BIOLOGICAL OPINION
FOR THE
BUREAU OF RECLAMATION OPERATIONS AND MAINTENANCE FOR PROJECTS IN THE SNAKE RIVER BASIN ABOVE BROWNLEE RESERVOIR

Effects to Bull Trout in the Powder River, Oregon and Critical Habitat in Idaho and Oregon

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1. BACKGROUND

1.1 Introduction

This Biological Opinion (Opinion), prepared by the U.S. Fish and Wildlife Service (Service), addresses the effects to bull trout (*Salvelinus confluentus*) critical habitat from the Bureau of Reclamation's (Reclamation) operations and maintenance (O&M) of projects within the Boise, Payette, Malheur, and Powder river systems (Boise Project, Vale Project, and Baker Project), and the hydrologic effects of all Reclamation projects in the upper Snake River Basin above Brownlee Reservoir on bull trout critical habitat in the mainstems of the upper Snake River and the Columbia River, in accordance with the Endangered Species Act (Act) of 1973, as amended. This Opinion also addresses the effects of the future O&M of Reclamation facilities in the Powder River on bull trout as a species listed under the Act. In 2011, two bull trout were documented in Phillips Reservoir[1] in the Powder River, an area which was previously believed to be unoccupied by bull trout, necessitating consultation on the species. Reclamation requested formal consultation in a letter received by the Service on December 30, 2013, for their continued O&M of the projects. As described in this Opinion, and based on the Biological Assessment (USBR 2013, entire) developed by Reclamation and other information, the Service has concluded that future O&M of the projects, as proposed, is not likely to jeopardize the continued existence of bull trout and is not likely to destroy or adversely modify critical habitat.

Reclamation consulted on the effects of O&M of their projects in the upper Snake River basin above Brownlee Reservoir (hereafter referred to as the upper Snake River projects) in 2004 and received an opinion from the Service in 2005 (USFWS 2005a; reference number OALS#1-4-05-F-432). The 2005 opinion addressed impacts to bull trout and other listed species in the project area through 2034, but not bull trout critical habitat, as none was listed in the project area at the time.

In 2007, Reclamation proposed refinements to their O&M regarding the salmon flow augmentation actions and revised its assessment on impacts to salmon and steelhead and their designated critical habitat below Brownlee Dam in the Biological Assessment for Bureau of Reclamation Operations and Maintenance in the Snake River Basin above Brownlee Reservoir (USBR 2007) to satisfy the direction given by a September 2006 U.S. District Court Opinion and Order of Remand. Reclamation concluded that the salmon flow augmentation refinements described in the 2007 biological assessment would not cause new effects to ESA-listed resident species that were not previously considered in the 2005 opinion and provided this conclusion in a letter to the Service dated September 6, 2007.

In October 2010, "Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States: Final Rule" (75 FR 63898) was posted in the Federal Register by the Service, designating bull trout critical habitat in portions of the Boise, Payette, Malheur, and Powder rivers and the mainstems of the Snake and Columbia rivers, all of which are hydrologically influenced in varying degrees by operation of the upper

[1] Phillips Reservoir was referred to as "Phillips Lake" in the Assessment.

Snake River projects. The designation of critical habitat and the discovery of bull trout in the Powder River have triggered the need for Reclamation to reinitiate consultation.

The 2013 Biological Assessment (Assessment) submitted by Reclamation and this Opinion should be considered companion to the 2004 biological assessment (USBR 2004a) and 2005 opinion (USFWS 2005a) which are incorporated by reference and include details not repeated in this Opinion. For example, the proposed actions are the same as described in the 2004 biological assessment and to ensure consistency and reduce duplicative efforts, only summaries of the action were included in the Assessment and the Opinion. Detailed information regarding O&M of each project can be found in the 2004 biological assessment.

The 2005 opinion contained reasonable and prudent measures with associated terms and conditions (T&Cs) aimed at reducing incidental take of bull trout from the upper Snake River projects in the Boise, Payette, and Malheur river systems. Since 2005 Reclamation has conducted numerous studies in compliance with the T&Cs. The new information provides more knowledge and data than were available in 2004. Reclamation considered the new information relevant to bull trout all through the process of writing the Assessment and determined, as described in their Assessment (USBR 2013, pp. 58-59; p. 101; p. 134; p. 199), that the new information do not indicate an effect of a different degree or nature than was previously considered by the Service in the 2005 opinion. Reclamation determined, and the Service agrees, that the previous conclusions are still valid and there is no need to reinitiate consultation for the species, except as described in the Powder River, at this time.

This Opinion evaluates the effects of the upper Snake River projects on designated bull trout critical habitat in the upper Snake River basin and on bull trout in the Powder River basin through the year 2034, taken into account current and future cumulative effects of climate change. The Service considers this consultation to extend through the year 2034 providing there are no changes that trigger re-initiation. Extending this consultation beyond 2034 is contingent upon the proposed actions, assumptions, and conclusions remaining valid.

1.2 Consultation History

The Service has been engaged with Reclamation in the development of materials and information necessary for initiation of formal consultation for over two years. Following is a summary of important correspondence and meetings relevant to our consultation with Reclamation and the development of the final Assessment and this Opinion. A complete record of this consultation is on file at the Service's Idaho Fish and Wildlife Office in Boise, Idaho. The Assessment (USBR 2013, pp. 2-3) provides additional background information relative to their consultations with the Service, National Marine Fisheries Service, and salmon flow augmentation actions. The consultation history provided below supplements that described in the 2005 opinion, which is incorporated by reference.

January 5, 2011	The Service and Reclamation met to discuss reinitiation of the 2005 opinion to address bull trout critical habitat.
March 1, 2011	A follow-up meeting from the January 5th meeting was held to discuss additional strategies, timelines, and process for reinitiation.

May 16, 2011	The Service sent an email to Reclamation with information confirming the presence of bull trout in Phillips Reservoir on the Powder River. The observations reflected new data showing the presence of bull trout, thus requiring reinitiation of the 2005 opinion (USFWS 2005a) specific to the Baker Project.
July 7, 2011	The Service and Reclamation met to review the reinitiation work plan that was developed by Reclamation.
March 15, 2012	The Service and Reclamation met to review and discuss the questions they had regarding the draft biological assessment they were writing.
October 12, 2012	Reclamation provided the Service via email with an updated schedule for completion of the Assessment.
January 18, 2013	Reclamation submitted a draft biological assessment to the Service for review.
Feb – March 2013	The Service provided comments on the draft biological assessment.
February 27, 2013	The Service and Reclamation held a large meeting at Reclamation to go over the draft biological assessment and to discuss the Service's initial comments.
May 1, 2013	The Service and Reclamation met to discuss the draft biological assessment. We went over the revisions, individual chapters, Service comments and the updated schedule.
May – June, 2013	The Service reviewed and provided comments on individual chapters of the revised draft biological assessment.
July 30, 2013	The Service received a newly revised draft biological assessment.
Sept – Oct 2013	The Service provided comments on the most recent version of the draft biological assessment.
December 9, 2013	The Service received a final draft biological assessment for review.
Dec 9 – 23, 2013	The Service and Reclamation discussed the final draft biological assessment in preparation for submission. The Service agreed via phone that the draft biological assessment was sufficient for submission.
December 30, 2013	The Service received the final Assessment and request for consultation.
May 27, 2014	The Service sent a draft biological opinion to Reclamation for review.
June 6, 2014	The Service received comments regarding the draft biological opinion from Reclamation.
June 12, 2014	The Service and Reclamation had a conference call to discuss Reclamation's comments.
June 16, 2014	The Service revised the draft biological opinion based on comments received and provided Reclamation with a draft for review.
June 20, 2014	The Service and Reclamation met to review the draft biological opinion.

2. BIOLOGICAL OPINION

2.1 Description of the Proposed Action

This section describes the proposed Federal action, including any measures that may avoid, minimize, or mitigate adverse effects to listed species or critical habitat, and the extent of the geographic area affected by the action (i.e., the action area). The term "action" is defined in the implementing regulations for section 7 as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." The term "action area" is defined in the regulations as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The upper Snake River project is inclusive of Reclamation's projects in Idaho and Oregon all above Brownlee Reservoir. The following projects are included when we refer to the upper Snake River project:

- Snake River system above Milner Dam (Michaud Flats, Minidoka, Palisades, and Ririe Projects)
- Little Wood River system (Little Wood River Project)
- Owyhee River system (Owyhee Project)
- Boise River system (Arrowrock Division of the Boise Project and Lucky Peak Project)
- Payette River system (Payette Division of the Boise Project)
- Malheur River system (Vale Project)
- Mann Creek system (Mann Creek Project)
- Burnt River system (Burnt River Project)
- Powder River system (Upper Division of the Baker Project)
- Lower Powder River system (Lower Division of the Baker Project)

Although combined, all of the projects influence critical habitat in the Snake and Columbia rivers, and are analyzed under the mainstem sections of this document, not every project has designated critical habitat associated with it. Several of the facilities do not overlap with critical habitat and therefore are not discussed in great detail in this Opinion, except how they influence overall hydrology in the mainstems of the Snake and Columbia rivers. Rather, this Opinion focuses on the long-term operational effects on bull trout critical habitat where it overlaps with specific projects – specifically, the Boise Project, the Vale Project, and the Baker Project.

