BUREAU OF RECLAMATION

Boise River Basin Feasibility Study

Specialist Report:

Fisheries

Boise Project, Idaho

Interior Region 9: Columbia Pacific Northwest Region,

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Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
cfs	cubic feet per second
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FR	*Federal Register*
IDFG	Idaho Department of Fish and Game
NEPA	National Environmental Policy Act
NFS	National Forest System
OHWM	ordinary high-water mark
Reclamation	Bureau of Reclamation
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service

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1. Introduction

The Boise River Basin Feasibility Study is a feasibility study to evaluate increasing water storage opportunities within the Boise River basin by expanding Anderson Ranch Reservoir. The project is located at Anderson Ranch dam and reservoir, the farthest upstream of the three reservoirs within the Boise River system and located 28 miles northeast of the city of Mountain Home in Elmore County, Idaho. Anderson Ranch Dam is a zoned earth fill embankment structure that provides irrigation water, flood control, power generation, and recreation benefits. The reservoir also provides a permanent dead storage pool for silt control and the preservation and propagation of fish and wildlife. Anderson Ranch Dam is operated by the Bureau of Reclamation (Reclamation). Reclamation, in partnership with the Idaho Water Resource Board, proposes to raise Anderson Ranch Dam. New water storage would provide the flexibility to capture additional water when available, for later delivery when and where it is needed to meet existing and future demands. The alternatives analyzed in this document include the No-Action Alternative (Alternative A), a 6-foot raise of Anderson Ranch Dam (Alternative B), and a 3-foot raise of Anderson Ranch Dam (Alternative C).

Alternative A provides a basis for comparison with the two action alternatives, Alternative B and Alternative C. Under Alternative A, current baseline conditions would continue, without increasing Anderson Ranch Dam height or constructing associated reservoir rim projects, access roads, or facilities. The expected project duration of Alternative B is approximately 51 months and Alternative C is 44 months. Reclamation would continue existing operations of Anderson Ranch Dam. Alternative B proposes to raise the dam by 6 feet from the present elevation of 4196 feet to 4202 feet to capture and store approximately 29,000 additional acre-feet of water. Alternative B would inundate an estimated 146 acres of additional land around the reservoir above the current full pool elevation of 4196 feet. Alternative C proposes to raise the dam by 3 feet to 4199 feet, allowing for the ability to capture and store approximately 14,400 additional acre-feet of water. Alternative C would inundate an estimated 73 acres of additional land around the reservoir above the current full pool elevation of 4196 feet.

Each of the two action alternatives, Alternative B and Alternative C, includes two separate, but similar, structural construction methods for the dam raise, downstream embankment raise, or mechanically stabilized earth wall raise. Otherwise, the only difference is the dam raise elevations of 6 feet for Alternative B and 3 feet for Alternative C. Project areas and construction durations for each method are nearly identical, except for a 200-foot difference in approach road length at the right abutment and an approximate 1-month difference in construction duration. The longer road length is within the dam footprint on previously disturbed ground. Because these differences are negligible, they are not differentiated within the analysis of each alternative. Alternative analysis assumes the longer road length and construction duration, however, a final construction method will be chosen during later phases of engineering evaluation.

Chapter 1 and Chapter 2 of the Boise River Basin Feasibility Study Environmental Impact Statement (EIS) provide a detailed description of the proposed action, project's purpose and need, project area, and alternatives including design features applicable to the action alternatives. This specialist report supports the analysis of expected impacts to fisheries as described in the EIS.

1.1 Regulatory Framework

The proposed action related to fisheries for the proposed alternatives under the Boise River Basin Feasibility Study follow these regulations, guidelines, and policies.

National Environmental Policy Act of 1969

The National Environmental Policy Act (NEPA) (42 U.S. Code 4321 et seq.) was one of the first laws written that establishes broad national framework for protecting the environment. NEPA's basic policy is to assure that all branches of government consider the environment before undertaking any major federal action that significantly affects the environment.

Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508)

NEPA is the basic national charter for protecting the environment; Section 102 establishes policy, sets goals, and provides means for carrying out the policy.

Department of Interior, NEPA Regulations (43 CFR Part 46)

A proposed action is subject to the procedural requirements of NEPA if it would affect the human environment (40 Code of Federal Regulations [CFR] 1508.14) and is subject to Department of Interior control and responsibility (40 CFR 1508.18). The determination of whether a proposed action is subject to the procedural requirements of NEPA depends on the extent to which bureaus exercise control and responsibility over the proposed action and whether federal funding or approval are necessary to implement it.

Bureau of Reclamation Manual

The Reclamation Manual (Reclamation, 2020) consists of a series of policy and directives and standards that assign program responsibility and establish and document Reclamation-wide methods of doing business.

Reclamation's NEPA Handbook

Reclamation's NEPA Handbook (Reclamation, 2012) serves as a guidance tool used by Reclamation staff and applicants, contractors, tribal representatives, the general public, and others who may be involved in Reclamation's NEPA process, or those who develop environmental reports for Reclamation's use in preparing NEPA documents.

Forest Service Handbook 1909.15 – National Environmental Policy Act Handbook

Forest Service Handbook 1909.15 Chapter 30 provides for categorical exclusions to implement NEPA for the purpose of reducing delay and paperwork. Regulations allow Federal agencies to exclude from documentation in an environmental assessment or environmental impact statement categories of actions that do not individually or cumulatively have a significant effect on the human environment (U.S. Forest Service [USFS], 2013).

