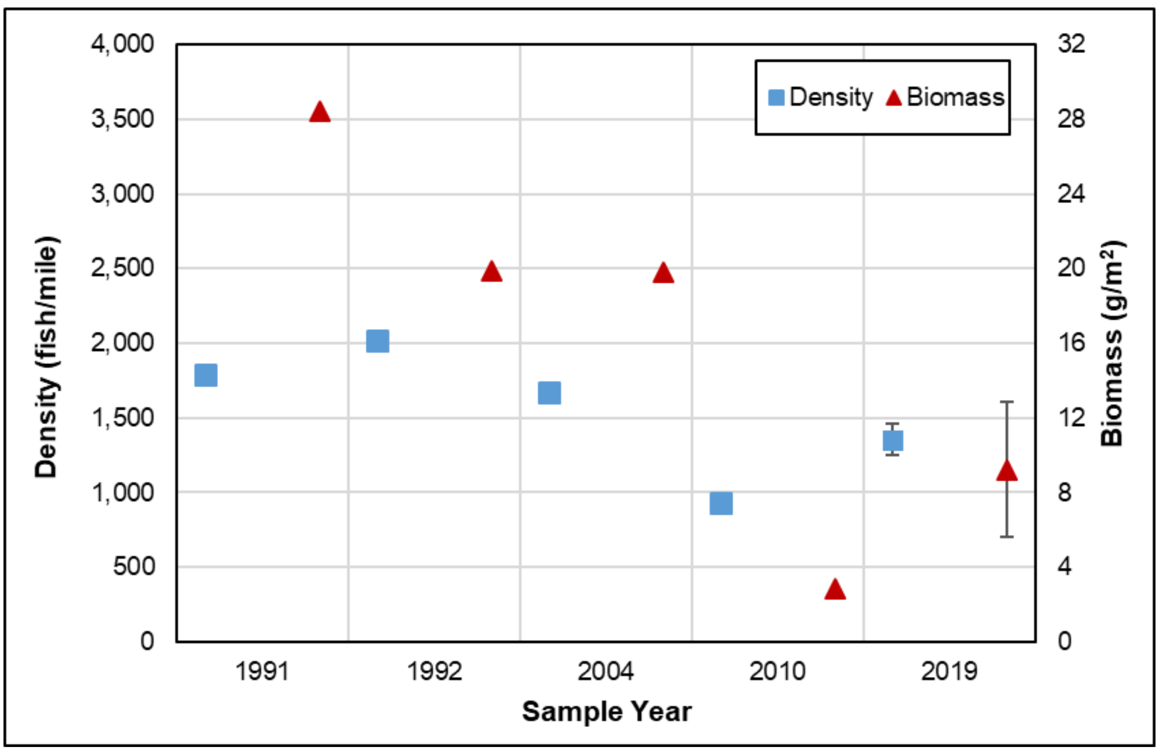


Figure 6.5-2. Brown Trout Estimated Density and Biomass in Bishop Creek at the Sada 3 Sample Site during 2019 (with 95% Confidence Intervals) and Previous Studies

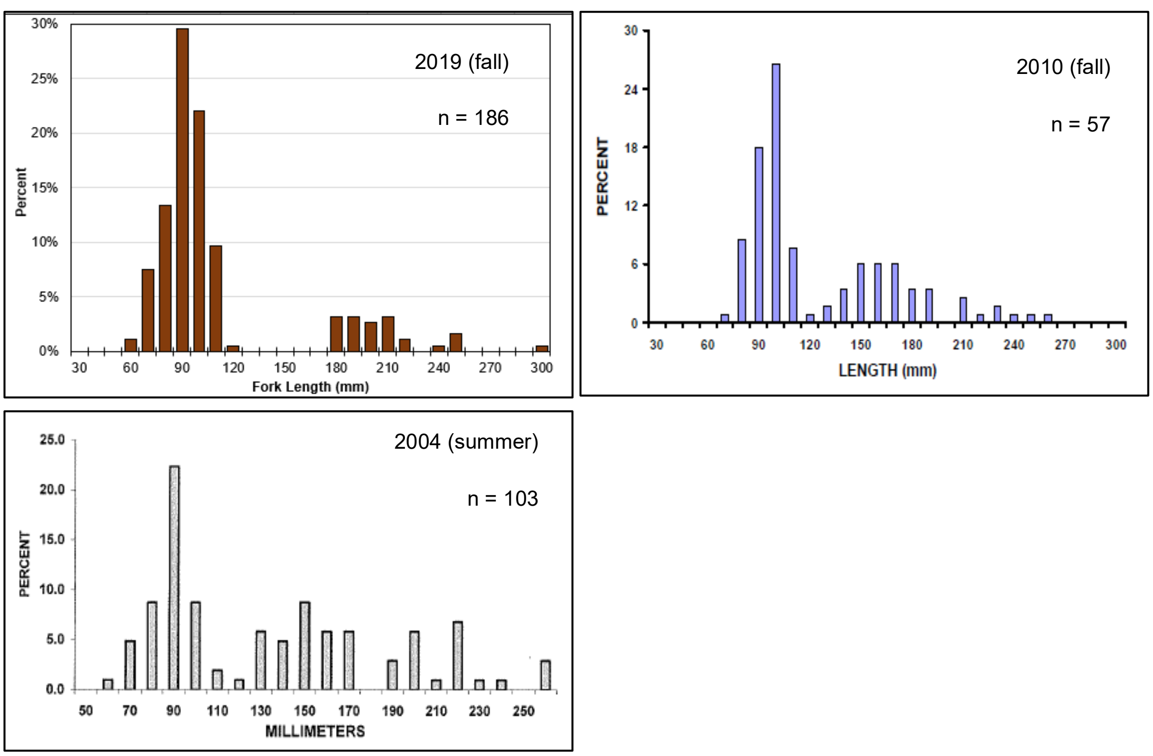
6.5.2 AGE CLASS DISTRIBUTION AND FISH CONDITION

On average, brown trout captured at the Sada 5 sample site during 2019 were slightly smaller than fish captured during the two previous survey years, whereas brown trout captured at the Sada 3 sample site during 2019 were slightly larger than fish captured during previous years (Table 6.5-2). The age-class distribution of brown trout in Bishop Creek at the Sada 5 sample site appeared similar across all sample years, showing a typical length-frequency distribution where YOY have the highest abundance followed by fewer of each subsequent age class, reflecting attrition due to natural mortality and angling exploitation (Figure 6.5-3). Length-frequency histograms for the Sada 3 sample site show a more typical distribution for brown trout in 2019, whereas length-frequency histograms from previous monitoring years had a higher proportion of older age classes indicative of lower recruitment (Figure 6.5-4).

Table 6.5-2 Average Brown Trout Length and Weight for the Sada 5 and Sada 3 Sample Sites during 2019 and Previous Studies in Bishop Creek

Sample year and season	(n)	Mean fork length (mm)	Range (mm)	Average weight (g)	Range (g)
Sada 5					
2019 Fall	186	106.2	53–299	23.3	1.8–326.8
2010 Fall	117	121.4	67–259	29.3	3.2–165.6
2004 Summer[a]	103	130.6	54–263	24.4	1.2–127.1
1991 and 1992[b]	--	--	--	--	--
Sada 3					
2019 Fall	103	147.9	66–289	51.8	3.6–235.4
2010 Fall	57	127.8	70–287	29.8	4.1–179.0
2004 Summer[a]	130	132.0	77–205	49.6	7.5–152.5
1991 Fall	120	147.5	73–250	38.5	4.7–100.5
1992 Fall	143	135.4	69–213	32.5	3.7–101.9

[a] The Sada 5 and Sada 3 sample sites were not sampled during the fall of 2004 due to high flows.
[b] The Sada 5 sample site was dry during the 1991 and 1992 monitoring efforts.



Note: Brown trout were not observed at the Sada 5 sample site during 1991 and 1992 when the stream channel was dry.

Figure 6.5-3. Brown Trout Length-frequency Distribution at the Sada 5 Sample Site Based on Fork Length