The proposed actions at the Reclamation projects, or facilities, in the upper Snake River above Brownlee are the same as the O&M activities described in the 2004 assessment (USBR 2004a, pp. 11-27) as refined by the 2007 biological assessment (USBR 2007, pp. 13-17). In general, activities associated with the proposed actions include water storage and release; diversion and pumping; power generation; routine maintenance activities; and the provision of salmon flow augmentation for salmon. T&Cs of the incidental take statements issued with the 2005 opinion (USFWS 2005a) and the 2008 NOAA Fisheries Service opinion (USNOAA 2008) are included as part of the proposed action and incorporated by reference.

2.1.1 Action Area

The action areas associated with the projects are the same as described in the 2004 biological assessment (USBR 2004a, pp.15-27). However, not all of the action areas discussed in the 2004 biological assessment overlap with designated bull trout critical habitat. The following project areas included in that document have no designated bull trout critical habitat:

- Upper Snake system above Milner Dam (Michaud Flats, Minidoka, Palisades, and Ririe projects)
- Little Wood River system (Little Wood River Project)
- Owyhee River system (Owyhee Project)
- Mann Creek system (Mann Creek Project)
- Burnt River system (Burnt River Project)

Action areas discussed in the 2004 biological assessment that do have designated bull trout critical habitat within the action area and are the subjects of this Opinion are:

- Boise River system (USBR 2004a, p. 20).
- Payette River system (USBR 2004a, p. 21).
- Malheur River system (USBR 2004a, p. 22).
- Powder River system (USBR 2004a, pp. 25-26).

For this Opinion, each of the three projects (the Boise, Vale, and Baker) has a distinct action area that begins at the proposed action's furthest upstream effect (i.e., the uppermost extent of the storage reservoir or point of diversion) and ends at the location of its farthest downstream effect on critical habitat or the species. The effects analysis focuses on where designated bull trout critical habitat intersects with the action areas.

The action area also includes the Snake River from Brownlee Dam to its confluence with the Columbia River and then downstream in the Columbia River corridor to its estuary and plume. The combined hydrologic impacts from Reclamation projects above Brownlee are evaluated for their effects on bull trout critical habitat in the Snake River below the Hell Canyon Dam complex and the mainstem Columbia River to the Columbia estuary. Critical habitat is not designated in the mainstem Snake River above Brownlee Dam, therefore analysis of effects and subsequent consultation of those effects in the river above Brownlee is not required under the Act.

2.1.1.1 Boise River Action Area

The action area for the Boise Project in the Boise River system includes:

- Anderson Ranch Reservoir (4,601.1 acres [1,862.0 hectares]) – part of the Anderson Ranch Critical Habitat Subunit (CHSU) and contains foraging, migratory, and overwintering (FMO) habitat.
- South Fork Boise River (22.7 miles [36.5 kilometers]) from approximately Anderson Ranch Dam to Arrowrock Reservoir – parts of the Anderson Ranch and Arrowrock CHSUs and contains FMO habitat.
- Arrowrock Reservoir (3,093.7 acres [1,252.0 hectares]) – part of the Arrowrock Reservoir CHSU and contains FMO habitat.

Figure 1, from the Assessment (USBR 2013) p. 34), displays the action area for the Boise River system.

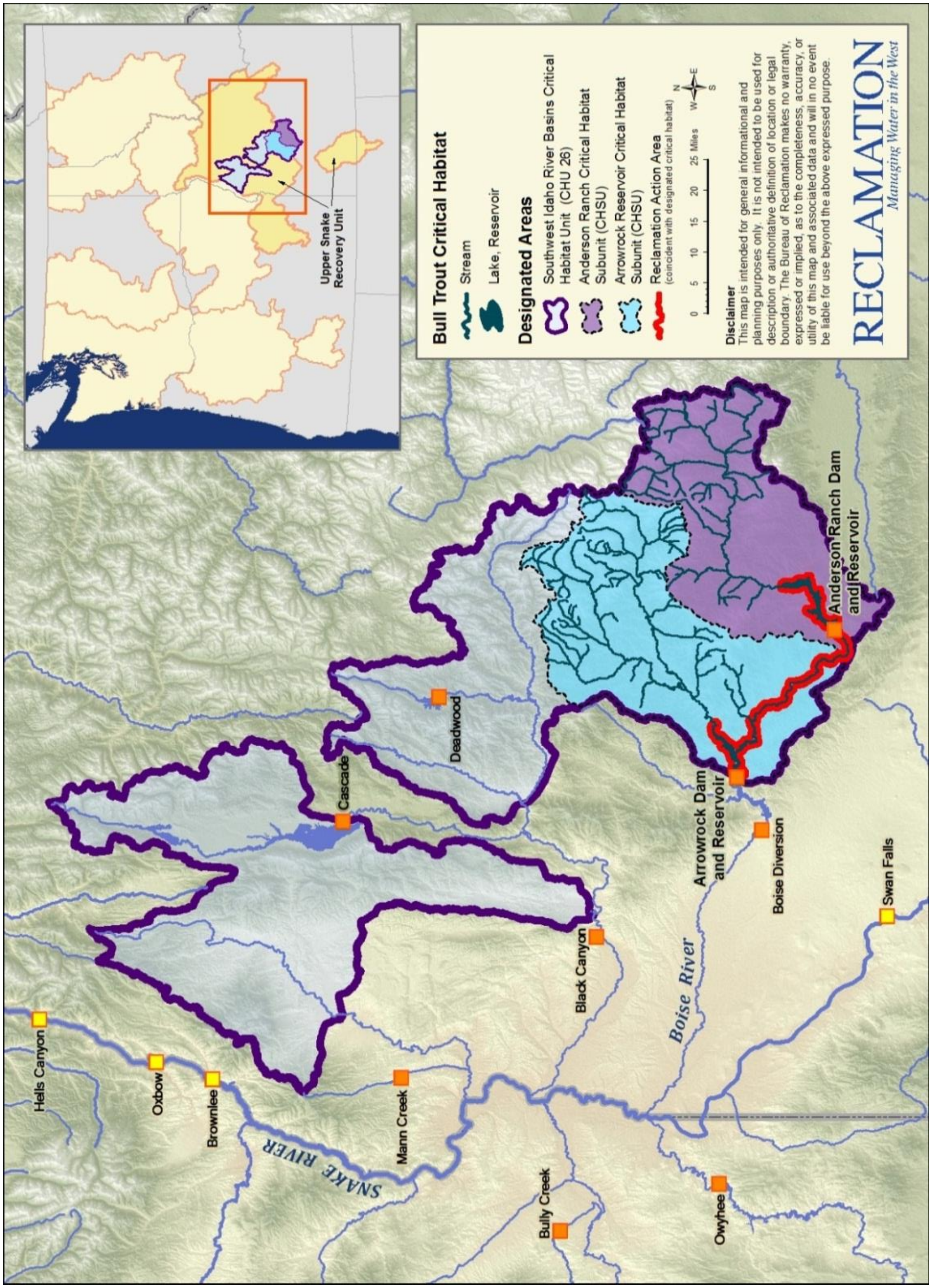

Figure 1. Boise River Action Area

2.1.1.2 Payette River System Action Area

The action area for the Payette River system includes:

- Deadwood Reservoir (2,957.8 acres [1,197.0 hectares]) – part of the Deadwood River CHSU and contains FMO habitat.
- Lower Deadwood River from its confluence with the South Fork Payette River upstream 23.0 miles (37.0 kilometers) to Deadwood Dam – part of the Deadwood River CHSU and contains FMO habitat.
- Portions of the South Fork Payette River from its confluence with the Middle Fork Payette River upstream to the confluence of Deadwood River 24.5 miles (39.4 kilometers) – part of the South Fork Payette River CHSU and contains FMO habitat.