10-35 Wild and Scenic Rivers Act of 1986 (Public Law 90-542)

The National Wild and Scenic Rivers System was created to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.

National Forest Management Act of 1976 (36 CFR Part 219)

The U. S. Department of Agriculture adopted a new National Forest System (NFS) land management planning rule (planning rule). The new planning rule guides the development, amendment, and revision of land management plans for all units of NFS, consisting of 155 national forests, 20 grasslands, and 1 prairie.

Endangered Species Act of 1973, Department of the Interior, U.S. Fish and Wildlife Service

The Endangered Species Act (ESA) of 1973, as amended, provides that all federal agencies use their authorities to carry out programs for the conservation of listed species. Fish, wildlife, and plant species protected under this legislation are addressed in the Threatened and Endangered Species Specialist Report in the EIS.

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2. Affected Environment

This report describes the affected environment related to fish and aquatic habitat for the proposed alternatives under the Boise River Basin Feasibility Study. Chapter 1 of the EIS describes the project area for fish and aquatic habitat potentially affected by the evaluated alternatives under the Boise River Basin Feasibility Study. The alternatives are evaluated in their respective areas below.

The same project area for fish and aquatic habitat was analyzed for all three alternatives, specifically the general vicinity in and around Anderson Ranch Reservoir extending downstream along the South Fork Boise River to Arrowrock dam and reservoir.

Habitat analyzed for fish include waters within the project area that provide potential habitat for fish and that may be affected as a result of either the existing Reclamation activities or by future construction activities and water operations related to either action alternative.

Reclamation operates the Boise River reservoir system as a unified storage system for joint irrigation and flood control. Construction on Arrowrock Dam, located on the Boise River approximately 22 miles upstream from the city of Boise, began in 1911. As the population and infrastructure in the Treasure Valley increased, water demands and the need for flood control increased. Reclamation constructed Anderson Ranch Dam in 1954 on the South Fork Boise River 42 river miles upstream from Arrowrock Dam to address these needs.

In the 1950s, the U.S. Army Corps of Engineers (USACE) built Lucky Peak Dam, approximately 10 miles upstream from Boise, to provide additional flood risk management for the Treasure Valley. Reclamation and USACE operate the three storage dams in a coordinated method for their authorized purposes. Individual facility authorizations include Anderson Ranch Reservoir: irrigation water supply, power development, flood control, with dead storage space providing for silt control, fish conservation, and recreation; Arrowrock Reservoir: irrigation water supply; and Lucky Peak Reservoir: irrigation water supply, flood control, and recreation.

To the extent possible, water is stored in the uppermost reservoir (Anderson Ranch Reservoir) to maximize refill capabilities of the system. At full pool, Anderson Ranch Reservoir stores 474,900 acre-feet of water with a surface elevation of 4196 feet and a surface area of 4,772 acres. Slightly more than 413,000 acre-feet of the full volume is active storage. Flood control operations could occur from November 1 through May 31 and the reservoirs typically reach their greatest volume in May or early June.

From April to October, Reclamation drafts Arrowrock Reservoir for irrigation. At full pool, Arrowrock Reservoir stores 271,700 acre-feet of water with a surface elevation of 3216 feet and a surface area of 3,141 acres. The lowest reservoir volumes occur October through March. In wet years, volumes may drop in early spring to meet flood control criteria (Reclamation, 2004).

The diversity of habitat within the project area supports abundant cold-water aquatic biota consisting of aquatic macroinvertebrates, and both native and introduced fishes, in both the reservoirs and their tributaries (including South Fork Boise River). In particular, the project area provides a diversity of suitable habitat for fish. These habitats include deep reservoir habitat that provide cold water refugia for native species during most times of the year, shallow shoreline habitat that promotes increased primary productivity and supports a diversity of native and non-native fishes (Idaho Department of Fish and Game [IDFG], 2019b), and complex riverine habitats in the South Fork, Middle Fork, and North Fork Boise rivers, and additional tributaries entering the system. Habitat in the project area supports a diverse and abundant fish assemblage. IDFG exclusively manages the fishery, including stocking and regulations, in a manner that favors the presence of individual species (Idaho State Statute 33).

Anderson Ranch Reservoir is well known as a kokanee trout (kokanee) (*Oncorhynchus nerka*) fishery; however, native fishes including bull trout (*Salvelinus confluentus*), redband trout (*Oncorhynchus mykiss* subspecies), and mountain whitefish (*Prosopium williamsoni*) as well as non-native fishes including yellow perch *(Perca flavescens)* and smallmouth bass *(Micropterus dolomieu)* occur in reservoir waters (IDFG, 2019b).

Rainbow trout *(Oncorhynchus mykiss)*, fall Chinook salmon (*Oncorhynchus tshawytscha*), and kokanee are consistently stocked in Anderson Ranch Reservoir. Historically, other fish species including bull trout, smallmouth bass, and coho salmon (*Oncorhynchus kisutch)* were stocked; however, introduction of these species by IDFG ended in 1979, 1975, and 1970, respectively (IDFG, 2109c).

The fishery in Arrowrock Reservoir is supported by a combination of stocking and natural production. It includes all species noted above for Anderson Ranch Reservoir as well as northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), bridgelip sucker (*Catostomus columbianus*), and chiselmouth (*Acrocheilus alutaceus*) (IDFG, 2019b and Butts, 2019), which may also be found in Anderson Ranch Reservoir. Rainbow trout have been consistently stocked in Arrowrock Reservoir since the late 1960s, and more recently (since 2004) kokanee have been stocked (IDFG, 2019b).