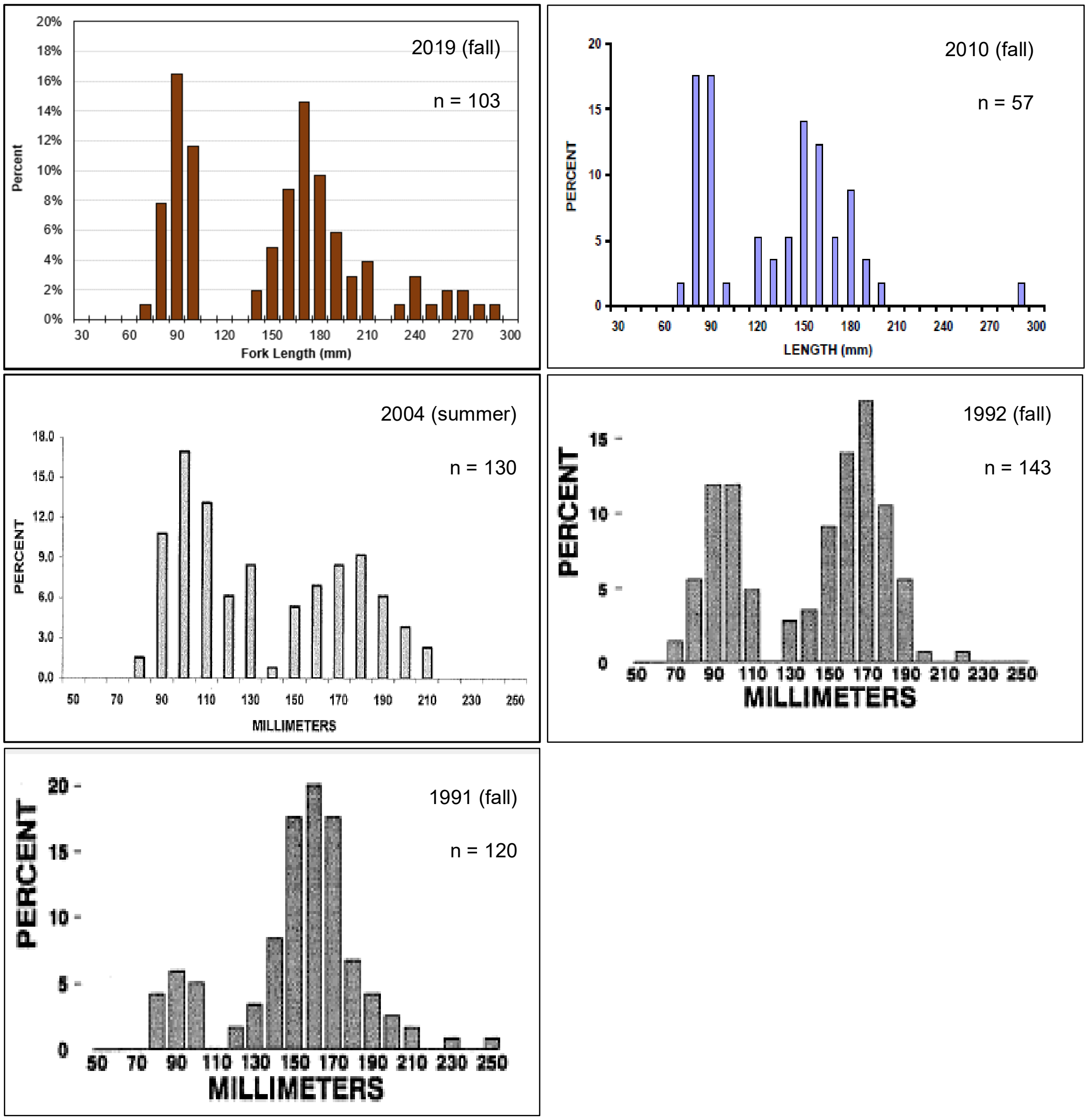


Figure 6.5-4. Brown Trout Length-frequency Distribution at the Sada 3 Sample Site Based on Fork Length

The average fish condition was similar across years at both the Sada 5 and Sada 3 sample sites (Table 6.5-3).

Table 6.5-3 Brown Trout Condition at the Sada 5 and Sada 3 Sample Sites during 2019 Compared to Historic Values

Sample period	(n)	Mean condition
Sada 5		
September 2019	186	1.090
Fall 2010	117	0.990
Summer 2004	130	0.999
Fall 1991–1992[a]	0	--
Sada 3		
September 2019	103	0.970
Fall 2010	57	0.980
Fall 2004	103	0.998
Fall 1991	120	0.98
Fall 1992	143	0.99

[a] The Sada 5 sample site was dry during 1991 and 1992 sampling efforts.

6.6 Habitat Conditions

General habitat conditions in the Bishop Creek watershed are summarized by sample site in Table 6.6-1 . Habitat condition data and water chemistry are provided in Appendix B. Riffle was the dominant habitat type at most stream sample sites except for South Fork, which primarily contained run habitat. The Sada 5 and Sada 3 sample sites had larger substrates (boulder and cobble) than the South Fork and Cardinal sample sites (cobble, gravel, and sand).[4] Estimated stream discharge was higher at the Sada 5 and Sada 3 sample sites than at the farther upstream South Fork and Cardinal sample sites. Water quality conditions measured during the study were comparable with reported values required to maintain and enhance cold freshwater habitat for DO levels and pH (CRWQCB 1995), while water temperatures were generally colder than the optimal ranges reported for brown trout (NDEP 2017) (Table 6.6-2).

Table 6.6-1 Summary of Habitat Conditions during the September 2019 Survey

Sample Site	Habitat Type (%)			Substrate		Water Temperature (°C)	Discharge (cfs)[1]
	Pool	Riffle	Run	Dominant	Subdominant		
Sada 5	5	90	5	Boulder	Cobble	10.0	22
Sada 3	28	58	14	Boulder	Cobble	13.8	20
South Fork	20	0	80	Sand	Gravel	8.5	14
Cardinal	16	61	23	Cobble	Gravel	11.0	10

[1] Discharge values provided by Southern California Edison

[4] The Sada 5, Sada 3, Cardinal, and South Fork sites are also Instream Flow Incremental Methodology (IFIM) study sites used in the Instream Flow Needs Physical Habitat Simulation (PHABSIM) model

Table 6.6-2 Water Quality Measurements at Sample Sites during September 2019 and Optimal Ranges Reported for Brown Trout

SAMPLE SITE	DISSOLVED OXYGEN (mg/L)[a]	WATER TEMPERATURE (°C)	pH
Sada 5	9.70	9.2	7.73
Sada 3	8.62	13.8	6.98
South Fork	7.99	8.5	7.28
Cardinal	8.07	11.0	6.77
Intake 4	10.18	8.6	6.84
Intake 5	8.52	9.8	7.60
Water Quality Criteria			
	> 7.00 [b]	12–19°C [c]	6.5–8.5 [b]

[a] milligrams per liter (mg/L)

[b] CRWQCB (1995) criteria for cold freshwater habitat

[c] NDEP (2017) optimal temperature for brown trout.

7.0 DISCUSSION

7.1 FISH POPULATIONS AND DISTRIBUTION IN PROJECT-INFLUENCED STREAM REACHES

The 2019 surveys found no evidence of Owens sucker recruitment in the reaches of Bishop Creek below Lake Sabrina and South Lake. No Owens speckled dace were detected in the study area. Only three fish species were observed in the study area: brown trout and rainbow trout, which were distributed throughout Bishop Creek downstream of South Lake and Lake Sabrina, and brook trout, which had a more limited distribution. Low abundance and the lack of historic data for both rainbow trout and brook trout within the study area limited the ability to analyze these populations; therefore, overall population discussion for the study area focuses on the brown trout populations.

Comparison of the naturally reproducing brown trout populations to the levels documented at historical monitoring locations indicate that naturally reproducing brown trout populations at the Sada 5 and Sada 3 sample sites are generally consistent with levels documented during monitoring from 1991 through 2010. Overall, the brown trout population at the Sada 5 sample site appears to be stable or growing compared to previous levels. Brown trout density estimates at the Sada 5 sample site are highest for the 2019 sample year compared to previous years, and the higher density is partially driven by higher numbers of YOY fish. Fish captured at the Sada 5 sample site in 2019 had slightly higher condition factors with a broader range of sizes present compared to previous years. At the Sada 3 sample site, the brown trout population data collected during this study were generally within range of prior studies (1991–2010), although results were more variable at this site across survey years.

Based on the absence of brown trout stocking in 2019 (CDFW, 2019), presence of the YOY age class, broad age-class distribution throughout most of the study area, and presence of suitable spawning habitat at most sample sites where brown trout of reproductive age (age 3+ and 4+ [Taube, 1976]) were present, brown trout populations appear to be naturally reproducing and sustaining. Locations with multiple years of data (Sada 5 and Sada 3 sample sites) suggest that the brown trout population size is stable or increasing. Three out of the four sample sites showed high numbers of YOY fish indicating signs of recruitment. The South Fork sample site did not have high numbers of YOY, likely because the habitat conditions (i.e., the predominately sand substrate lacking escape cover) at that location were not favorable for YOY brown trout, but YOY brown trout habitat appears abundant in nearby higher gradient locations where larger substrate is available. This is likely a source of recruitment to the population of larger fish in the South Fork sample site.

Scale analysis from brown trout estimated some fish captured during this study were over 7 years old (Table 6.3-1), which is considered fairly long-lived in California where the oldest brown trout was previously estimated to be 9 years old (Moyle, 2002). In addition, several brown trout captured in 2019 were estimated to be age 3+ or older based on both scale analysis and length-frequency distribution, which indicates that the population includes reproductive adult fish. Although many brown trout captured during this study were estimated to be age 3+ or older, they rarely exceeded 250 mm FL and tended to have slower growth rates compared to other locations. Brown trout growth rates are highly variable but average approximately 100 mm per year for the first three years and then roughly 50 mm per year thereafter (Simpson and Wallace, 1982, as cited in Adams et al., 2008). Growth rates in the study area are likely constrained by limited prey and cold water temperatures, which are generally below the optimal ranges reported for brown trout (12°C to 19°C [NDEP, 2017]). While trout smaller than 200 mm FL can prey on both invertebrates or small fish, once stream-dwelling salmonids reach around 270 mm FL, they must be predominately piscivorous to grow larger (Keeley and Grant, 2001). The only two fish prey sources for mature trout in Bishop Creek are either smaller rainbow trout or brown trout (especially YOY). However, the low number of YOY trout observed is likely less than the quantity needed to maintain the bioenergetic demands of mature resident trout (Beauchamp, 1990).

The brown trout populations in the study area appear healthy based on criteria described in Moyle et al., (1998), including age-class structure (evidence of reproduction), population size, and individual health. Brown trout populations in the study area included multiple age classes with evidence of reproduction. Comparison with historic monitoring data indicates that the brown trout populations are either stable or growing. Individual fish appeared healthy with condition factors within the range considered healthy for trout populations in Sierra Nevada streams (Ebasco Environmental, 1993; Wilcox, 1994; EA, 1987; Beak, 1991). Growth rates for brown trout within the study area may be lower than in other watersheds, but they do not appear to be limiting the population, recruitment, or condition of the fish.

7.2 Localized Water Quality Parameters that May Affect the Growth and Distribution of Fish Species

Water quality conditions observed during this study are suitable for brown trout with high oxygen levels, cold water temperatures, and suitable pH levels. Although water temperatures may be slightly cooler than optimal, thus limiting brown trout growth, they do not appear to be having an adverse effect on the overall health of the brown trout population or its distribution within the study area.