Figure 2, from the Assessment (USBR 2013, p. 78), displays the action area for the Payette River system.

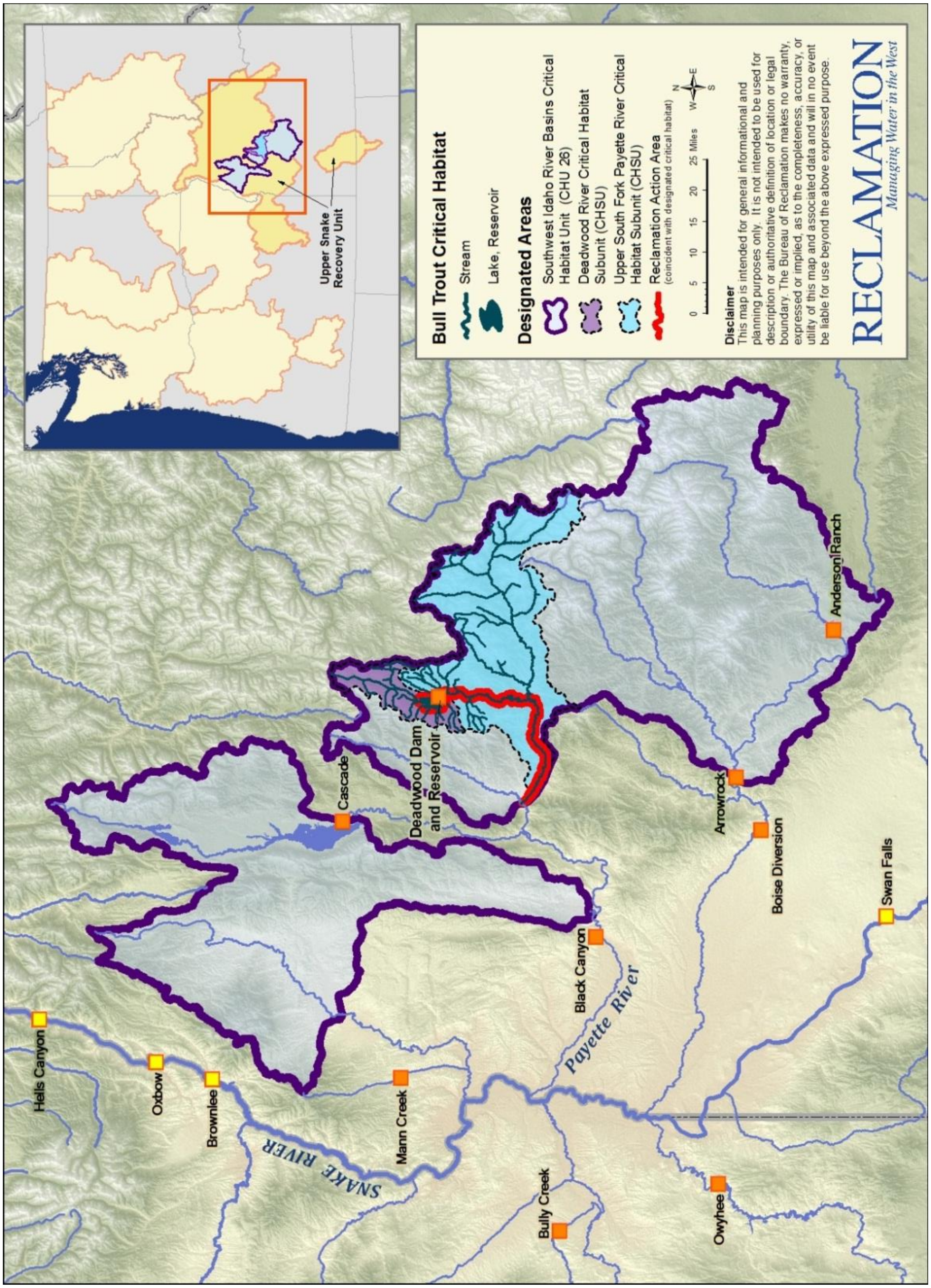

Figure 2. Payette River Action Area

2.1.1.3 Malheur River System Action Area

The action area for the Malheur River system includes:

- Beulah Reservoir (1,769 acres [716 hectares]) – part of the North Fork Malheur River CHSU and contains FMO habitat.

Figure 3, from the Assessment (USBR 2013, p. 118), displays the action area for the Malheur River system.

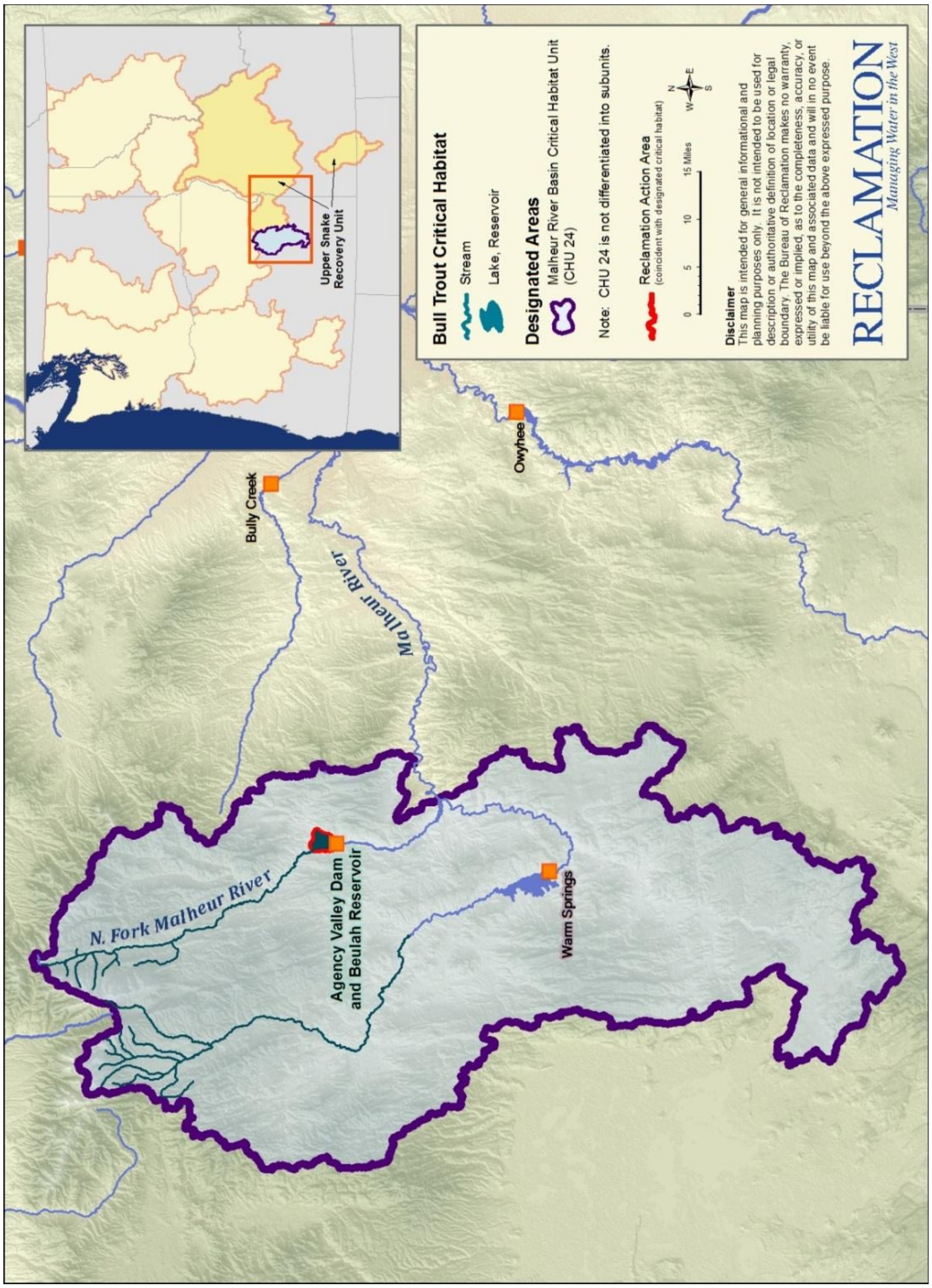

Figure 3. Malheur River System Action Area

2.1.1.4 Powder River System Action Area

The action area for the Powder River system includes:

- Phillips Reservoir (897 hectares [2216.5 surface acres]): This part of the Upper Powder River Critical Habitat Unit (CHU) provides potential FMO habitat and connectivity to the upper Powder River, Deer Creek, and Lake Creek populations. This area is referred to as the "Phillips Reservoir" section throughout this document.
- Powder River - North Powder River: The portion of the Powder River CHU from the confluence with Wolf Creek upstream 0.5 miles (0.8 kilometers) to the confluence with the North Powder River. This area provides potential FMO habitat between populations in the North Powder River and Wolf Creek, but the primary function is thought to be as a migratory corridor. This area is referred to as the "North Powder River" section throughout this document.
- Powder River - Eagle Creek: The portion of the Powder River CHU from the historic confluence with the Snake River (currently within Brownlee Reservoir) upstream 9.5 miles (15.3 kilometers) to the confluence with Eagle Creek. Less than a mile of this portion of the action area is currently upstream of the full pool elevation of Brownlee Reservoir. This area provides potential FMO habitat. This area is referred to as the "Eagle Creek" section throughout this document.