Popular reservoir fishing within the Boise River drainage exists at Arrowrock and Anderson Ranch reservoirs. Anderson Ranch Reservoir provides a "two-story" fishery with smallmouth bass occupying the warm, inshore waters, and rainbow trout and kokanee occupying the cooler, mid-water fishery. The rainbow trout fishery relies on stocked fish. In good water years, Arrowrock Reservoir also provides excellent fishing for hatchery-raised rainbow trout, smallmouth bass, and kokanee. Spawning conditions in tributary streams allow recruitment of kokanee to Anderson Ranch Reservoir. Before IDFG began stocking kokanee in Arrowrock Reservoir, only a marginal fishery existed, supported by small amounts of natural production and entrainment from Anderson Ranch Reservoir. The magnitude and variability of these sources of recruitment are not well understood but are likely influenced by inflows and reservoir levels.

IDFG management of Anderson Ranch Reservoir is focused on the kokanee population, improving trout fishing, and maintaining the smallmouth bass population for a diversity of fishing opportunities. Approximately 8.5 million fish representing seven species have been stocked in Anderson Ranch Reservoir since 1968 with kokanee and rainbow trout accounting for 82% of the stocked fish (Table 1). Annual stocking of fingerling and catchable-size rainbow trout and kokanee in Arrowrock Reservoir dates to 1968. Approximately 7.3 million fish have been stocked in Arrowrock Reservoir representing six species since 1968 with rainbow trout accounting for 75% of the stocked fish (Table 2).

Table 1. Summary of the number of fish stocked in Anderson Ranch Reservoir

Period	# of Years	Species	Quantity	% of Total
1979	2	Bull Trout	17,160	0%
1968-1970	2	Coho Salmon	968,130	11%
1982-2019	10	Fall Chinook	175,967	2%
1968-2018	18	Kokanee	2,850,854	33%
1967-2014	47	Rainbow Trout	4,163,452	49%
1972-1975	4	Smallmouth Bass	78,862	1%
1995-1996	2	Steelhead Trout	256,626	3%
Total			8,511,051	100%

Source: IDFG, 2019a.

Table 2. Summary of the number of fish stocked in Arrowrock Reservoir

Period	# of Years	Species	Quantity	% of Total
1968-1972	5	Coho Salmon	680,190	9%
1990	1	Cutbow[1]	36,000	0%
1996-1998	3	Fall Chinook	29,457	0%
2004-2019	12	Kokanee	1,071,173	15%
1968-2019	50	Rainbow Trout	5,487,412	75%
2000	1	Steelhead	13,260	0%
		Total	7,317,492	100%

Source: IDFG, 2019a

[1]Cutthroat / rainbow trout hybrid

Upstream of Arrowrock Reservoir, streams and tributaries (including South Fork Boise River both above and below Anderson Ranch Dam) contain populations of redband trout, mountain whitefish, brook trout (*Salvelinus fontinalis*), bull trout, Westslope cutthroat trout (*Oncorhynchus clarkii*) as well as other common lotic system species such as redside shiner (*Richardsonius balteatus*), longnose dace (*Rhinichthys cataractae*), leopard dace (*Rhinichthys falcatus*), shorthead sculpin (*Cottus confusus*), and mottled sculpin (*Cottus bairdii*) (Butts, 2019).

Catchable-size hatchery rainbow trout are stocked to supplement wild populations in the South Fork Boise River downstream of Anderson Ranch Dam. The South Fork Boise River downstream from Anderson Ranch Dam is a nationally renowned trout fishery and was the first river section in the IDFG Southwest Region to be managed under "trophy trout" regulations. This fishery remains a prime wild trout fishery and is supported by populations of wild rainbow trout and mountain whitefish. Migratory bull trout are present at very low densities as well as native non-game fish including largescale sucker, bridgelip sucker, northern pikeminnow, and sculpin.

The South Fork Boise River wild trout population, downstream of Anderson Ranch Reservoir, is thought to be supported primarily through mainstem spawning with little recruitment from tributaries because of migration barriers on most tributaries that provide spawning habitat. Until recently, information on fish populations within these tributaries had not been collected since the late 1970s when many of the South Fork Boise River tributaries below Anderson Ranch Reservoir were evaluated for the presence of spawning trout and spawning habitat. More recently, IDFG identified Pierce, Rock, Cayuse, Bock, Meinecke, and Trail creeks as spawning and rearing habitats (Butts et al., 2013; Kozfkay et al., 2010).

Kokanee are the non-anadromous form of sockeye salmon *(Oncorhynchus nerka)*. They occur in many of the land-locked lakes throughout the Pacific Northwest and likely diverged thousands of years ago as a result of glacial events. Kokanee have a similar life history to sockeye salmon, except adults reside in freshwater their entire lives and feed on zooplankton and aquatic insect larvae (Wydoski and Whitney, 1979). They are typically much smaller than anadromous sockeye salmon, as a result of their life history requirements and prey base. Kokanee males turn bright red during spawning that occurs in the fall where they use tributaries and shallow shoreline areas of lakes and reservoirs.