Before minimum flow requirements were established, Bishop Creek below Intake 5 occasionally experienced extensive periods with no flow and, therefore, did not historically support an aquatic community (SCE, 1986). Results from this study and previous studies have not documented native fish species within the Project area. Bishop Creek is a popular destination for recreational angling where nonnative trout are targeted. As a popular sport fish, brown trout are considered a desirable nonnative fish. Results from this study suggest that there is a healthy, naturally reproducing population of brown trout in the study area, which is in line with the Desired Conditions described in the Land Management Plan for the Inyo National Forest (USDA 2019) as they relate to ecological sustainability and diversity of plant and animal communities.

Desired Conditions described in the Land Management Plan for the Inyo National Forest (USDA 2019) relevant to this study include the following:

1. **(SPEC-FW-DC) 01:** Sustainable populations of native and desirable nonnative, plant and animal species are supported by healthy ecosystems, essential ecological processes, and land stewardship activities, and reflect the diversity, quantity, quality, and capability of natural habitats on the Inyo National Forest.
2. **(SPEC-FW-DC) 05:** The Inyo National Forest provides high quality hunting and fishing opportunities. Habitat for nonnative fish and game species is managed in locations and ways that do not pose substantial risk to native species, while still contributing to economies of local communities.
3. **(RCA-RIV-DC) 01:** Stream ecosystems, riparian corridors, and associated stream courses sustain ecosystem structure; are resilient to natural disturbances (such as flooding) and climate change; promote the natural movement of water, sediment and woody debris; and provide habitat for native aquatic species or desirable nonnative species.

Based on findings of this study, there does not appear to be a conflict with the desired conditions.

8.0 CONSULTATION SUMMARY

During studies, biologists consulted and coordinated with CDFW to analyze fish scale samples collected during the 2019 surveys. CDFW provided scale age analysis results on February 7, 2020. These results were summarized in the Bishop Creek Stream Fish Distribution Technical Memorandum, distributed as a draft in April 2020.

Site selection and placement was determined in consultation with CDFW and USFS in 2019.

SCE distributed periodic progress reports on the following schedule:

- Progress Report 1: December 19, 2019
- Progress Report 2: April 14, 2020
- Progress Report 3: July 24, 2020
- Initial Study Report (Progress Report 4): October 30, 2020
- Initial Study Meeting: November 10, 2020
- 2021 Progress Report 1: March 2, 2021
- 2021 Progress Report 2: May 28, 2021
- 2021 Progress Report 3: August 27, 2021
- Updated Study Report Filing: November 4, 2021
- Updated Study Report Meeting: November 18, 2021

Three progress reports were filed in 2021 after the ISR, as identified above. This Final Technical Report was submitted to agencies and stakeholders for a 60-day review period on May 14, 2021. The comment period was extended, at the request of the agencies, and comments received on this report are shown in Table 8.1-1. A meeting was held with CDFW and USFS on October 6, 2021 to discuss those comments received as well as SCE's draft responses to them.

SCE held a Project Effects meeting on October 28, 2021 for all stakeholders and agencies to discuss what project effects (if any) had been identified through the implementation of each of the approved study plans. The Updated Study Report (USR) was filed with FERC on November 4, 2021, and a USR Meeting was held on November 18, 2021. At this meeting, SCE only discussed those studies which were still in progress at the time of the ISR (Water Quality, Sediment and Geomorphology, Operations Model, Recreation Use and Needs, Recreation Facilities Condition Assessment, Project Lands and Boundary, and Cultural and Tribal Studies). The Baseline Fish Distribution Study was not discussed at the USR, and thus received no comments.

Table 8.1-1 Comment Response Table

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
28	Bishop Creek Fish Distribution Technical Memo	May 21, 2020	CDFW	[SCE] Addressed but did not specifically refer to naturally reproducing brown trout populations. CDFW recommends the technical memorandum assess the distribution of the naturally reproducing brown trout populations. [Referring to *Assess distribution of other fish species in Bishop Creek downstream from Lake Sabrina and South Lake.*]	The discussion section (Section 7.1) of the FTR report has been revised to specify that the brown trout observed in the study area "*appear to be naturally reproducing and sustaining.*" Section 8.5 of Exhibit E of the DLA includes language about naturally reproducing and sustaining brown trout populations.
28	Bishop Creek Fish Distribution Technical Memo	May 21, 2020	CDFW	An analysis was done but no real discussion. CDFW recommends the technical memorandum provide a discussion of the population comparison and the evaluation showing the populations are self-sustaining consistent with levels documented during the 1990s through 2010. [Referring to *Obtain population data sufficient to identify the extent to which self-sustaining brown trout populations are consistent with levels documented during the 1990s through 2010 at historic monitoring sites.*]	The Discussion Section (Section 7.2) of the FTR report has been revised to include a comparison of the current population data to historic population data for the Sada 5 and Sada 3 Sample Sites. Historical comparisons between Sada 5 and Sada 3 with current population data is discussed in Section 8.5 of Exhibit E of the DLA.
30	Bishop Creek Fish Distribution Technical Memo	May 21, 2020	CDFW	Reported in Appendix B but not evaluated. [Referring to *Evaluate select, localized water quality parameters that may affect the growth and distribution of fish species.*]	A full evaluation of localized water quality parameters has been added to this report including detailed results (Section 7.6) and discussion (Section 8.2). A summary of the water quality parameters discussed in the FTR is included in Section 8.5 of Exhibit E of the DLA.
31	Bishop Creek Fish	May 21, 2020	CDFW	The technical memorandum determined that study results suggest that trout	The Discussion Section of this report has been revised to include rational supporting

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
	Distribution Technical Memo			populations within Bishop Creek sample sites are in line with the 'Desired Conditions' described in the Land Management Plan for the Inyo National Forest (USDA 2019). It is unclear how this determination was made. CDFW recommends the technical memorandum provide more detail on the methodology and assessment.	the conclusion that the brown trout populations observed in Bishop Creek are in line with "Desired Conditions" included in the Land Management Plan for the Inyo National Forest (USDA 2019). The Desired Conditions for the Inyo National Forest in relation to brown trout and water quality is discussed in the FTR and included in the Section 8.5 of Exhibit E of the DLA.
1	Fish Distribution Baseline Study (Creeks) – AQ3	June 21, 2021; updated October 4, 2021	CDFW	The report should include a discussion of the flow regime during the lifespan of the sampled fishes (2016-2019) - the flows in the creek are not necessarily indicative of the bypass flow regime required by the license. <u>October 14, 2021, CDFW Updated Comment:</u> Of concern is that the report assumes that the MIF will be continued in the new license, however, this has not yet been determined. The sentence should be removed. The Forest Service (FS) asked why we see differences in the bypass reaches; Kleinschmidt stated that the study wasn't designed to determine why there are differences in the bypass reaches. CDFW agrees the study was not designed to answer this question.	SCE understands that this request was prompted by an observed change in growth of trout in the two historic Bishop Creek survey reaches that occurred in 2017 (N. Buckmaster, personal communication). SCE reviewed project operation data for the past 5 years and confirmed there were no flow regime deviations (defined as flows being less than the MIF) within the two surveyed stream reaches. Additionally, the Operations Model has not identified any systematic/systemic issues with meeting the current MIF requirements and will be useful for investigating the compliance challenges with any changes to MIF. MIF and flow variances are discussed in Section 8.5 in Exhibit E of the DLA. Proposed MIF are included as PME1 in Appendix B of the FLA. Potential impacts associated with the proposed flows are analyzed in several sections of the FLA

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
					including Water Resources, Fish and Aquatics and Geology and Soils.
2	Fish Distribution Baseline Study (Creeks) – AQ3	June 21, 2021; updated October 4, 2021	CDFW	The trend of decreasing brown trout biomass (Figure 7.5-2) since 1991 should be discussed in further detail	Wild riverine fish populations are rarely perfectly stable and routinely increase or decrease naturally over time due to varying environmental, ecological or angling pressure factors. SCE notes that the brown trout population developed and expanded subsequent to the inception of the habitat-based flow during the prior relicensing. Brown trout populations in Project reaches would have adapted to the habitat-based flows initiated under the current License in 1994. The subsequent wild riverine fish populations would be expected to increase and decrease naturally over time as they become established and due to varying environmental, ecological, or angling pressure factors. Both the biomass and density estimate at the Sada 3 Study Site for 2010 and 2019 are lower than estimates from 1991, 1992, and 2004; however it is unclear whether the differences in biomass are statistically significant. While the density estimates at the Sada 3 Study Site were lower in 2019 compared to estimates from 1991, 1992, and 2004, results from the t-test analysis indicate there is no significant difference between the population size in 2019 compared to prior years. Additionally, while the biomass estimates for 2019 is lower compared to 1991, 1992, and 2004, individual fish sizes were actually larger in

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
					2019 compared to prior years based on the average length and weight for brown trout captured. Biomass values reported from previous studies do not include sufficient detail (i.e., standard error) to perform a t-test to evaluate whether differences in biomass between sample years are statistically significant; however, given the population densities and individual fish sizes, the population does not appear to be statistically different from prior years. This comment is addressed in Section 8.5 of Exhibit E of the DLA.
3	Fish Distribution Baseline Study (Creeks) – AQ3	June 21, 2021; updated October 4, 2021	CDFW	For each species and each reach, use the data to discuss if the overall population characteristics align with current agency management goals (e.g., native, non-native fish) and strategies (e.g., active versus passive management). <u>October 14, 2021, CDFW Updated Comment:</u> CDFW's concern is that California has such a diverse array of stream habitats that a single reach-based criteria and goal is infeasible. Other resources besides the CDFW Management Report include the Bear Creek 5937 studies, Flosi (2010), and the Rush Creek synthesis report. Of these, the Synthesis report is probably the most relevant. Also, CDFW's Fisheries Branch is updating the 'Strategic Trout Management Plan', but it will be some time.	In developing the Study Plan, SCE included relevant resource management plans and objectives provided by TWG participants. SCE also considered published guidance, including the Inyo National Forest Land Management Plan. Existing management objectives provided by CDFW in the Strategic Plan for Trout Management; A Plan for 2004 and Beyond (CDFW 2003) do not include clear guidance on reach-based assessments. SCE requests that CDFW provide detailed agency management targets for each reach. SCE can then collaborate with CDFW to develop this discussion. To date, no formal plan or guidance have been received from CDFW. At a PME meeting in March 2022, CDFW and USFS reviewed and presented agency goals. Details about discussions held during this meeting are included in Section 9.5.5.2 of Exhibit E of this FLA.