Figure 4, from the Assessment (USBR 2013, p.143), displays the action area for the Powder River system.

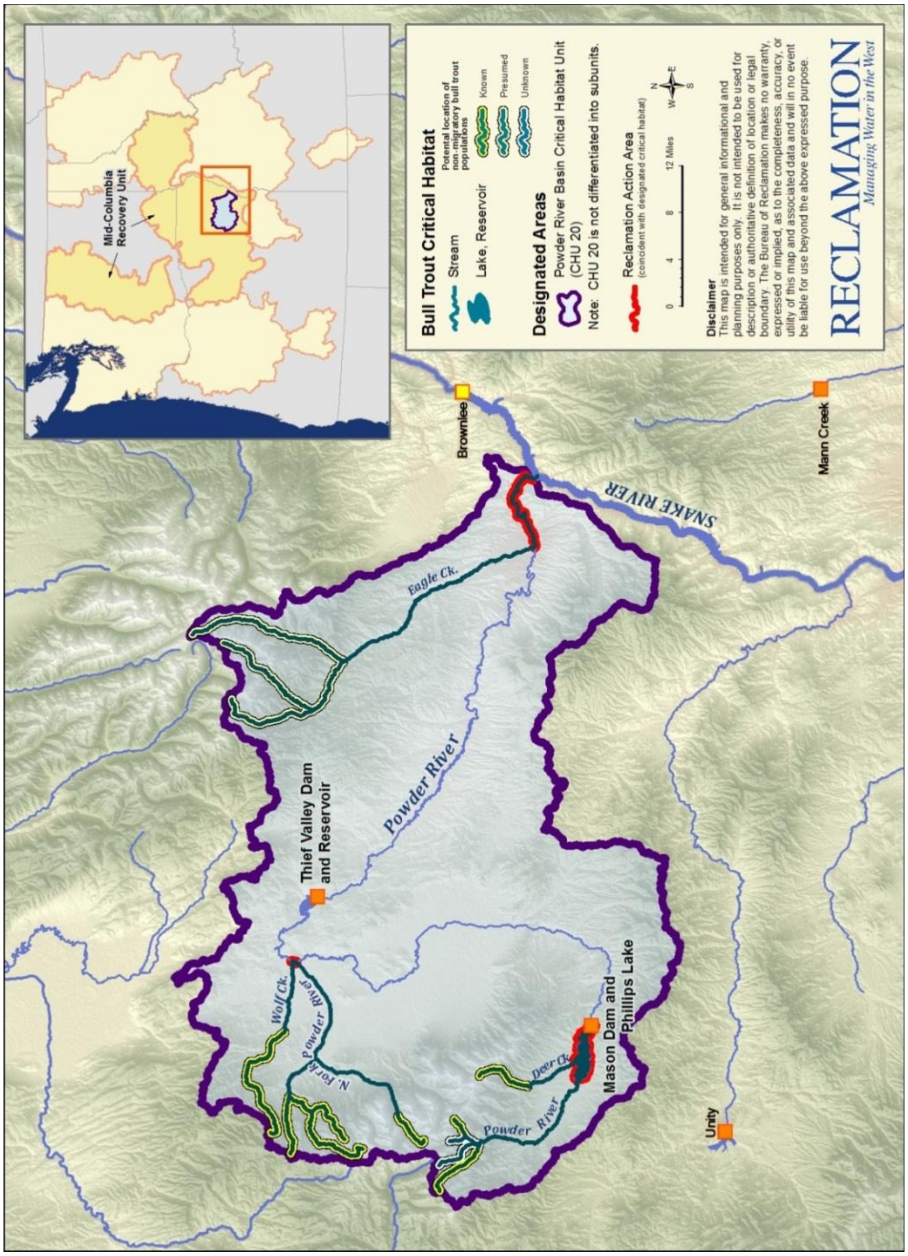

Figure 4. Powder River System Action Area

2.1.1.5 Mainstem Snake and Columbia River Action Area

The action area for the mainstem Snake and Columbia rivers includes:

- The mainstem Snake River includes the mainstem Snake River CHU (CHU 23) and extends from Brownlee Dam downstream 280.6 miles (451.7 kilometers) to the confluence with the Columbia River.
- The mainstem Columbia River includes portions of the upper mainstem Columbia River CHU (323.3miles [520.1 kilometers]; CHU 22) from the confluence of the Snake and Columbia rivers to John Day Dam, and the entire Lower Columbia CHU (211.5 miles [340.4 kilometers]; CHU 8) from John Day Dam to the mouth of the Columbia River.

- The mainstem Snake River and Upper Columbia River CHUs provide feeding, migratory, and/or over-wintering habitat and connectivity. The mainstem Snake River provides connectivity for bull trout in the Hells Canyon Complex CHU and tributaries to the Snake River (i.e., Sheep and Granite creeks). The mainstem Upper Columbia River CHU provides only connectivity between the mainstem CHUs and to numerous CHSUs associated with tributary systems of the Columbia River.

None of the units addressed in this section support spawning and rearing habitat. Figure 5, from the Assessment (USBR 2013, p. 184), displays the action area for the mainstems.