Rainbow trout and redband trout are the same species; however, redband trout (a native sub-species of rainbow trout) are more of a stream species and have limited habitat in the Boise River. Redband trout are thought to be resident steelhead trout where they coexist with anadromous steelhead (Behnke, 1992). Interior redband trout are an Idaho species of concern and a Bureau of Land Management (BLM)- and USFS-sensitive species (Western Native Trout Status Report, 2018). They have at least three life history strategies (lake dwelling [adfluvial], stream dwelling, and resident) that allow them to occur in Anderson Ranch Reservoir, Arrowrock Reservoir, and the South Fork Boise River system (Western Native Trout Status Report, 2018). Redband trout spawn February through June when water

temperatures are 42°F to 45°F (Sigler and Zaroban, 2018). Fry take several years to mature. Hybridization with non-native rainbow trout poses the greatest threat to this species.

Westslope cutthroat trout are listed as a state of Idaho and federal species of concern (by both BLM and USFS and has been proposed for federal ESA listing in some areas of its range (U.S. Forest Service, 2016). They are known to have occurred in the Boise National Forest and documented in recent surveys (IDFG, 2019a and IDFG, 2019b) in the South Fork Boise River. Westslope cutthroat spawn in April and May, with emergence in June and July (Behnke, 1992). Migration occurs seasonally to locate spawning or wintering habitat (Bjornn and Mallett, 1964). Overwintering survival is highly dependent on deep pools.

Mountain whitefish are native to Idaho and the Boise River drainage but have no special Federal or state status. They are regulated primarily through state law as a game fish. Little is known about mountain whitefish life history specific to the subbasin. In general, mountain whitefish migrate within stream systems over the course of a year. They migrate from smaller streams in the summer where they are feeding to larger streams during fall, where they spawn from October through early December (Sigler and Zaroban, 2018). They then migrate to deep water pools to overwinter (Davies and Thompson, 1976). Emergence occurs in March and April (Sigler and Zaroban, 2018). Younger juveniles inhabit shallow, slow moving water; side channels; and pools; larger juveniles and adults prefer bottom habitat in mainstem pools and runs. Because mountain whitefish prefer cold streams and rivers, threats include increasing water temperature and sediment loads that fill spawning gravel.

The Columbia River Basin bull trout was listed (under a final rule) as threatened under the ESA on June 10, 1998 (63 *Federal Register* [FR] 31647). On October 18, 2010 (75 FR 63897), USFS designated critical habitat for bull trout throughout their U.S. range, which includes foraging, migrating, and overwintering habitat in Anderson Ranch and Arrowrock reservoirs and the South Fork Boise River. Stable or slightly increasing population trends of bull trout have been documented in the South Fork Boise River basin above Anderson Ranch Reservoir and the adfluvial population in the Boise River basin above Arrowrock Reservoir (Reclamation, 2013). More detail on bull trout is included in the Threatened and Endangered Species Specialist Report in the EIS and anticipated effects to this species and other ESA-listed species in the project area are described there.

Brook trout are an eastern North America species. Spawning occurs in late September and October with emergence during April and May. Redds are constructed in gravel but may be constructed in sand or silt if groundwater upwelling occurs (Meehan and Bjornn, 1991). They are present in the South Fork Boise River and were historically stocked in many Idaho drainages (Reclamation, 2003). First introduced to Idaho in the early 1900s, they have spread throughout the Boise, Salmon, and Clearwater river systems (Reclamation, 2003). Although no longer stocked by IDFG, they still pose a threat to many native species. Brook trout hybridize with bull trout and displace Westslope cutthroat trout, particularly in low-gradient streams.

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3. Environmental Consequences

3.1 Methods for Evaluating Impacts

Impacts to fish and their aquatic habitat were evaluated based on available data and reports relating to the fish community, fish habitat, species spatial distribution, and fish migratory characteristics (time of year and preferred habitat/spawning area). Additional information used in the analysis included spatial geographic information system files related to fish populations, distribution, and migration from IDFG, relevant to the Anderson Ranch Reservoir and associated tributaries that may be impacted by the proposed projects.

3.1.1 Assumptions

The geographic focus of the fish and aquatic habitat analysis includes the existing footprint of Anderson Ranch Reservoir, up to the new area of inundation (under the proposed action), as well as connected waters downstream including the South Fork Boise River and Arrowrock Reservoir. The area of analysis terminates at Arrowrock Dam. Implementing the proposed action is not expected to have a measurable effect on fisheries beyond this area.

The impacts of the proposed project were determined by assessing the project's perceived impacts to the fish community in the project area.

3.1.2 Impact Indicators and Significance Criteria

Potential short-term impacts were identified if construction activities would temporarily displace fish. Long-term impacts were identified if project components and operational conditions could cause permanent displacement. Adverse impacts were identified if changes would cause fish mortality.

Table 3. Fisheries impact indicators and significance criteria

Impact Indicator	Significance Criteria
Increase turbidity via erosion (outside of isolated work areas)	Measurably shift existing conditions over the long term or exceed state water quality standards
Increase nutrient and pollutant levels	Results in fish mortality
Disconnect or limit reservoir and tributary connectivity	Permanent disconnection or limitations post-construction
Change in river flows	Not consistent with existing flows or do not meet instream flow requirements for salmonids
Reduce overall reproductive fitness of established fisheries	Directly or indirectly reducing existing fish populations. Increased introduction of invasive species Reduce habitat availability and function (including deleterious impacts to the riparian corridor and in-water structure, decreased bank stability, and/or altered flows).

3.2 Direct, Indirect, and Cumulative Impacts

3.2.1 Alternative A – No Action

The No-Action Alternative represents the baseline scenario of current system storage capacity, operations, and demand levels. Current water management operations of the system would not change so that fishery resources and habitats, as well as existing seasonal barriers to fish passage, within the project area would remain as they are now.