Comment Number	Study	Date of Comment	Entity	Comments	SCE Response
					Materials used in Study Plan development were included in Section 8.5 of Exhibit E of the DLA.

9.0 REFERENCES

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APPENDIX A

SITE PHOTOS

Figure A-1 Sada 5 segment 1, lower block net looking upstream, September 22, 2019

Figure A-2 Sada 5 segment 1, lower block net and segment 2 lower block net looking downstream, September 22, 2019

Figure A-3 Sada 5 segment 2, upper block net looking downstream, September 22, 2019

Figure A-4 Sada 5 segment 3, lower block net looking downstream, September 23, 2019

Figure A-5 Sada 5 segment 3, lower block net looking upstream, September 23, 2019

Figure A-6 Sada 5 segment 3, upper block net and segment 4, lower block net looking upstream, September 23, 2019

Figure A-7 Sada 5 segment 3, upper block net and segment 4, lower block net looking downstream, September 23, 2019

Figure A-8 Sada 5 segment 4, upper block net and Segment 5, lower block net looking downstream, September 23, 2019

Figure A-9 Sada 5 segment 4, upper block net and segment 5, lower block net looking upstream, September 23, 2019

Figure A-10 Sada 5 segment 5, upper block net looking upstream, September 23, 2019

Figure A-11 Sada 5 segment 5, upper block net looking downstream, September 23, 2019

Figure A-12 Sada 3 segment 1, lower block net looking downstream, September 26, 2019

Figure A-13 Sada 3 segment 1, lower block net looking upstream, September 26, 2019

Figure A-14 Sada 3 segment 1, upper block net and segment 2 lower block net looking upstream, September 26, 2019

Figure A-15 Sada 3 segment 1, upper block net and segment 2, lower block net looking downstream, September 26, 2019

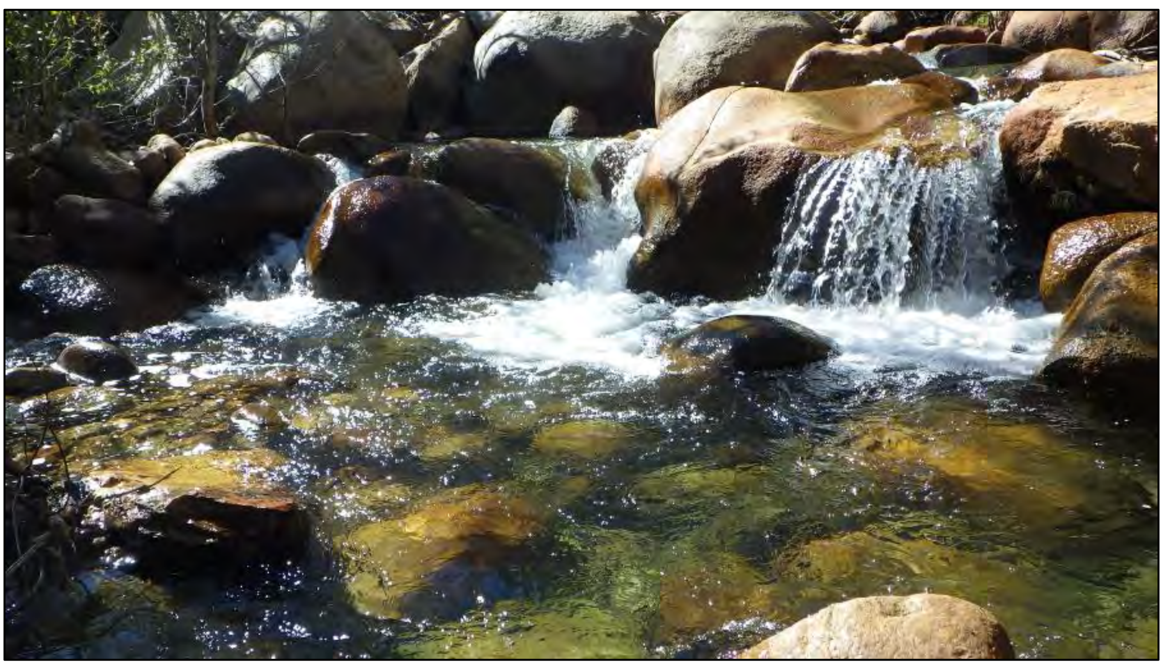

Figure A-16 Sada 3 segment 2, upstream end at natural break, September 26, 2019

Figure A-17 Sada 3 step pool habitat in segment 1 (left) and segment 2 (right), September 26, 2019

Figure A-18 Sada 3 segment 3, lower block net looking downstream, September 26, 2019

Figure A-19 Sada 3 segment 3, lower block net looking upstream, September 26, 2019

Figure A-20 Sada 3 upper natural barrier and overall site condition, September 26, 2019

Figure A-21 Sada 3 segment 4, lower block net looking upstream, September 26, 2019

Figure A-22 Sada 3 segment 4, lower block net looking downstream, September 26, 2019

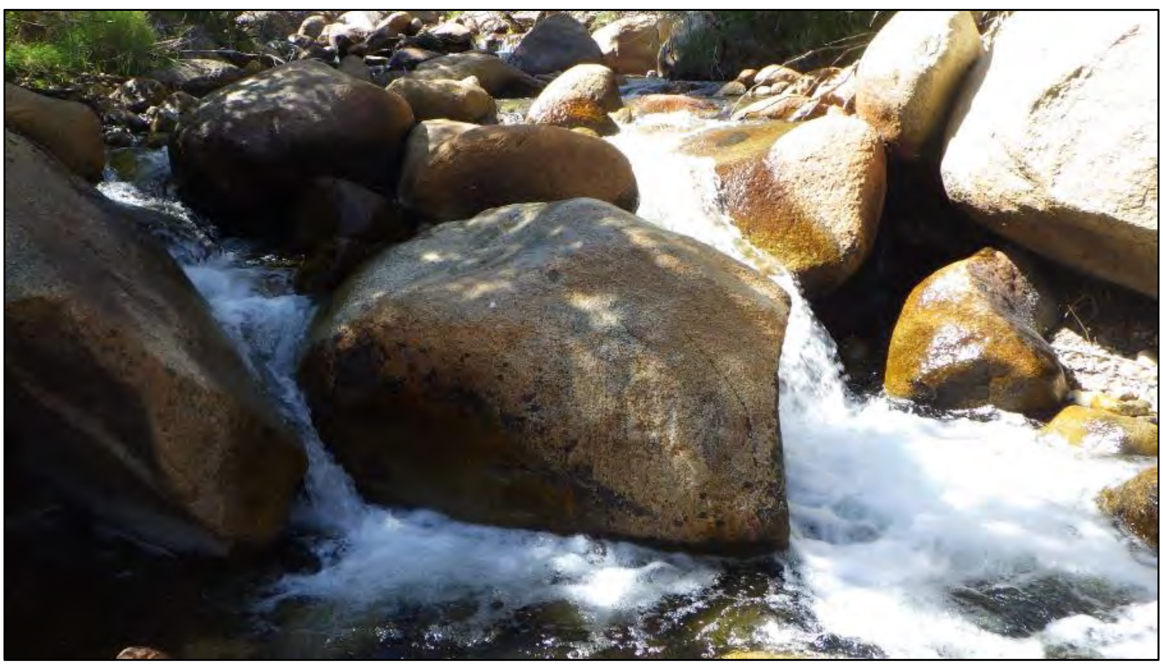

Figure A-23 Sada 3 segment 4, upper natural barrier, September 26, 2019

Figure A-24 Sada 3 segment 5, lower block net looking upstream, September 26, 2019

Figure A-25 Sada 3 segment 5, lower block net looking downstream, September 26, 2019