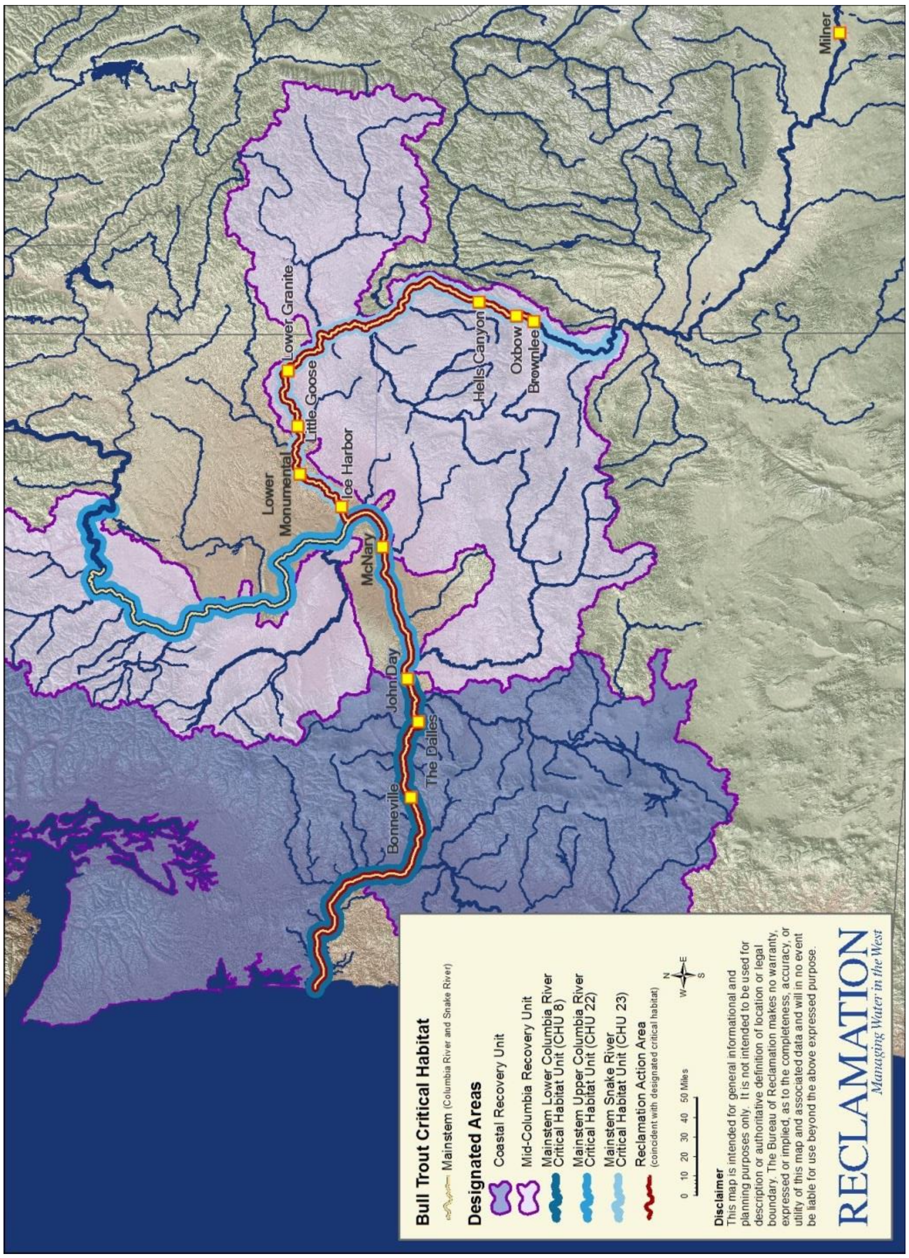

Figure 5. Mainstem Columbia and Snake Rivers

2.1.2 Proposed Action

As stated in the introduction, the proposed actions at the Reclamation facilities in the upper Snake River above Brownlee Dam are the same as the O&M activities described in the 2004 assessment (USBR 2004a, pp. 11-27) and include the terms and conditions issued with the 2005 opinion (USFWS 2005a) and the 2008 NOAA Fisheries opinion (USNOAA 2008). Following are short descriptions of the proposed action at the facilities included in this consultation.

2.1.2.1 Operations in the Boise River System

The O&M in the Boise River system includes continued O&M activities of the Arrowrock Division of the Boise Project and the Lucky Peak Project[2]. Since the 2004 biological assessment, a new power plant and valves were added to Arrowrock Dam; however, power production is subordinate to flood control and irrigation deliveries. The operations are still functioning within the range analyzed in the 2004 biological assessment and 2005 opinion and all other features and O&M activities remain the same as described therein.

The proposed action also includes implementation of terms and conditions (T&Cs) from the 2005 opinion. Table 1 lists the T&Cs, purposes of the T&Cs, and current status of studies or activities designed to address the T&Cs.

Table 1. Terms and Conditions from the 2005 opinion that pertain to Arrowrock or Anderson Ranch reservoirs.

T&C	Action Area	Description	Purpose	Studies/Activities[3]
1.a.	Arrowrock Reservoir	Within the range of proposed operation, decrease the frequency, duration, and extent of drawdowns below elevation 3100 feet in Arrowrock Reservoir during the fall migration period (September 15-October 31).	Reduce the level of take (bull trout) from habitat loss and death from predation in the varial zone.	Ongoing
1.b.	Arrowrock Reservoir	Within the range of proposed operations, decrease the rate and extent of drafting at Arrowrock Reservoir during the summer months (June through September).	Minimize harm associated with reduced reservoir productivity and reduced prey abundance that results from extreme drawdown.	Ongoing

[2] Critical habitat is not designated below Arrowrock in Lucky Peak Reservoir, or the Boise River, therefore it is not discussed further in this Opinion. Lucky Peak Dam is managed by U.S. Army Corps of Engineers but releases are coordinated with operations of Anderson Ranch Dam and Arrowrock Dam in order to meet the primary purpose of flood control.

[3] Reclamation submits annual reports to the Service regarding studies, research, and findings.

T&C	Action Area	Description	Purpose	Studies/Activities[3]
1.c.	Arrowrock Reservoir	Minimize conditions that increase risk of entrainment of bull trout through clamshell outlet conduits in Arrowrock Dam.	Conditions leading to entrainment may occur during three general operating seasons (USFWS 2005a, page 238).	Structural changes (valve replacement) have occurred to eliminate each of the three conditions described.
1.d.	Arrowrock Reservoir	Implement a trap-and-haul program below Arrowrock Dam.	Capture bull trout in Lucky Peak Reservoir and release in Arrowrock Reservoir to return these individuals to the Arrowrock adfluvial population.	Ongoing trap and haul implemented according to Monitoring and Implementation Plan (Reclamation 2006).
2.a.	Anderson Ranch Reservoir and South Fork Boise River	Determine and implement ramping rates (increasing and decreasing) of flows from Anderson Ranch Reservoir that reduce take of bull trout in the South Fork Boise River.	The South Fork Boise River below Anderson Ranch Reservoir provides 26 miles of habitat that is used by bull trout in the Arrowrock Reservoir meta-population.	Ongoing studies.
2.b.	Anderson Ranch Reservoir and South Fork Boise River	Determine the flexibility in the proposed action to manage flows from Anderson Ranch Reservoir to minimize disruption of biological processes, particularly migratory cues of bull trout in the South Fork Boise River.	To determine how discharge from Anderson Ranch Reservoir may affect the migratory and biological cues of bull trout from the Arrowrock Reservoir meta-population that use the South Fork Boise River.	Ongoing bull trout studies including tracking, surveys, and habitat evaluations.

To implement the 2005 T&Cs, Reclamation prepared a monitoring and implementation plan that identified operational indicators to monitor incidental take associated with the proposed action (USBR 2006). Operational indicators describe a set of measurable criteria, such as specific reservoir elevations, that allow Reclamation to verify compliance with the T&Cs (USFWS 2005a, pp. 251-256). Table 2 lists the eight operational indicators associated with the Boise River projects.

Table 2. Operational indicators associated with Anderson Ranch and Arrowrock dams and reservoirs. Data updated through Water Year 2012.

Facility	Anticipated Take	Operational Indicator	Critical Season	Expected Occurrence/ Recorded Occurrences
Anderson Ranch Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by the spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates.	Water is dicharged over the spillway.	Spring	6 of 30 years/ this has occurred once since 2006.
Anderson Ranch Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by the altered flow and temperature regime that disrupts migration and spawning and that increases metabolic rates.	Water is stored and released at Anderson Ranch Dam.	Spring through fall	30 of 30 years/ this has occurred seven times since 2006.
Anderson Ranch Dam and Reservoir	Up to 10 percent of bull trout in the reservoir are entrained into the South Fork Boise River.	Storage and release operations at Anderson Ranch Dam alter the natural flow regime.	Spring	6 of 30 years/ this has not occurred since 2006.
Anderson Ranch Dam and Reservoir	Up to 4 percent of bull trout in the reservoir experience degraded water quality.	Reservoir storage volume falls below 62,000 acre-feet.	Summer	2 of 30 years/this has not occurred since 2006.
Arrowrock Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by low reservoir productivity and decreased prey.	Reservoir volume of less than 200,000 acre-feet at the end of June.	June 30	3 of 30 years/ this has occurred once since 2006.
Arrowrock Dam and Reservoir	Up to 8 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period.	Water is discharged over the spillway.	March through June	15 of 30 years/ this has occurred once since 2006.

Facility	Anticipated Take	Operational Indicator	Critical Season	Expected Occurrence/ Recorded Occurrences
Arrowrock Dam and Reservoir	Up to 2 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir.	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3111 feet.	July through September	30 of 30 years/ this has occurred 5 times since 2006.
Arrowrock Dam and Reservoir	Up to 20 percent of bull trout in the reservoir, as averaged over any 5 consecutive years, experience habitat degradation and predation.	Mean daily reservoir elevation falls below 3100 feet.	September 15 through October 31	18 of 30 years/ this has not occurred since 2006.
Arrowrock Dam and Reservoir	Up to 5 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period.	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3111 feet.	Winter	20 of 30 years/ this has not occurred since 2006.

2.1.2.2 Operations in the Deadwood River and South Fork Payette River Systems

The future O&M of the Deadwood and South Fork Payette River systems (Payette Division of the Boise Project) are described in the 2004 biological assessment (USBR 2004a, p. 20) and in the 2004 Operations Descriptions for Reclamation's projects in the Snake River above Brownlee (USBR 2004b, pages 79-115). In 2010 Reclamation repaired the access bridge to Deadwood Dam. Other than this repair, all facilities and O&M activities remain the same as described in the 2004 biological assessment. The proposed action also incorporates T&Cs from the 2005 opinion that pertain to operation of Deadwood Dam. Table 3 shows the T&Cs, the purpose of the T&Cs, the studies or activities designed to address the T&Cs, and the current status of the studies or activities.