Conditions under the No-Action Alternative could vary from existing conditions over time based on future changes that may occur regardless of whether action alternatives are implemented. Future actions could include climate variability, other water development projects, land use changes, or municipal development.

3.2.2 Alternative B – 6-foot Anderson Ranch Dam Raise

Construction

In-water construction activities under Alternative B may affect fisheries in the project area over the short term until construction is completed. Underwater noise and vibration, releasing sediment into live water, limited habitat access, and other effects associated with the proposed dam raise and infrastructure (such as staging areas, roads, bridges, culverts and campgrounds) have the potential to adversely affect fish. Construction activities have the potential to displace fish, inhibit use of migratory corridors, and limit access to forage habitat.

Constructing a cofferdam and replacing the spillway, pier, bridge, and ogee crest structure as well as removing and installing radial gates may adversely affect water quality, specifically an increase in turbidity. Changes in water quality would temporarily impact fish within the immediate area. Fish in the project area would be isolated from all in-water work areas during construction activities, except for coffering and coffer removal. Fish in the vicinity during periods of in-water construction activities would likely be displaced and move outside of the area on their own with the onset of noise-generating activities.

Sound waves generated in the water column (as a result of construction activities such as bridge and culvert work) can affect fish in several ways (altered behavior, physical injury, or mortality). These effects depend on the intensity and characteristics of the sound, the duration, the distance and location of fish in the water column relative to the sound source, the size and mass of the fish, and the fish's anatomical characteristics (Yelverton et al., 1975).

Pile driving would occur in the dry (which would attenuate noise and vibration considerably) and during the designated in-water work window to reduce the potential effects of noise and vibration to fish. Regardless, fish in the area during pile driving have the potential to be adversely affected. Direct effects as a result of underwater noise generated from construction would be short term only while construction is underway. Passage upstream of Pine Bridge would be maintained during construction, and no in-water construction or pile driving would occur during nighttime hours when salmonids may be migrating through the area. However, migration through the area during daylight may be affected as a result of noise during construction (not to exceed 60 days). Construction of culvert modifications at Deer Creek and Fall Creek culverts would restrict access to fish moving up or downstream in Deer Creek and Fall Creek for a period of approximately 30 days in each instance and the total area of isolation required for each culvert would not exceed 16,000 square feet (0.37 acre). Dewatering and work area isolation would be conducted to reduce or eliminate the need for fish handling/salvage. Restricted passage for fish through these areas would limit access to forage either upstream into the creeks or downstream into the reservoir until construction is completed.

Constructing cofferdams to isolate the work area at Anderson Ranch Dam would also reduce forage habitat for fish. At full pool Anderson Ranch Reservoir provides approximately 4772 acres of open water habitat. The extent of habitat made inaccessible to fish adjacent to the dam in Anderson Ranch Reservoir during construction would not exceed 3000 square feet or 0.07 acre (which represents only 0.00144% of available reservoir habitat at full pool) located at the spillway crest, and the area would be inaccessible for approximately 51 months. The timing of in-water construction and extent of other suitable habitat in the analysis area reduces the likelihood that fisheries would be adversely affected as a result of limited habitat access at the dam. Additionally, in-water work at Pine Bridge would limit access to approximately 1,800 square feet (0.04 acre) of riverine habitat along the fringes of both banks of the South Fork Boise River for up to 60 days.

In-water construction activities will also release distinct pulses of sediment-laden water that may result in turbidity above background levels for brief periods of time. Increased sediment levels can adversely affect salmonids and their habitat. Turbidity may increase physiological stress, result in physical injury (such as gill abrasion), and potentially displace fish (Bisson and Bilby, 1993). Salmonid avoidance of turbid waters may be one of the most important effects of suspended sediments (Birtwell et al., 1984; Scannell, 1988). Although adult and larger juvenile salmonids can tolerate higher concentrations of suspended sediments (Bjornn and Reiser, 1991), chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding et al., 1987; Lloyd, 1987; Servizi and Martens, 1991).

Water quality proximate to in-water work areas in Anderson Ranch Reservoir would be adversely affected over the short term primarily while installing and removing cofferdams used to isolate construction areas. Once coffered and dewatered, most of the sediment released from construction activities would be contained within isolated work areas. Isolation of in-water work areas in Anderson Ranch Reservoir, in conjunction with other Conservation Measures (See Environmental Commitments, EIS Section 3.28), will limit the release of sediment into live water (waters adjacent to isolated work areas and accessible to fish) during construction. However, spillway construction (including installing and removing coffering), roadway construction (including bridge and culvert work), and other infrastructure construction below the ordinary high-water mark (OHWM) will release small pulses of sediment into live water. Release of sediment is anticipated to be primarily contained in isolated areas and to persist for a short time, reducing adverse effects on fish or other aquatic species (such as prey base for fisheries in the project area). Furthermore, sediment or turbidity released during construction activities in Anderson Ranch Reservoir waters would not be expected to exceed background levels beyond 600 feet of the isolated construction areas.