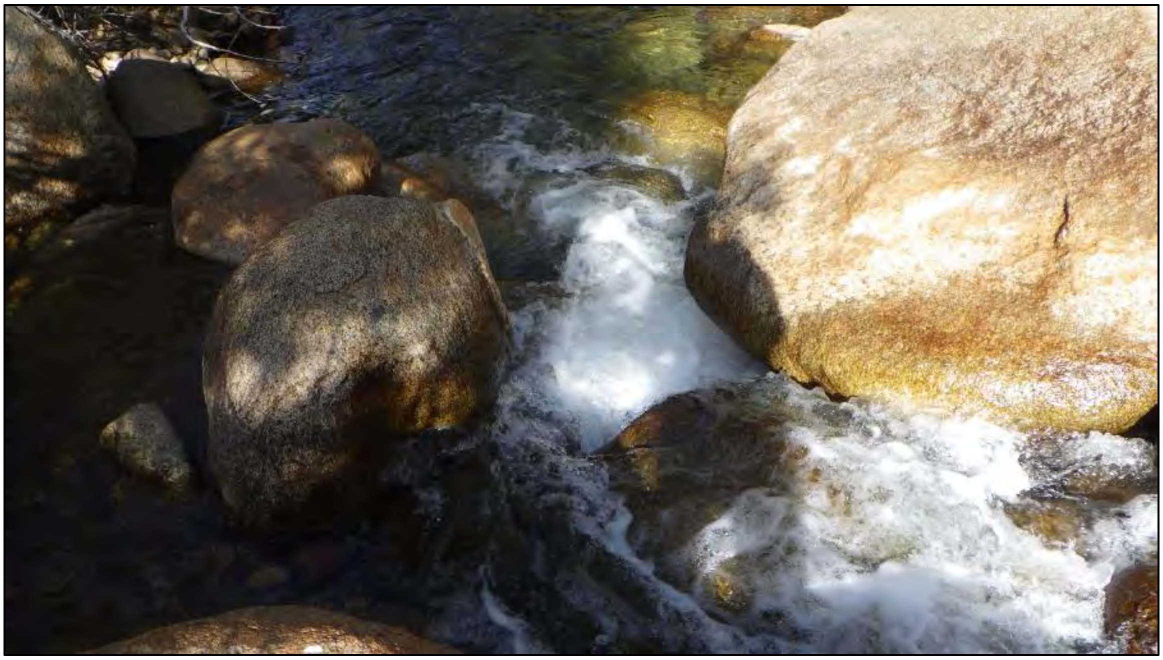

Figure A-26 Sada 3 segment 5, upper natural barrier, September 26, 2019

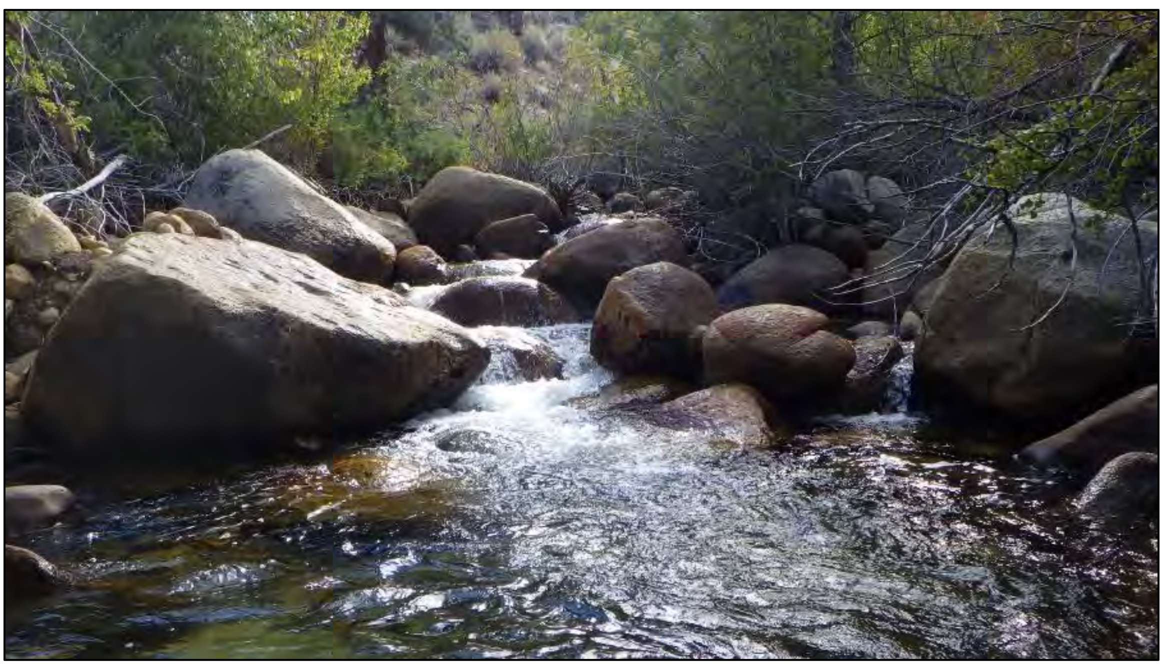

Figure A-27 Sada 3 segment 5, upper natural barrier looking upstream, September 26, 2019

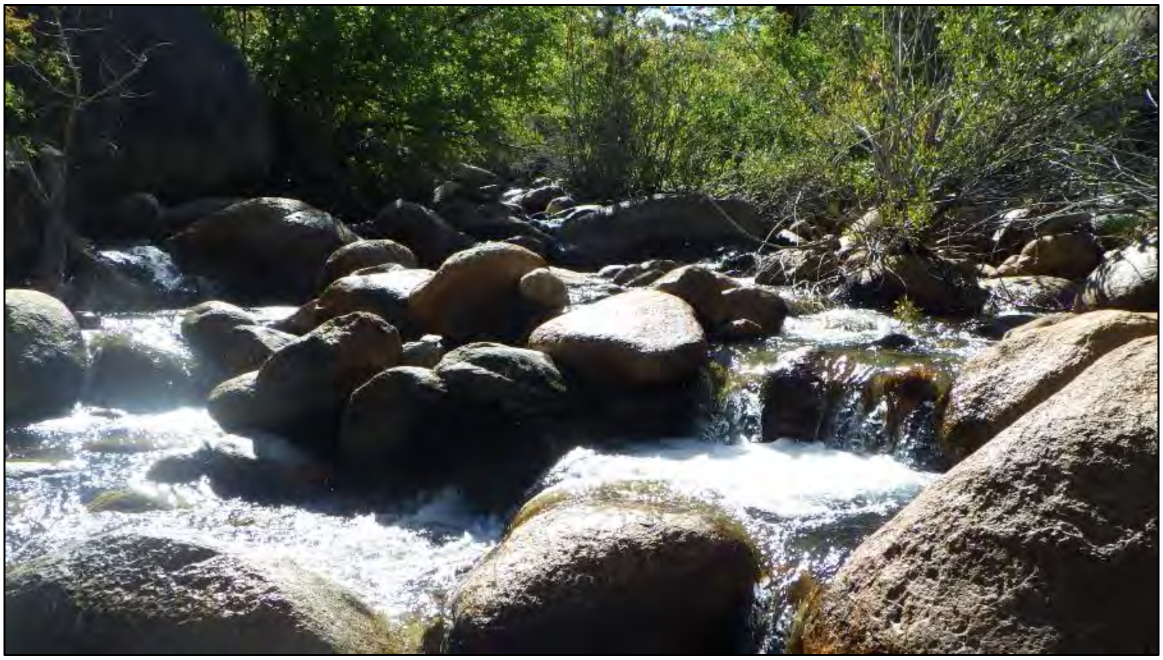

Figure A-28 Sada 3 segment 5, high gradient riffle habitat, September 26, 2019

Figure A-29 South Fork Bishop Creek lower block net looking downstream, September 25, 2019

Figure A-30 South Fork Bishop Creek lower block net looking upstream, September 25, 2019

Figure A-31 South Fork Bishop Creek deep pool habitat, September 25, 2019

Figure A-32 South Fork Bishop Creek boulder cover and undercut bank habitat, September 25, 2019

Figure A-33 Cardinal side channel habitat conditions, September 24, 2019

Figure A-34 Cardinal lower segment large woody debris cover habitat, September 24, 2019

Figure A-35 Cardinal upper segment riffle habitat, September 24, 2019

Figure A-36 Cardinal lower segment B undercut bank and run habitat, September 24, 2019

Figure A-37 Forebay 4 overview photo, September 24, 2019

Figure A-38 Forebay 5 overview photo and gillnet placement, September 25, 2019

Figure A-39 Brook trout captured by gillnet in Forebay 5, September 25, 2019

Figure A-40 Brown trout captured by electrofishing at Sada 5, September 23, 2019

Figure A-41 Rainbow trout captured by electrofishing at Sada 3, September 26, 2019

Figure A-42 Brown Trout captured by electrofishing at South Fork Bishop Creek, September 26, 2019

Figure A-43 Suspected hatchery rainbow trout captured by electrofishing at South Fork Bishop Creek, September 26, 2019

APPENDIX B

BISHOP CREEK STREAM FISH DISTRIBUTION STUDY SAMPLE SITE HABITAT AND WATER QUALITY DATA

Table B-1 Summary of Physical Habitat Measurements at Sample Sites, September 2019

Sample site	Segment	Habitat type (%)			Segment width (m)					Avg. width (m)	Length (m)	Max depth (ft)	Substrate composition (%)						Cover %						
		Pool	Low gradient riffle	Run	1	2	3	4	5				Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Undercut bank	Bubble	Instream veg.	Over-hanging veg.	No cover	Lg. woody material	Lg. boulder
Sada 5	1	10	90		8.4	7.7	4.8	6.6	4.6	6.4	29.1	3.0		90	10				10	5		10	25		50
	2		100		5.1	6.0	5.5	5.7	5.5	5.6	25.0	2.5		75		25				20		10	20		50
	3		90	10	11.5	7.2	6.3	6.1	6.3	7.5	19.8	2.5		60	30	10			10	5		15			20
	4		100		8.3	8.1	6.8	4.0	5.3	6.5	23.5	2.5		50	40	10				10		30	40		20
	5	10	80	10	6.0	4.2	6.2	5.0	5.2	5.3	25.0	4.0		50	50				5	10	5	10	60		10
Sada 3	1		100		4.4	4.9	3.6	5.2	4.0	4.4	25.0	3.0		60	40				25			50			25
	2	45	5	50	4.5	5.6	3.2	5.9	5.9	5.0	29.9	2.0		33	33	33			10	10		10	30		40
	3	30	60	10	4.4	3.9	4.1	5.9	4.3	4.5	21.0	3.0		70	30				5	15		5	5		70
	4	35	65		5.2	4.6	4.2	2.6	4.0	4.1	21.5	3.5		85	10		5		5	10			15		70
	5	30	70		5.7	8.1	9.6	7.3	7.7	7.7	25.7	3.0		65	30		5		10	5		10			75
South Fork	1	20		80	8.1	6.0	12.4	7.0	8.7	8.4	60.0	4.0		10	5	15	70		15			15	45		25
Cardinal	Side Channel	15	5	80	3.5	3.3	3.4	3.4	3.7	3.4	24.7	1.0				75	20	5	5			40	50	5	
	Lower Segment	20	80		5.0	6.5	8.0	6.8	7.5	6.8	19.7	2.0			90	10			10	5		20	20	45	
	Upper Segment		100		7.8	9.5	7.2	5.7	7.7	7.6	51.0	2.5		50	50				5	10			80	5	
	Lower Segment B	50	20	30	5.3	2.4	8.3	7.0	10.2	6.6	23.0	3.5			75	25			40		5	30	20	5	

Table B-2 Summary of Water Chemistry Measurements at Project Sites in Bishop Creek, September 2019