Table 3. Terms and Conditions from the 2005 opinion that pertain to Deadwood Dam and Reservoir.

T&C	Action Area	Description	Purpose	Studies[4]
3.a.	Deadwood Reservoir and River	Within the range of proposed operation, decrease the effects to bull trout below the dam when winter outflow does not match inflow.	Reduce the level of take (bull trout) from loss of winter habitat.	Ongoing
3.b.	Deadwood Reservoir and River	Within the range of proposed operations, reduce the extreme low temperatures below the dam.	Minimize harm associated with reduced prey abundance that results from extreme cold discharge.	Ongoing
3.c.	Deadwood Reservoir and River	Determine and implement ramping rates that reduce harassment and harm of bull trout downstream of the dam.	Ramping rates could strand or flush bull trout or prey base.	Ongoing
3.d.	Deadwood Reservoir and River	Determine flexibility within the proposed action to manage flows from and to minimize disruption of biological processes to bull trout in the river downstream of the dam.	How may discharge from Deadwood Dam affect the migratory and biological cues of bull trout below the dam.	Ongoing
3.e.	Deadwood Reservoir and River	Minimize use of the spillway to avoid entrainment.	Conditions leading to entrainment could occur when the spillway is being used.	Ongoing

To implement the T&Cs, Reclamation prepared a monitoring and implementation plan that identified operational indicators to monitor incidental take associated with the proposed action (USBR 2006). Operational indicators describe a set of measurable criteria, such as specific reservoir elevations, that allow Reclamation to verify compliance with the T&Cs (USFWS 2005a, pp. 251-256). Table 4 lists the four operational indicators associated with Deadwood Dam.

[4] Reclamation submits annual reports to the Service regarding studies, research, and findings.

Table 4. Operational indicators associated with Deadwood Dam. Data updated through Water Year 2012.

Facility	Anticipated Take	Operational Indicator	Critical Season	Expected Occurrence/ Recorded Occurrences
Deadwood Dam	Up to 4 percent of bull trout in Deadwood Reservoir are entrained into the Deadwood River below the dam.	Water discharged over the spillway.	Spring	11 of 30 years/ this has occurred 4 times since 2006.
Deadwood Dam	Up to 4 percent of bull trout in Deadwood Reservoir are affected by degraded water quality.	Reservoir storage volume falls below 50,000 acre-feet.	August through October	2 of 30 years/ this has not occurred since 2006.
Deadwood Dam	All bull trout in the Deadwood River downstream from the dam are affected by spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates.	Water is discharged over the spillway.	May through July	11 of 30 years/ this has occurred 4 times since 2006.
Deadwood Dam	All bull trout in the Deadwood River downstream from the dam are affected by low winter stream flows and temperatures that affect bull trout movement and growth and reproduction of bull trout and the prey base.	Deep water releases at Deadwood Dam and low flows below the dam.	Spring increases, fall reductions, winter discharge.	30 of 30 years/ this has occurred each year since 2006.

2.1.2.3 Operations in the Malheur River System

The future O&M of the Malheur River system is described in the 2004 biological assessment (USBR 2004a, p. 21) and in the 2004 Operations Descriptions for Reclamation's projects in the Snake River above Brownlee (USBR 2004b, pp. 119-127). The proposed action includes the continued O&M of the Vale Project which consists of Agency Dam and Beulah Reservoir. Since the 2004 biological assessment, no new facilities have been constructed in the Malheur River system. All other features and O&M activities are the same as described in the 2004 Upper Snake assessment.

The proposed action also incorporates implementation of T&Cs from the 2005 opinion. Table 5 lists T&Cs, the purposes of the T&Cs, and the current status of studies or activities designed to address the T&Cs.

Table 5. Terms and Conditions from the 2005 opinion that pertain to Agency Valley Dam and Beulah Reservoir.

T&C	Action Area	Description	Purpose	Studies[5]
4.a	Agency Valley Dam	Reduce frequency and extent of drawdown of Beulah Reservoir. Work to identify target reservoir elevation to minimize take effects from reservoir drawdown.	Reduce harm and harassment associated with reduced or eliminated prey.	Ongoing
4.b.	Agency Valley Dam	When conditions preclude maintaining water levels that support a viable bull trout prey base, supplement Beulah Reservoir with suitable prey fish. Supplemental stocking occurs every year that Beulah Reservoir is reduced below the level identified as part of Term and Condition 4.a.	Reduce take associated with reduced reservoir productivity and prey abundance that results from extreme drawdown.	Ongoing
4.c.	Agency Valley Dam	Work to implement any potential mechanism to reduce reservoir drawdown so that the reservoir does not go below a level sufficient to maintain some habitat for bull trout prey.	Reduce anticipated take from reservoir drawdown.	A minimum pool of 2,000 acre-feet has been put in place during ongoing studies until reservoir levels identified in T&C 4.a. have been identified[6].

[5] Reclamation submits annual reports to the Service regarding studies, research, and findings.

[6] A minimum pool of 2000 acre-feet has been put in place through 2015 in order to identify a biologically-based minimum pool recommendation that will reduce the adverse impacts to the prey base in Beulah Reservoir from periodic drawdowns. As stated in the April 23, 2010 letter, should this study fail to identify a minimum pool, the Service recommended defaulting to a minimum conservation pool equal to approximately 18,500 acre feet starting April 30, 2015.

T&C	Action Area	Description	Purpose	Studies[5]
4.d.	Agency Valley Dam	Continue all existing efforts to trap and return bull trout that are entrained during all years when the spillway is used at Agency Valley Dam back to Beulah Reservoir or the North Fork Malheur River upstream of Agency Valley Dam.	Reduce anticipated take from entrainment during years when spill occurs.	Implemented according to Monitoring and Implementation Plan (Reclamation 2006).

To implement the T&Cs of the 2005 opinion, Reclamation prepared a monitoring and implementation plan that identified operational indicators to monitor incidental take associated with the proposed action (USBR 2006). Operational indicators describe a set of measurable criteria, such as specific reservoir elevations, that allow Reclamation to verify compliance with the T&Cs. Table 6 lists the two operational indicators associated with the Vale Project.

Table 6. Operational indicators associated with Agency Valley Dam/ Beulah Reservoir Data updated through Water Year 2012.

Facility	Anticipated Take	Operational Indicator	Critical Season	Expected Occurrence/Recorded Occurrences
Agency Valley Dam/Beulah Reservoir	Up to 10 percent of bull trout in Beulah Reservoir are entrained into the North Fork Malheur River below Agency Valley Dam.	Water is dicharged over the spillway.	May through June	3 of 30 years/ this has occurred twice since 2006.
Agency Valley Dam/Beulah Reservoir	All bull trout that return to Beulah Reserovir to over-winter are affected by a reduced prey base.	Reservoir storage volume falls below 2,000 acre-feet.	August through October	10 of 30 years/ this has occurred 4 times since 2006.

2.1.2.4 Operations in the Powder River

The proposed action for the future O&M of Reclamation facilities in the Powder River system is detailed in the 2004 biological assessment (USBR 2004a, p. 25) and the 2004 Operations Descriptions for Reclamation’s projects in the Snake River above Brownlee (USBR 2004b, pp. 137-142). The proposed action is summarized as the continued O&M of the Upper and Lower Divisions of the Baker Project including Mason Dam and Phillips Reservoir; Savely Dam; Lilley

Pumping Plant; and Thief Valley Dam and Reservoir. Since the 2004 biological assessment, no new facilities have been constructed in the Powder River system. All features and O&M activities remain the same as presented 2004. Effects to bull trout were not analyzed in the Powder River basin in the 2005 opinion because they were not known to use Phillips Reservoir until recently.

2.1.2.5 Proposed Action for the Mainstems Snake River and Columbia River

This section considers the collective hydrologic effect of the several actions described on pp. 4-5 of this Opinion and focuses on how the operation of the upper Snake River projects influences hydrology downstream of Brownlee Reservoir. No new facilities that would affect the downstream hydrology have been constructed in the Snake River system and operations have not changed since the 2004 biological assessment, as amended by the 2007 biological assessment (2004/2007 Upper Snake assessment). No T&Cs were included in the 2005 opinion specifically for the mainstem Snake and Columbia rivers.

2.2 Analytical Framework for the Jeopardy and Adverse Modification Determinations

2.2.1 Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components:

1. The *Status of the Species*, which evaluates the bull trout's rangewide condition, the factors responsible for that condition, and its survival and recovery needs.
2. The *Environmental Baseline*, which evaluates the condition of the bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the bull trout.
3. The *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the bull trout.
4. *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the bull trout's current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the bull trout in the wild.