Effects from new road construction also have the potential to extend to hillslopes downsteam of the work area and adjacent to the South Fork Boise River when realigning the road to accommodate traffic that currently uses the existing Cow Creek road. Required road construction, maintenance, and/or increased road activity adjacent to the South Fork Boise River is also likely to contribute to fugitive dust and release sediment downslope that could be transferred into live water. Effects to water quality as a result of construction activity along the South Fork Boise River would not be anticipated to occur greater than 600 feet downstream of construction footprints and no effects would extend to Arrowrock Reservoir downstream. Conservation measures (See Environmental Commitments, EIS Section 3.28) implemented to reduce the transfer of sediment into water bodies in the project area will minimize these effects but not eliminate them completely.

The project is anticipated to cause short-term increases in turbidity, for a short distance within the water column. The duration, magnitude, and extent of turbidity and fine sediment that may occur under Alternative B may result in adverse effects to fisheries in the analysis area, if they are present during construction. Sediment and noise generated as a result of

these construction activities is not expected to alter tributary connectivity; however, excess turbidity could potentially limit forage area for fish in the analysis area or reduce their access to prey while construction is occurring. Adverse effect as a result of sediment and turbidity would occur for a short duration and not be anticipated to occur at a level that would measurably shift existing conditions over the long term.

Hazardous spills will be reduced to the extent practicable. To protect water quality from chemical contamination associated with construction under Alternative B, uncured concrete would be separated from flowing water; vehicles and other equipment would be refueled away from standing or flowing water; and spill containment equipment would be available during refueling. The risk of hazardous material adversely affecting fisheries in the analysis area during construction is considered negligible.

In addition, to introduced species such as brook trout, many water bodies in Idaho have invasive aquatic species that can adversely affect aquatic ecosystems, such as the New Zealand mudsnail (*Potamopyrgus antipodarum*) and parasites causing whirling disease. Equipment used to draft, dip, store, or deploy water can be exposed to aquatic invasive organisms. Many of these species are practically invisible to the naked eye and impossible to detect if attached to heavy equipment, vessels, or even the boots of anglers entering Idaho waters. A variety of aquatic invasive species are already identified as occurring in state waters. Some examples include Asian clam (*Corbicula fluminea*), bull frog (Lithobates catesbeianus), oriental weather loach (Misgurnus anguillicaudatus), and multiple crayfish species (Pacifastacus spp.). Fortunately, other aquatic invasive species present in the U.S. are not yet known to occur in Idaho and aggressive measures have been put in place to prevent many of these from entering the state. Zebra (*Dreissena rostriformis)* and quagga mussels (*Dreissena polymorpha)* have not yet entered Idaho, but 31 boats with mussels were stopped at the border in 2017 and 50 in 2018 (Carlson, 2019). Introducing aquatic invasive species into waters in the project area could have adverse effects to fish and their aquatic habitat that may not be realized for many years. To reduce the spread of aquatic invasive species from contaminated to uncontaminated sources, equipment proximate to waters in the project area will be sanitized and cleaned. Methods to further reduce the spread of aquatic invasive organisms are described in the Environmental Commitments (EIS Section 3.28), which include prevention, cleaning and sanitation, and disposal. Therefore, introducing aquatic invasive species into the project area as a result of construction activity is not expected to occur.

Despite conservation measures and best management practices, short-term adverse effects are expected from construction of the Anderson Ranch Dam raise and associated projects surrounding Anderson Ranch Reservoir (including entering tributaries) as well as along portions of the South Fork Boise River that may be influenced by road work and road use. These effects would occur over the short term, until disturbed hillslopes and other lands have stabilized. Outside of isolated work areas, turbidity would not be expected to exceed state water quality standards. Conservation Measures (See Environmental Commitments, EIS Section 3.28) would be implemented to reduce the potential for sediment and pollutants to

enter waters in the project area, reduce underwater noise, and reduce the potential to introduce aquatic invasive species. Sediment and contaminant releases into live water are not expected, and restricted habitat access would not limit migration or significantly inhibit access to foraging activity or the prey base for fish assemblages in the project area. Furthermore, isolated work areas would be restricted to the minimum footprint required and active construction below the OHWM (including pile driving) will not occur during nighttime hours when bull trout are known to typically migrate. Once in-water work is completed no physical or chemical barriers to fish would persist. No fish mortality from construction activities over the short term is expected. Overall, fisheries in the project area would not be significantly affected as a result of construction activities under Alternative B.

Long Term

Under Alternative B, a 6-foot raise of Anderson Ranch Dam, will have insignificant direct effects on the fisheries resources because water management practices will remain largely unchanged. The 6-foot raise will increase the storage capacity of Anderson Ranch Reservoir by approximately 29,000 acre-feet for an active capacity of approximately 442,074 acre-feet. The dam raise represents a 7% increase in the active capacity of Anderson Ranch Reservoir and a 3% increase in system active capacity.

The operation model for the 6-foot dam raise simulated current operational objectives that include the following when possible (Appendix F of the EIS).

1. Maintain a minimum storage volume in Arrowrock Reservoir of 50,000 acre-feet
2. Keep Lucky Peak Reservoir above 264,000 acre-feet from May 31 through September 1
3. Manage peak flows on the Boise River at the location of the Glenwood gauge to be less than 7,000 cubic feet per second (cfs)
4. Reach and maintain the “elk pool” (40,000 acre-feet) in Lucky Peak from the end of the irrigation season through the middle of February
5. Meet minimum flow requirements in the South Fork Boise River and at Glenwood gauge.