Site	Date	Dissolved oxygen		Conductivity (uS/cm)		Temp (°C)	Discharge (cfs)	pH	Visibility (ft)
		%	mg/l	to 25°C	to °C				
Sada 5	9/22/2019	84.6	9.70	46.8	33	9.2	22	7.73	clear
Sada 3	9/26/2019	83.8	8.62	44.7	35	13.8	14	6.98	clear
South Fork	9/25/2019	68.6	7.99	36.4	25	8.5	15	7.28	clear
Cardinal	9/24/2019	73.5	8.07	26.7	20	11.0	20	6.77	clear
Forebay 4	9/24/2019	87.4	10.18	41.8	29	8.6	n/a	6.84	>10
Forebay5	9/25/2019	75.1	8.52	82.9	59	9.8	n/a	7.60	>10

APPENDIX C

TROUT ABUNDANCE, DENSITY, AND BIOMASS AT THE SADA 5 AND SADA 3 SAMPLE SITES

Table C-1 Trout abundance, density, and biomass at the Sada 5 and Sada 3 sample sites, September 2019

Segment number	Length (ft)	Average width (m)	Trout species	Fish removal pattern	Total no. observed	Biomass (g/m^2)	Density					
							Trout per m^2			Trout per mile		
							Estimate	Lower 95% C.I.	Upper 95% C.I.	Estimate	Lower 95% C.I.	Upper 95% C.I.
Sada 5												
1	29.1	6.4	Rainbow	2, 0, 0	2	0.03	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	21, 7, 5	33	6.31	0.19	0.16	0.21	1,936	1,659	2,212
			All Trout	23, 7, 5	35	6.34	0.20	0.17	0.23	2,046	1,770	2,323
2	25.0	5.6	Rainbow	1, 0, 0, 0	1	0.46	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	11, 6, 11, 4	32	6.59	0.36	0.08	0.64	3,219	708	5,729
			All Trout	12, 6, 11, 4	33	7.05	0.35	0.12	0.57	3,090	1,094	5,086
3	19.8	7.5	Rainbow	2, 0, 0	2	0.05	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	28, 10, 4	42	4.43	0.29	0.26	0.32	3,488	3,164	3,812
			All Trout	30, 10, 4	44	4.48	0.30	0.28	0.32	3,650	3,407	3,894
4	23.5	6.5	Rainbow	1, 0, 0	1	0.04	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	19, 12, 2	33	3.18	0.22	0.20	0.25	2,328	2,054	2,602
			All Trout	20, 12, 2	34	3.22	0.23	0.20	0.26	2,397	2,123	2,671
5	25.0	5.3	Rainbow	1, 0, 1	2	0.07	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	25, 12, 9	46	8.45	0.41	0.30	0.51	3,476	2,575	4,377
			All Trout	26, 12, 10	50	8.52	0.44	0.32	0.56	3,734	2,704	4,764
Site	122.4	6.3	Rainbow	7, 0, 3	8	0.13	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	104, 47, 31	186	5.80	0.29	0.20	0.39	2,889	2,032	3,745
			All Trout	111, 47, 32	194	5.92	0.30	0.22	0.39	2,983	2,220	3,747

Segment number	Length (ft)	Average width (m)	Trout species	Fish removal pattern	Total no. observed	Biomass (g/m^2)	Density					
							Trout per m^2			Trout per mile		
							Estimate	Lower 95% C.I.	Upper 95% C.I.	Estimate	Lower 95% C.I.	Upper 95% C.I.
Sada 3												
1	25.0	4.39	Rainbow	2, 0, 0	2	1.06	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	16, 3, 2	21	12.59	0.19	0.18	0.20	1,352	1,287	1,416
			All Trout	18, 3, 2	23	13.66	0.21	0.20	0.22	1,481	1,416	1,545
2	29.9	4.99	Rainbow	2, 0, 0	2	0.38	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	25, 6, 4	35	11.53	0.24	0.22	0.26	1,938	1,776	2,099
			All Trout	27, 6, 4	37	11.91	0.25	0.23	0.26	1,991	1,884	2,099
3	21.0	4.52	Rainbow	0, 0, 1	1	4.18	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	14, 8, 2	24	12.03	0.26	0.22	0.31	1,916	1,609	2,222
			All Trout	14, 8, 3	25	16.21	0.28	0.22	0.35	2,069	1,609	2,529
4	21.5	4.12	Rainbow	0, 1, 0	1	0.77	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	9, 1, 0	10	7.37	0.11	0.11	0.11	749	749	749
			All Trout	9, 2, 0	11	8.14	0.12	0.12	0.12	823	823	823
5	25.7	7.68	Rainbow	3, 1, 0	4	1.52	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	9, 2, 2	13	2.67	0.07	0.06	0.08	814	689	939
			All Trout	12, 3, 2	17	4.19	0.09	0.08	0.10	1,065	939	1,190
Site	123.1	5.1	Rainbow	7, 2, 1	10	1.58	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
			Brown	73, 20, 10	103	9.24	0.17	0.16	0.19	1,354	1,222	1,485
			All Trout	80, 22, 11	113	10.82	0.19	0.17	0.21	1,486	1,334	1,637

[a] Density estimates could not be calculated due to low capture numbers or poor fish removal pattern.

APPENDIX D

FISH CAPTURE DATA FOR THE BISHOP CREEK STREAM FISH DISTRIBUTION STUDY

Table D-1 Stream fish distribution monitoring data for Bishop Creek, September 2019

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		69	66	2.9	1.01
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-1	95	90	7.8	1.07
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-2	99	95	9.3	1.08
9/22/2019	Bishop Creek	Sada 5	1	1	Rainbow trout		82	79	5.3	1.10
9/22/2019	Bishop Creek	Sada 5	1	1	Rainbow trout		69	66	2.4	1.10
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-3	93	90	8.0	1.18
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-4	99	95	9.4	1.07
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-5	95	92	9.2	1.28
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-6	104	100	10.7	1.08
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		82	79	6.3	1.05
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		99	94	9.0	0.98
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		85	81	5.6	1.11
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		92	89	6.9	1.13
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		83	80	5.7	1.12
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-7	198	186	72.4	1.13
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-8	102	98	10.5	1.25
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-9	215	208	102.0	0.95
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-10	101	97	11.4	1.13
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout		93	90	6.9	1.02
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-11	202	193	81.4	1.29
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-12	228	218	105.6	1.24
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-13	258	250	202.0	1.07
9/22/2019	Bishop Creek	Sada 5	1	1	Brown trout	S5-14	255	245	182.3	0.83
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout		77	74	4.3	1.06
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout	S5-15	106	102	12.0	1.13
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout	S5-16	115	110	14.6	1.10
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout	S5-17	110	108	12.3	0.98

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout	S5-18	114	109	13.1	1.01
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout	S5-19	112	109	14.0	1.08
9/22/2019	Bishop Creek	Sada 5	1	2	Brown trout		98	93	9.6	1.19
9/22/2019	Bishop Creek	Sada 5	1	3	Brown trout		93	89	7.2	1.02
9/22/2019	Bishop Creek	Sada 5	1	3	Brown trout		91	86	7.3	1.15
9/22/2019	Bishop Creek	Sada 5	1	3	Brown trout	S5-20	184	178	59.6	1.06
9/22/2019	Bishop Creek	Sada 5	1	3	Brown trout	S5-21	105	100	10.9	1.09
9/22/2019	Bishop Creek	Sada 5	1	3	Brown trout	S5-22	198	189	78.3	1.16
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-23	107	104	11.3	1.00
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-24	115	112	13.3	0.95
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-25	186	179	56.5	0.99
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout		91	88	6.4	0.94
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout		89	85	6.6	1.07
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-26	255	245	174.6	1.19
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-27	199	185	69.0	1.09
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-28	249	240	163.3	1.18
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout		78	75	4.3	1.02
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-29	112	105	13.1	1.13
9/22/2019	Bishop Creek	Sada 5	2	1	Rainbow trout		191	182	64.5	1.17
9/22/2019	Bishop Creek	Sada 5	2	1	Brown trout	S5-30	211	200	93.2	1.07
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout	S5-31	184	175	60.7	1.13
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout		78	75	4.0	0.95
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout		91	86	6.7	1.05
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout		87	81	5.9	1.11
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout		90	86	6.8	1.07
9/22/2019	Bishop Creek	Sada 5	2	2	Brown trout	S5-32	216	204	93.3	1.10
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		94	90	8.4	1.15
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		99	95	8.9	1.04

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout	S5-33	105	100	11.5	1.15
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout	S5-34	102	99	10.3	1.06
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		92	89	8.3	1.18
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		93	90	8.2	1.12
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		79	75	4.4	1.04
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		77	75	4.7	1.11
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		86	84	6.2	1.05
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout	S5-35	105	101	11.0	1.07
9/22/2019	Bishop Creek	Sada 5	2	3	Brown trout		92	89	7.6	1.08
9/22/2019	Bishop Creek	Sada 5	2	4	Brown trout		90	86	7.2	1.13
9/22/2019	Bishop Creek	Sada 5	2	4	Brown trout	S5-36	104	100	10.3	1.03
9/22/2019	Bishop Creek	Sada 5	2	4	Brown trout	S5-37	116	110	16.0	1.20
9/22/2019	Bishop Creek	Sada 5	2	4	Brown trout		73	71	3.5	0.98
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-38	107	100	11.2	1.12
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		73	68	3.3	1.05
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		60	56	2.1	1.20
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-39	202	191	78.4	1.13
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		73	68	3.5	1.11
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		81	76	5.1	1.16
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		90	84	6.3	1.06
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		81	76	4.9	1.12
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-40	217	210	108.7	1.17
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		93	88	8.2	1.20
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-41	181	173	57.0	1.10
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		76	73	4.3	1.11
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		98	93	8.9	1.11
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		72	68	3.6	1.14
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		96	90	7.6	1.04