As discussed below under the *Status of the Species*, interim recovery units have been designated for the bull trout for purposes of recovery planning and application of the jeopardy standard. Per Service national policy (USFWS 2006, entire), it is important to recognize that the establishment of recovery units does not create a new listed entity. Jeopardy analyses must always consider the impacts of a proposed action on the survival and recovery of the species that is listed. While a proposed Federal action may have significant adverse consequences to one or more recovery units, this would only result in a jeopardy determination if these adverse consequences reduce appreciably the likelihood of both the survival and recovery of the listed entity; in this case, the coterminous U.S. population of the bull trout.

The joint Service and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS and NMFS 1998, p. 4-38), which represents national policy of both agencies, further clarifies the use of recovery units in the jeopardy analysis:

> When an action appreciably impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, include in the biological opinion a description of how the action affects not only the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole.

The jeopardy analysis in this Opinion conforms to the above analytical framework.

2.2.2 Adverse Modification Determination

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Opinion relies on four components:

1. The *Status of Critical Habitat*, which evaluates the rangewide condition of designated critical habitat for the bull trout in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall.
2. The *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area.
3. The *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units.
4. *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

The analysis in this Opinion places an emphasis on using the intended rangewide recovery function of bull trout critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

2.3 Status of the Species and Critical Habitat

This section presents information about the regulatory, biological and ecological status of the bull trout and its critical habitat that provides context for evaluating the significance of probable effects caused by the proposed action.

2.3.1 Bull Trout

2.3.1.1 Listing Status

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout occurs in the Klamath River Basin of south-central Oregon, the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound, east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, and east of the Continental Divide in northwestern Montana (Cavender 1978, pp. 165-166; Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Leary and Allendorf 1997, pp. 715-720). The Service completed a 5-year Review in 2008 and concluded that the bull trout should remain listed as threatened (USFWS 2008, p. 53).

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647, 64 FR 17110). The preamble to the final listing rule for the U.S. coterminous population of the bull trout discusses the consolidation of these DPSs, plus two other population segments, into one listed taxon and the application of the jeopardy standard under Section 7 of the Act relative to this species (64 FR 58930):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under Section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Thus, as discussed above under the *Analytical Framework for the Jeopardy and Adverse Modification Determinations*, the Service's jeopardy analysis for the proposed Project will involve consideration of how the Project is likely to affect the Mid- Columbia interim recovery unit for the bull trout based on its uniqueness and significance as described in the DPS final listing rule cited above, which is herein incorporated by reference. However, in accordance with Service national policy, the jeopardy determination is made at the scale of the listed species: In this case, the coterminous U.S. population of the bull trout.

2.3.1.1.1 Reasons for Listing

Though wide ranging in parts of Oregon, Washington, Idaho, and Montana, bull trout in the interior Columbia River basin presently occur in only about 45 percent of the historical range (Quigley and Arbelbide 1997, p. 1177; Rieman et al. 1997, p. 1119). Declining trends due to the combined effects of habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, angler harvest and poaching, entrainment into diversion channels and dams, and introduced nonnative species (e.g., brook trout, *Salvelinus fontinalis*) have resulted in declines in range-wide bull trout distribution and abundance (Bond 1992, p. 4; Schill 1992, p. 40; Thomas 1992, pp. 9-12; Ziller 1992, p. 28; Rieman and McIntyre 1993, pp. 1-18; Newton and Pribyl 1994, pp. 2, 4, 8-9). Several local extirpations have been reported, beginning in the 1950s (Rode 1990, p. 1; Ratliff and Howell 1992, pp. 12-14; Donald and Alger 1993, p. 245; Goetz 1994, p. 1; Newton and Pribyl 1994, p. 2; Berg and Priest 1995, pp. 1-45; Light et al. 1996, pp. 20-38; Buchanan and Gregory 1997, p. 120).

Land and water management activities such as dams and other diversion structures, forest management practices, livestock grazing, agriculture, road construction and maintenance, mining, and urban and rural development continue to degrade bull trout habitat and depress bull trout populations (USFWS 2002a, p. 13).

2.3.1.2 Species Description

Bull trout (*Salvelinus confluentus*), member of the family Salmonidae, are char native to the Pacific Northwest and western Canada. The bull trout and the closely related Dolly Varden (*Salvelinus malma*) were not officially recognized as separate species until 1980 (Robins et al. 1980, p. 19). Bull trout historically occurred in major river drainages in the Pacific Northwest from the southern limits in the McCloud River in northern California (now extirpated), Klamath River basin of south central Oregon, and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, pp. 165-169; Bond 1992, pp. 2-3). To the west, the bull trout's current range includes Puget Sound, coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992, pp. 2-3). East of the Continental Divide bull trout are found in the headwaters of the Saskatchewan River in Alberta and the MacKenzie River system in Alberta and British Columbia (Cavender 1978, pp. 165-169; Brewin and Brewin 1997, pp. 209-216). Bull trout are wide spread throughout the Columbia River basin, including its headwaters in Montana and Canada.

2.3.1.3 Life History

Bull trout exhibit resident and migratory life history strategies throughout much of the current range (Rieman and McIntyre 1993, p. 2). Resident bull trout complete their entire life cycle in the streams where they spawn and rear. Migratory bull trout spawn and rear in streams for 1 to 4 years before migrating to either a lake (adfluvial), river (fluvial), or, in certain coastal areas, to saltwater (anadromous) where they reach maturity (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Resident and migratory forms often occur together and it is suspected that individual bull trout may give rise to offspring exhibiting both resident and migratory behavior (Rieman and McIntyre 1993, p. 2).

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993, p. 4). Watson and Hillman (1997, p. 248) concluded that watersheds must have specific physical characteristics to provide habitat requirements for bull trout to successfully spawn and rear. It was also concluded that these characteristics are not necessarily ubiquitous throughout these watersheds, thus resulting in patchy distributions even in pristine habitats.

Bull trout are found primarily in colder streams, although individual fish are migratory in larger, warmer river systems throughout the range (Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2 and 1995, p. 288; Buchanan and Gregory 1997, pp. 121-122; Rieman et al. 1997, p. 1114). Water temperature above 15°C (59°F) is believed to limit bull trout distribution, which may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989, p. 133; Rieman and McIntyre 1995, pp. 255-296). Spawning areas are often associated with cold water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Goetz (1989, pp. 22, 24) suggested optimum water temperatures for rearing of less than 10°C (50°F) and optimum water temperatures for egg incubation of 2 to 4°C (35 to 39°F).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Goetz 1989, pp. 22-25; Pratt 1992, p. 6; Thomas 1992, pp. 4-5; Rich 1996, pp. 35-38; Sexauer and James 1997, pp. 367-369; Watson and Hillman 1997, pp. 247-249). Jakober (1995, p. 42) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that suitable winter habitat may be more restrictive than summer habitat. Bull trout prefer relatively stable channel and water flow conditions (Rieman and McIntyre 1993, p. 6). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 368-369).

The size and age of bull trout at maturity depend upon life history strategy. Growth of resident fish is generally slower than migratory fish; resident fish tend to be smaller at maturity and less fecund (Goetz 1989, p. 15). Bull trout normally reach sexual maturity in 4 to 7 years and live as long as 12 years. Bull trout are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, p. 95; Fraley and Shepard 1989, p. 135; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133).

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Migratory bull trout frequently begin spawning migrations as early as April, and have been known to move upstream as far as 250 kilometers (km) (155 miles (mi)) to spawning grounds (Fraley and Shepard 1989, p. 135). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p.1) and, after hatching, juveniles remain in the substrate. Time from egg deposition to emergence may exceed 200 days. Fry normally emerge from early April through May depending upon water temperatures and increasing stream flows (Pratt 1992, p. 1).

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up and downstream, not only for repeat spawning, but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous (fishes that spawn once and then die, and therefore require only one-way passage upstream) salmonids. Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route.

Bull trout are opportunistic feeders with food habits primarily a function of size and life history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, zooplankton and small fish (Boag 1987, p. 58; Goetz 1989, pp. 33-34; Donald and Alger 1993, pp. 239-243). Adult migratory bull trout are primarily piscivores, known to feed on various fish species (Fraley and Shepard 1989, p. 135; Donald and Alger 1993, p. 242).