The 6-foot raise of Anderson Ranch Dam and the relatively small increase in storage capacity compared to the total storage of Anderson Ranch Reservoir and the system will have insignificant direct effects on the fisheries’ resources. Modeling results of the South Fork Boise River stream flow indicate there will be no changes to the ability of Anderson Ranch Dam to continue meeting the minimum flow targets under Alternative B. Daily average flows are projected to be within +/- 50 cfs from October through February, +/- 100 cfs from March through May, and approximately 125 cfs more in early August, compared to existing conditions. Use of the Anderson Ranch Dam spillway would not increase compared to existing conditions, and there would be little change in the annual operating range of Arrowrock Reservoir. Changes to fish habitat, thermal refugia, food cycle dynamics, water quality, or effects on migration corridors and seasonal habitat use are expected to be

insignificant based on operations modeling under Alternative B that show water management practices will remain largely unchanged (Appendix F of the EIS). Future conditions in Anderson Ranch and Arrowrock reservoirs throughout most of the year will continue to provide conditions important for existing fish assemblages. Yearly and seasonal fluctuations in water supply and irrigation demand will continue. However, an elevated pool in Anderson Ranch Reservoir and altered refill regime into Arrowrock Reservoir (via South Fork Boise River) may improve temporal access to cold water refugia for salmonids in the system and increase seasonal connectivity to tributaries entering Anderson Ranch and Arrowrock reservoirs. During annual periods of warm summer conditions and extreme drawdowns, migration corridors may provide improved access to more favorable conditions, compared to baseline conditions in unregulated portions of the watershed with limiting habitat conditions throughout the year.

Although some long-term impacts to fisheries and their habitat reflective of a managed system would persist under Alternative B, they would not be anticipated to occur at or be elevated to a level of significance in the analysis area as a result of this alternative. No increased introduction of aquatic invasive species would be anticipated to occur over the long term as a result of Alternative B. Tributary connectivity would be maintained or improved. In-river flows would not be altered outside of the range that currently exists. Existing habitat availability and function would persist, and existing fish populations would not be expected to be measurably affected. Therefore, no long-term significant impacts to fish or other aquatic species under Alternative B are anticipated to occur.

Over the long term, beneficial effects from Alternative B may be realized as a result of an elevated pool in Anderson Ranch Reservoir, extended temporal connection with entering tributaries, and altered refill regime of waters into Arrowrock Reservoir (via South Fork Boise River). In particular, beneficial effects for salmonids and other species are anticipated as a result of regrading and construction activities at Deer Creek and Fall Creek culverts. Once completed the culverts will provide year-round passage into Deer Creek and Fall Creek that currently does not exist at pool elevations when the culverts are perched. Although this additional access to forage habitat in Deer Creek and Fall Creek, as well as other extended temporal access to tributaries entering Anderson Ranch Reservoir (as a result of higher pool elevations under certain conditions) are anticipated to benefit salmonids and other fish, these benefits would likely not measurably shift baseline conditions.

3.2.3 Alternative C – 3-foot Anderson Ranch Dam Raise

Construction

In-water construction activities under Alternative C would affect fisheries in the project area over the short term, in a similar manner as described under Alternative B above, until construction is completed. Underwater noise and vibration, releasing sediment into live water, limited habitat access, and other effects associated with construction of the proposed dam raise and rim projects under Alternative C have the potential to adversely affect fish in a

similar manner as described under Alternative B. Construction activities have the potential to displace fish, inhibit use of migratory corridors, and limit access to forage habitat.

Constructing a cofferdam and replacing the spillway, pier, bridge, and ogee crest structure, as well as removing and installing radial gates may adversely affect water quality (i.e., turbidity and release of sediment) in the same manner as described above for Alternative B. Additionally, impacts to water quality and passage, as well as from noise/vibration, coffering/area isolation, and introduction of aquatic invasive species as a result of construction and in-water work under Alternative C would be similar to those described under Alternative B. Effects from new road construction and/or contaminants from roadway or other construction as a result of Alternative C would also be similar to those described above under Alternative B.

In contrast to Alternative B, with Alternative C, no work would be required at Pine Bridge. Therefore, effects described under Alternative B specific to Pine Bridge (including temporary limited access to fringe habitat) would not occur under Alternative C. Additionally, the duration of effects as a result of general construction noise and activities would be reduced as a result of the shorter project duration under Alternative C.

Overall, fisheries in the project area would not be significantly affected as a result of construction activities under Alternative C.

Long Term

Similar to Alternative B, under Alternative C, a 3-foot raise of Anderson Ranch Dam, will have insignificant direct effects on the fisheries resources because water management practices will remain largely unchanged. The 3-foot raise will increase the storage capacity of Anderson Ranch Reservoir by approximately 14,400 acre-feet for an active capacity of approximately 427,474 acre-feet. The dam raise represents a 3% increase in the active capacity of Anderson Ranch Reservoir and a 1% increase in system active capacity.

The operation model for the 3-foot dam raise simulated current operational objectives the same as described under Alternative B. The 3-foot raise of Anderson Ranch Dam and the even smaller increase (when compared to Alternative B) in storage capacity compared to the total storage of Anderson Ranch Reservoir, and the system will have insignificant direct effects on the fisheries' resources. The same as with Alternative B, modeling results of South Fork Boise River stream flow under Alternative C indicate there will be no changes to the ability of Anderson Ranch Dam to continue meeting the minimum flow targets under the No-Action Alternative.

Daily average flows are projected to be within +/- 50 cfs from October through February, +/- 100 cfs from March through May, and are approximately 125 cfs more in early August as compared to the No-Action Alternative. Similar to conditions with Alternative B, use of the Anderson Ranch Dam spillway under Alternative C would not increase compared to existing conditions, and there would be little change in the annual operating range of Arrowrock Reservoir.