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-42	111	105	11.8	1.02
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-43	105	100	10.7	1.07
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout	S5-44	196	186	71.1	1.10
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		106	100	11.9	1.19
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		94	90	8.1	1.11
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		87	83	6.4	1.12
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		113	106	13.4	1.13
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		88	84	6.7	1.13
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		86	81	5.8	1.09
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		90	85	6.9	1.12
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		91	85	6.7	1.09
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		75	71	3.3	0.92
9/23/2019	Bishop Creek	Sada 5	3	1	Brown trout		74	70	3.5	1.02
9/23/2019	Bishop Creek	Sada 5	3	2	Rainbow trout		76	71	3.9	0.95
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		68	64	2.5	0.97
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		70	66	2.8	1.11
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		77	73	4.3	1.08
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		106	100	10.8	1.15
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		95	90	8.4	1.05
9/23/2019	Bishop Creek	Sada 5	3	2	Rainbow trout		69	64	3.4	0.99
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		100	95	9.0	1.08
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		71	68	3.1	1.01
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout	S5-45	221	208	96.8	1.00
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		99	94	8.4	1.09
9/23/2019	Bishop Creek	Sada 5	3	2	Brown trout		66	63	2.5	1.30
9/23/2019	Bishop Creek	Sada 5	3	3	Brown trout		82	77	5.2	1.14
9/23/2019	Bishop Creek	Sada 5	3	3	Brown trout		116	110	14.9	1.12
9/23/2019	Bishop Creek	Sada 5	3	3	Brown trout		74	70	3.5	1.02

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/23/2019	Bishop Creek	Sada 5	3	3	Brown trout		88	82	5.8	1.05
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		102	97	9.1	1.00
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout	S5-46	219	210	107.6	1.16
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout	S5-47	206	197	95.0	1.24
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout	S5-48	193	184	72.2	1.16
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		94	89	7.8	1.11
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		86	82	6.6	1.20
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		83	79	5.4	1.10
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		82	78	5.3	1.12
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		95	90	7.8	1.07
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		100	95	9.5	1.11
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		100	95	9.7	1.13
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		111	109	12.6	0.97
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		103	98	9.4	1.00
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		100	94	8.9	1.07
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		103	98	10.9	1.16
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		105	100	10.5	1.05
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		81	76	5.4	1.23
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		74	70	3.6	1.05
9/23/2019	Bishop Creek	Sada 5	4	1	Brown trout		85	81	5.8	1.09
9/23/2019	Bishop Creek	Sada 5	4	1	Rainbow trout		82	77	5.6	1.23
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		87	83	5.0	0.87
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		88	82	-- [a]	-- [a]
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		77	73	4.4	1.13
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		80	76	5.0	1.14
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		80	75	4.3	1.02
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		91	85	--[a]	-- [a]
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		101	96	9.6	1.09

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		97	91	7.8	1.04
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		95	100	9.1	0.91
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		86	91	7.3	0.97
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		101	107	12.2	1.00
9/23/2019	Bishop Creek	Sada 5	4	2	Brown trout		68	72	3.2	0.86
9/23/2019	Bishop Creek	Sada 5	4	3	Brown trout		77	82	4.6	0.83
9/23/2019	Bishop Creek	Sada 5	4	3	Brown trout		85	89	5.8	0.82
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		93	88	8.0	1.17
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		88	83	6.3	1.10
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-49	226	218	120.1	1.16
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		74	71	2.8	0.78
9/23/2019	Bishop Creek	Sada 5	5	1	Rainbow trout		70	66	3.2	1.08
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		87	84	6.4	1.13
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		95	91	8.5	1.19
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		93	88	8.1	1.18
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-50	198	190	80.8	1.26
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		71	67	3.8	1.15
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		89	86	7.3	1.17
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		97	92	9.1	1.26
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		96	92	9.8	1.13
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		90	86	7.2	1.16
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		108	103	12.7	1.09
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		94	91	8.2	1.17
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		93	88	8.0	0.99
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-51	183	177	55.1	1.10
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-52	221	210	102.3	1.07
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		93	88	7.3	1.16
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		102	96	10.3	1.18

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		102	97	10.8	1.12
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout		104	98	10.5	1.31
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-53	180	172	66.6	1.02
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-54	202	191	71.3	1.22
9/23/2019	Bishop Creek	Sada 5	5	1	Brown trout	S5-55	310	299	326.8	1.11
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		99	94	8.9	1.07
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		114	108	14.0	1.11
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		95	90	7.9	1.08
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		74	71	3.7	1.03
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		67	64	2.7	1.03
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		90	86	7.6	1.19
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		114	107	13.2	1.08
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		94	90	7.8	1.07
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		80	76	4.3	0.98
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		95	90	6.9	0.95
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		94	89	7.9	1.12
9/23/2019	Bishop Creek	Sada 5	5	2	Brown trout		93	90	8.1	1.11
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		110	105	13.2	1.14
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		91	87	7.3	1.11
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		90	86	7.1	1.12
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		56	53	1.8	1.21
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		72	68	3.5	1.11
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		96	91	8.7	1.15
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		83	80	5.8	1.13
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		100	95	8.9	1.04
9/23/2019	Bishop Creek	Sada 5	5	3	Brown trout		88	84	6.8	1.15
9/23/2019	Bishop Creek	Sada 5	5	3	Rainbow trout		87	83	6.3	1.10
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout		94	89	8.0	1.13

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S-3-1	159	150	37.5	0.93
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout		95	90	7.4	0.86
9/26/2019	Bishop Creek	Sada 3	1	1	Rainbow trout	S5-2	170	160	55.4	0.92
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout		96	90	8.1	1.04
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-3	270	261	204.7	1.03
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-4	174	164	54.1	0.98
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-5	188	177	65.3	1.13
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-6	219	210	118.7	1.00
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout		87	83	6.6	1.03
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-7	195	184	76.3	1.06
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-8	187	182	69.0	0.90
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-9	283	270	204.0	0.96
9/26/2019	Bishop Creek	Sada 3	1	1	Rainbow trout	S3-10	180	170	61.4	1.07
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-11	169	161	46.1	1.04
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-12	244	235	156.0	0.98
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-13	208	198	93.6	1.13
9/26/2019	Bishop Creek	Sada 3	1	1	Brown trout	S3-14	196	184	73.7	1.05
9/26/2019	Bishop Creek	Sada 3	1	2	Brown trout	S3-15	194	185	80.0	1.10
9/26/2019	Bishop Creek	Sada 3	1	2	Brown trout	S3-16	105	99	11.2	0.97
9/26/2019	Bishop Creek	Sada 3	1	2	Brown trout	S3-17	105	100	10.2	0.88
9/26/2019	Bishop Creek	Sada 3	1	3	Brown trout		96	92	9.1	1.03
9/26/2019	Bishop Creek	Sada 3	1	3	Brown trout	S3-18	170	162	42.6	0.87
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		82	78	5.4	0.98
9/26/2019	Bishop Creek	Sada 3	2	1	Rainbow trout	S3-19	158	148	39.5	0.84
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		96	85	7.4	0.91
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		88	84	6.2	0.89
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-20	165	157	40.0	0.93
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-21	168	159	44.3	0.99

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		95	92	8.5	0.88
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		89	85	6.2	0.83
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-22	305	289	235.4	0.99
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-23	166	158	45.3	0.88
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		86	83	5.6	1.05
9/26/2019	Bishop Creek	Sada 3	2	1	Rainbow trout	S3-24	188	176	64.8	0.91
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-25	183	176	64.4	0.96
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-26	182	173	54.8	0.99
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-27	204	196	81.8	0.97
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-28	172	165	50.3	0.82
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-29	176	167	52.9	0.89
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-30	291	278	201.1	1.06
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout		89	85	6.3	0.98
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-31	236	234	138.7	1.03
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-32	181	172	58.3	0.97
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-33	185	176	65.5	0.90
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-34	211	199	91.0	0.95
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-35	164	156	39.8	0.97
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-36	199	190	75.0	0.98
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-37	181	171	57.4	1.00
9/26/2019	Bishop Creek	Sada 3	2	1	Brown trout	S3-38	170	162	48.2	0.98
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout		87	83	6.4	0.97
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout		79	75	4.8	0.97
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout		86	82	6.1	0.96
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout		94	90	8.7	1.05
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout	S3-39	168	160	45.7	0.96
9/26/2019	Bishop Creek	Sada 3	2	2	Brown trout	S3-40	100	96	9.8	0.98
9/26/2019	Bishop Creek	Sada 3	2	3	Brown trout		81	77	5.0	0.94

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/26/2019	Bishop Creek	Sada 3	2	3	Brown trout		175	167	49.5	0.92
9/26/2019	Bishop Creek	Sada 3	2	3	Brown trout		94	90	7.2	0.87
9/26/2019	Bishop Creek	Sada 3	2	3	Brown trout		159	150	39.8	0.99
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout	S3-41	160	151	37.7	0.92
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		171	163	49.6	0.99
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout	S3-42	261	251	174.8	0.98
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		152	146	33.8	0.96
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		95	91	7.8	0.91
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		79	76	5.0	1.01
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		69	66	3.6	1.10
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout	S3-43	259	245	161.0	0.93
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		91	87	7.9	1.05
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		164	158	45.8	1.04
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		79	76	5.3	1.07
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		179	170	56.3	0.98
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout		181	174	61.2	1.03
9/26/2019	Bishop Creek	Sada 3	3	1	Brown trout	S3-44	234	225	131.0	1.02
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		76	73	4.6	1.05
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		177	171	51.2	0.92
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		77	74	3.6	0.79
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		162	155	38.6	0.91
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		169	161	45.6	0.94
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		97	93	9.5	1.04
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout		171	163	42.7	0.85
9/26/2019	Bishop Creek	Sada 3	3	2	Brown trout	S3-45	219	210	107.2	1.02
9/26/2019	Bishop Creek	Sada 3	3	3	Brown trout		95	91	8.4	0.98
9/26/2019	Bishop Creek	Sada 3	3	3	Brown trout		75	72	4.4	1.04
9/26/2019	Bishop Creek	Sada 3	3	3	Rainbow trout	S3-46	310	295	328.1	1.10

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		92	88	7.8	1.00
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		182	173	56.0	0.93
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		164	157	44.1	1.00
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		155	149	34.0	0.91
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout	S3-47	147	140	30.0	0.94
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout	S3-48	214	204	95.1	0.97
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		174	166	55.3	1.05
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		180	170	56.8	0.97
9/26/2019	Bishop Creek	Sada 3	4	1	Brown trout		195	184	75.7	1.02
9/26/2019	Bishop Creek	Sada 3	4	2	Brown trout	S3-49	270	260	197.9	1.01
9/26/2019	Bishop Creek	Sada 3	4	2	Rainbow trout	S3-50	185	175	67.9	1.07
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		88	84	7.0	1.03
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		91	87	7.4	0.98
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout	S3-51	105	100	11.5	0.99
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout	S3-52	102	97	9.6	0.90
9/26/2019	Bishop Creek	Sada 3	5	1	Rainbow trout	S3-53	185	174	59.2	0.89
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout	S3-54	249	237	136.9	0.99
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		170	162	48.6	0.99
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		151	144	34.0	0.93
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		147	140	29.7	0.91
9/26/2019	Bishop Creek	Sada 3	5	1	Brown trout		99	94	8.8	0.93
9/26/2019	Bishop Creek	Sada 3	5	1	Rainbow trout	S3-55	157	147	38.2	0.99
9/26/2019	Bishop Creek	Sada 3	5	1	Rainbow trout	S3-56	170	161	48.5	0.99
9/26/2019	Bishop Creek	Sada 3	5	2	Brown trout		186	176	63.8	0.99
9/26/2019	Bishop Creek	Sada 3	5	2	Brown trout		99	96	9.1	0.94
9/26/2019	Bishop Creek	Sada 3	5	2	Rainbow trout	S3-57	244	233	154.9	1.07
9/26/2019	Bishop Creek	Sada 3	5	3	Brown trout		178	170	51.8	0.92
9/26/2019	Bishop Creek	Sada 3	5	3	Brown trout	S3-58	223	210	108.4	0.98

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF1	231	219	120.0	1.14
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF2	274	265	211.5	1.03
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Rainbow trout		291	280	249.2	1.01
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Rainbow trout		220	220	128.9	1.21
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF3	237	226	226.7	1.70
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF4	257	242	145.9	0.86
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF5	226	215	101.5	0.88
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF6	220	212	104.8	0.98
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF7	228	216	112.3	0.95
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF8	229	218	106.3	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF9	202	193	77.0	0.93
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF10	185	173	56.5	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF11	228	220	114.8	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF12	114	108	14.0	0.94
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF13	172	162	43.7	0.86
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF14	197	185	74.5	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF15	212	202	85.0	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF16	230	272	113.3	0.93
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF17	179	169	56.7	0.99
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Rainbow trout		297	285	277.4	1.06
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF18	241	232	132.7	0.95
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF19	182	172	53.6	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF20	218	210	96.1	0.93
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF21	230	220	117.8	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF22	190	179	61.7	0.90
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF23	156	147	32.0	0.84
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF24	133	125	22.8	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF25	210	202	87.1	0.94

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		99	95	9.2	0.95
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF26	242	233	137.4	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF27	223	212	83.5	0.75
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF28	263	250	162.0	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF29	229	221	126.9	1.06
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF30	197	187	77.7	1.02
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		227	215	116.3	0.99
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		252	240	142.1	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		249	240	159.5	1.03
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		229	221	110.5	0.92
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		211	200	81.1	0.86
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF31	151	142	28.5	0.83
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		211	200	84.0	0.89
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		205	193	77.6	0.90
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		204	192	77.6	0.91
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		239	229	146.5	1.07
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		243	234	142.0	0.99
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		225	217	100.4	0.88
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout	SF32	192	181	69.0	0.97
9/25/2019	South Fork Bishop Creek	South Fork	1	1	Brown trout		211	204	98.0	1.04
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-1	221	212	103.9	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		56	59	1.8	1.02
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		55	53	1.1	0.66
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-2	194	185	75.4	1.03
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-3	152	143	30.8	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		66	62	2.5	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-4	141	133	24.2	0.86
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		70	66	3.3	0.96

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		70	66	3.0	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		52	50	1.6	1.14
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		57	54	1.7	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		103	98	10.4	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-5	122	116	16.1	0.89
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		67	64	2.6	0.86
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		69	65	2.4	0.73
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-6	184	175	58.2	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-7	113	108	13.4	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-8	132	126	21.2	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-9	138	130	21.3	0.81
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-10	125	118	17.7	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-11	191	187	72.2	1.04
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-12	158	148	36.9	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-13	135	127	22.4	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout		64	61	2.3	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-14	112	107	13.4	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-15	190	181	65.1	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-16	182	175	59.3	0.98
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-17	246	236	148.0	0.99
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-18	120	112	15.0	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Side Channel	1	Brown trout	C-19	123	116	16.0	0.86
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-20	122	116	16.0	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout		67	64	2.8	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-21	145	137	26.8	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-22	126	119	19.2	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-23	234	226	128.8	1.01
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-24	244	238	150.3	1.03

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-25	118	112	15.0	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-26	255	246	158.6	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-27	135	127	22.6	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-28	234	225	124.7	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-29	121	115	16.5	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout		69	65	2.8	0.85
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-30	260	250	183.7	1.05
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-31	135	127	20.7	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-32	246	235	142.4	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-33	189	179	61.5	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-34	150	142	29.8	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-35	176	167	49.0	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-36	134	128	23.4	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-37	190	182	70.1	1.02
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower Segment	1	Brown trout	C-38	118	112	15.9	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		66	63	6.2	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-39	207	200	86.3	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-40	225	214	107.4	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-41	141	132	24.2	0.86
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-42	137	129	23.9	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		62	59	2.0	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-43	133	127	22.9	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		61	58	2.1	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		138	130	22.2	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		125	118	17.0	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		134	126	22.3	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-44	221	212	111.5	1.03
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		139	131	25.2	0.94

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-45	175	156	42.2	0.79
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		131	125	19.8	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		64	60	2.2	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-46	212	204	91.2	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-47	252	242	154.1	0.96
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		124	118	17.7	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-48	219	209	104.0	0.99
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		137	130	21.5	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		133	127	22.1	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-49	163	156	37.5	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-50	205	195	78.5	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		68	65	2.8	0.89
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-51	213	204	90.2	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		120	113	15.6	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-52	240	239	149.0	1.08
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		71	67	3.2	0.89
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-53	192	182	64.2	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		66	63	2.5	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-54	187	176	56.6	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-55	153	145	32.1	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		149	140	29.8	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-56	227	218	114.8	0.98
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-57	163	155	38.2	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		68	64	3.0	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		141	132	24.1	0.86
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		110	104	11.3	0.85
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-58	196	189	49.3	0.65
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		142	134	26.0	0.91

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-59	171	160	44.9	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		143	135	27.4	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		79	75	5.3	1.07
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-60	225	214	106.4	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		71	68	3.4	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		137	129	24.0	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-61	158	149	34.6	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		165	157	41.0	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		167	159	42.9	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-62	201	191	74.9	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-63	203	194	78.5	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		70	66	3.1	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		137	130	22.6	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		152	144	31.2	0.89
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		127	121	19.8	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		140	133	25.1	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		142	134	28.7	1.00
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout	C-64	204	195	84.5	1.00
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		165	157	44.6	0.99
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		65	63	2.4	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		136	128	22.7	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		71	67	3.0	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Upper Segment	1	Brown trout		168	161	44.9	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		66	62	2.4	1.01
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		121	114	16.2	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		129	121	20.1	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		241	232	147.9	1.06
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Rainbow trout	C-65	299	285	252.2	0.94

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		228	214	109.8	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		275	265	215.0	1.03
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		65	61	2.6	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		113	106	13.5	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		64	60	2.2	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		197	189	69.2	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		147	138	28.1	0.88
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		73	69	3.6	0.93
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		70	65	3.0	0.87
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		79	75	4.0	0.81
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		178	170	52.0	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		127	120	20.5	1.00
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		131	124	22.0	0.98
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		78	74	4.3	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		75	71	3.8	0.90
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		57	54	1.9	1.03
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		120	114	15.8	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		198	187	73.2	0.94
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		161	152	41.3	0.99
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		68	64	2.8	0.89
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		65	62	2.3	0.84
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		137	130	24.5	0.95
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		118	111	15.0	0.91
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		69	65	3.2	0.97
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		151	143	31.8	0.92
9/24/2019	Middle Fork Bishop Creek	Cardinal	Lower B	1	Brown trout		118	112	15.3	0.93
9/24/2019	Bishop Creek	Forebay 4	--	F4-1	Rainbow trout	F4-1	385	400	690.0	1.21
9/24/2019	Bishop Creek	Forebay 4	--	F4-1	Brown trout	F4-2	276	262	243.1	1.16

Date	Stream	Site	Segment	Pass	Species	Scale sample ID	Fork length (mm)	Total length (mm)	Weight (g)	k-value
9/24/2019	Bishop Creek	Forebay 4	--	F4-1	Brown trout	F4-3	253	240	176.9	1.09
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brook trout	F5-2	177	168	52.8	0.95
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-1	245	238	158.3	1.08
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-4	218	205	103.3	1.00
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-8	249	239	167.1	1.08
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-9	227	217	123.0	1.05
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-10	230	216	111.8	0.92
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-11	223	209	102.5	0.92
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Brown trout	F5-12	218	205	98.4	0.95
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Rainbow trout	F5-3	221	208	101.8	0.94
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Rainbow trout	F5-6	269	254	204.1	1.05
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Rainbow trout	F5-7	239	223	125.7	0.92
9/25/2019	Bishop Creek	Forebay 5	--	F5-1	Rainbow trout	F5-8	218	205	104.2	1.01

[a] Weight not recorded, therefore condition (k-value) could not be determined for these fish.