Similar to conditions with Alternative B, changes to fish habitat, thermal refugia, food cycle dynamics, water quality, or effects on migration corridors and seasonal habitat use under Alternative C are expected to be insignificant based on operations modeling that show water management practices will remain largely unchanged (Reclamation, 2019). Future conditions in Anderson Ranch and Arrowrock reservoirs throughout most of the year will continue to provide conditions important for existing fish assemblages. Yearly and seasonal fluctuations in water supply and irrigation demand will continue.

As described under Alternative B, an elevated pool in Anderson Ranch Reservoir and altered refill regime into Arrowrock Reservoir (via South Fork Boise River) that would occur under Alternative C is anticipated to improve temporal access to cold water refugia for salmonids in the system and increase seasonal connectivity to tributaries entering Anderson Ranch and Arrowrock reservoirs. During annual periods of warm summer conditions and extreme drawdowns, migration corridors may provide improved access to more favorable conditions, compared to baseline conditions in unregulated portions of the watershed that provide limited habitat conditions throughout the year. This would be anticipated to occur to a lesser extent under Alternative C (due to the decrease in realized pool elevation and reservoir capacity), than with Alternative B, but to occur to some extent nonetheless.

Although limited long-term impacts to fisheries and their habitat reflective of a managed system would persist under Alternative C, they would not be anticipated to occur at or be elevated to a level of significance in the analysis area under the proposed action. Consistent with Alternative B, no increased introduction of aquatic invasive species would be anticipated, tributary connectivity would be maintained or improved, and in-river flows would not be altered outside of the range that currently exists. With Alternative C, existing habitat availability and function would persist, and existing fish populations would not be expected to be measurably affected. No long-term significant impacts to fish or other aquatic species under Alternative C are anticipated to occur.

Over the long term, beneficial effects from Alternative C may be realized as a result of an elevated pool in Anderson Ranch Reservoir, extended temporal connection with entering tributaries, and altered refill regime of waters into Arrowrock Reservoir (via South Fork Boise River); however, these would be anticipated to occur to a lesser extent than under Alternative B.

3.2.4 Cumulative Effects

Cumulative effects are analyzed for the Alternative B and Alternative C. Cumulative effects are those that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. The cumulative effects analysis considers projects, programs, and policies that are not speculative and are based on known or reasonably foreseeable long-range plans, regulations, operating agreements, or other information that establishes them as reasonably foreseeable. While no present actions are identified, Reclamation has identified two past actions: Pine Bridge at the South Fork Boise River and the 4-foot Anderson Ranch Dam crest raise for security enhancement. Reclamation

has also identified two potential future projects to be considered for the cumulative impact analysis: Cat Creek Energy Project and South Fork Boise River Diversion Project. Additional project proposal information for these, as known by Reclamation to date, is provided in Chapter 2 of the EIS.

The analysis boundary is the Boise River system. Implementing Alternative B or Alternative C would increase the area of inundation in Anderson Ranch Reservoir at maximum pool raise by as much as 146 acres (under Alternative B) and as much as 72 acres under Alternative C. This would increase aquatic habitat in the shoreline area under certain conditions. An elevated pool in Anderson Ranch Reservoir would essentially shift access from terrestrial to aquatic habitat along the shoreline, which would likely result in altered access to habitats that occur along the fringe of the shoreline used by fish and other aquatic species. No increased fish mortality is expected as a result of factors that may occur during the approximately 18 additional days of inundation above existing full pool elevation of 4196 under Alternative B, nor during the approximately 9 additional days of inundation under Alternative C. Beneficial impacts to fisheries are anticipated to occur with increased habitat and extended temporal connectivity with some tributaries entering Anderson Ranch Reservoir.

Native fish populations in the project area have been impacted by decades of land use actions that have resulted in disconnected and degraded habitats and introduced competition from non-native species. Adverse effects such as these will continue as a result of water use and land management in the area from existing activities and those that may occur in the future. The Cat Creek Lease of Power Project and the South Fork Boise River Diversion Project, if implemented, would be anticipated to further affect native fish populations. Once completed, the projects may adversely affect water quantity, water quality in the analysis area, or introduce sediment, contaminants, or noise into the aquatic environment during construction or in association with operating and managing these projects. For example, reduced flows during high water years in the South Fork River downstream of Anderson Ranch dam (that could result under either of these future alternatives) would be anticipated to reduce important ecological benefits such as scour and sediment transport that are important to healthy fisheries and their habitat. Without specific project details it is difficult to ascertain the extent of these effects, however depending on the duration and extent of impacts the potential for significant effects to fisheries resources exists.

Impacts as a result of construction activities from the proposed action are temporary and would not continue after construction is completed. Any cumulative effects on fisheries, although not anticipated to be significant based on the details and analysis of the proposed action, would be dependent on activities developed for construction and operations of the Cat Creek Lease of Power Project and the South Fork Boise River Diversion Project.

3.2.5 Mitigation

Under the proposed action, adverse effects to fisheries and their environment (i.e. water quality) have the potential to occur as a result of construction activities. Conservation measures and environmental commitments would be implemented as necessary to minimize potential significant impacts to fish and aquatic resources in the project area. Such measures

for fisheries under Alternative B and Alternative C are described in detail in the Environmental Commitments, EIS Section 3.28.

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