2.3.1.3.1 Population Dynamics

The draft bull trout Recovery Plan (USFWS 2002a, pp. 47-48) defined core areas as groups of partially isolated local populations of bull trout with some degree of gene flow occurring between them. Based on this definition, core areas can be considered metapopulations. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meefe and Carroll 1994, p. 188). In theory, bull trout metapopulations (core areas) can be composed of two or more local populations, but Rieman and Allendorf (2001, p. 763) suggest that for a bull trout metapopulation to function effectively, a minimum of 10 local populations are required. Bull trout core areas with fewer than 5 local populations are at increased risk of local extirpation, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk (USFWS 2002a, pp. 50-51).

The presence of a sufficient number of adult spawners is necessary to ensure persistence of bull trout populations. In order to avoid inbreeding depression, it is estimated that a minimum of 100 spawners are required. Inbreeding can result in increased homozygosity of deleterious recessive alleles which can in turn reduce individual fitness and population viability (Whitesel et al. 2004, p. 36). For persistence in the longer term, adult spawning fish are required in sufficient numbers to reduce the deleterious effects of genetic drift and maintain genetic variation. For bull trout, Rieman and Allendorf (2001, p. 762) estimate that approximately 1,000 spawning adults within any bull trout population are necessary for maintaining genetic variation indefinitely. Many local bull trout populations individually do not support 1,000 spawners, but this threshold may be met by the presence of smaller interconnected local populations within a core area.

For bull trout populations to remain viable (and recover), natural productivity should be sufficient for the populations to replace themselves from generation to generation. A population that consistently fails to replace itself is at an increased risk of extinction. Since estimates of population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an indicator of a spawning adult population. The direction and magnitude of a trend in an index can be used as a surrogate for growth rate.

Survival of bull trout populations is also dependent upon connectivity among local populations. Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution even in pristine habitats (Rieman and McIntyre 1993, p. 7). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991, p. 22). Burkey (1989, p. 76) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth of local populations may be low and probability of extinction high. Migrations also facilitate gene flow among local populations because individuals from different local populations interbreed when some stray and return to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished in this manner.

In summary, based on the works of Rieman and McIntyre (1993, pp. 9-15) and Rieman and Allendorf (2001, pp 756-763), the draft bull trout Recovery Plan identified four elements to consider when assessing long-term viability (extinction risk) of bull trout populations: (1) number of local populations, (2) adult abundance (defined as the number of spawning fish present in a core area in a given year), (3) productivity, or the reproductive rate of the population, and (4) connectivity (as represented by the migratory life history form).

2.3.1.4 Status and Distribution

As noted above, in recognition of available scientific information relating to their uniqueness and significance, five population segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as: (1) Jarbidge River, (2) Klamath River, (3) Coastal-Puget Sound, (4) St. Mary-Belly River, and (5) Columbia River. Each of these segments is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within the Columbia River is provided below. A comprehensive discussion of the other five population segments is found in the draft bull trout Recovery Plan (USFWS 2002a, entire).

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002a, p. 54). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and, in some cases, their use of spawning habitat. Each of the population segments listed below consists of one or more core areas. One hundred and twenty one core areas are recognized across the United States range of the bull trout (USFWS 2005b, p. 9).

A core area assessment conducted by the Service for the 5 year bull trout status review determined that of the 121 core areas comprising the coterminous listing, 43 are at high risk of extirpation, 44 are at risk, 28 are at potential risk, 4 are at low risk and 2 are of unknown status (USFWS 2008, p. 29).

2.3.1.4.1 Columbia River

The Columbia River population segment includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997, p. 1177). This population segment currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in Idaho and northwestern Montana.

The condition of the bull trout populations within these core areas varies from poor to good, but generally all have been subject to the combined effects of habitat degradation, fragmentation and alterations associated with one or more of the following activities: Dewatering, road construction and maintenance, mining and grazing, blockage of migratory corridors by dams or other diversion structures, poor water quality, incidental angler harvest, entrainment into diversion channels, and introduced nonnative species.

The Service has determined that of the total 97 core areas in this population segment, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, 2 are at low risk, and 2 are at unknown risk (USFWS 2005b, pp. 1-94).

The draft bull trout Recovery Plan (USFWS 2002a, p. v) identifies the following conservation needs for this population segment: (1) maintain or expand the current distribution of the bull trout within core areas, (2) maintain stable or increasing trends in bull trout abundance, (3) maintain and restore suitable habitat conditions for all bull trout life history stages and strategies, and (4) conserve genetic diversity and provide opportunities for genetic exchange.

2.3.1.4.1.1 Columbia River Recovery/Management Units

Achieving recovery goals within each management unit is critical to recovering the Columbia River population segment. Recovering bull trout in each management unit would maintain the overall distribution of bull trout in their native range. Individual core areas are the foundation of management units and conserving core areas and their habitats within management units preserves the genotypic and phenotypic diversity that will allow bull trout access to diverse habitats and reduce the risk of extinction from stochastic events. The continued survival and recovery of each individual core area is critical to the persistence of management units and their role in the recovery of a population segment (USFWS 2002a, p. 54).

The draft bull trout Recovery Plan (USFWS 2002a, p. 2) identified 22 recovery units within the Columbia River population segment. As per the 2002 draft plan, these units are now referred to as management units. Management units are groupings of bull trout with historical or current gene flow within them and were designated to place the scope of bull trout recovery on smaller spatial scales than the larger population segments. The action area for the Powder River is encompassed by the Hells Canyon Complex unit.

2.3.1.4.1.1.1 Hells Canyon Complex Recovery Unit

The Hells Canyon Complex Recovery Unit is 1 of 22 recovery units (RU) designated for bull trout in the Columbia River basin. The Hells Canyon Complex RU includes basins in Idaho and Oregon, draining into the Snake River and its associated reservoirs from below the confluence of the Weiser River downstream to Hells Canyon Dam. This RU contains three Snake River reservoirs, Hells Canyon, Oxbow, and Brownlee. Major watersheds are the Pine Creek, Powder River, and Burnt River drainages in Oregon, and the Indian Creek and Wildhorse River drainages in Idaho.

As summarized in the Draft Recovery Plan (USFWS 2002b, p. 32) bull trout currently occupy areas associated with each of the three Snake River reservoirs in the Hells Canyon Complex RU. For Hells Canyon Reservoir, bull trout occur in the reservoir and two tributary basins, Pine Creek and Indian Creek. For Oxbow Reservoir, bull trout occur in at least two streams (Bear Creek and Crooked River) within Wildhorse River, a tributary basin to the reservoir. For Brownlee Reservoir, bull trout occur in various streams within the Powder River basin, a tributary to the reservoir. Migratory bull trout occur in Hells Canyon Reservoir and likely spawn in the Pine Creek basin and perhaps the Indian Creek basin. Bull trout inhabiting the Wildhorse River and Powder River basins are likely resident fish.

The Hells Canyon Complex RU Team identified two core areas within the recovery unit (USFWS 2002b, p. 32). The Pine-Indian-Wildhorse Core Area encompasses Hells Canyon

Reservoir, Oxbow Reservoir, and their tributaries. A total of seven local populations and two unoccupied areas with potential spawning and rearing habitat were identified in the Pine-Indian-Wildhorse Core Area. The Powder River core area encompasses the Powder River basin upstream from the confluence with Brownlee Reservoir. A total of 10 local populations and 1 unoccupied area with potential spawning and rearing habitat was identified in the Powder River Core Area.

Detailed information about the Hells Complex RU is contained in chapter 13 of the Draft Bull Trout Recovery Plan (USFWS 2002b, entire).

2.3.1.4.1.1.1.1 Powder River Core Area

The Powder River Core Area has 10 local populations including: Upper Powder River (Silver Creek and Little Cracker Creek), Lake Creek, Pine Creek, Salmon Creek, Rock Creek, Big Muddy Creek, North Powder River, Anthony Creek (including North Fork Anthony Creek), Indian Creek, and Wolf Creek (USFWS 2002b, pp. 36-38). The current and recovered status of bull trout in the recovery unit were evaluated in the Draft Recovery Plan based on four population elements: 1) number of local populations; 2) adult abundance; 3) productivity, or the reproductive rate of the population; and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Hells Canyon Complex Recovery Unit Team classified bull trout into relative risk categories based on best available data and the professional judgment of the team. The team determined that the Powder River is at intermediate risk due to the low numbers of local populations and the partial ability of migratory forms to connect with other local populations.

The Service's Five Year Status Review (USFWS 2008, p. 34) concluded that the Powder River core area is at risk of extirpation based on very low population abundance and/or rapidly declining bull trout numbers, range, and/or habitat. We determined that threats to the viability of this core area are substantial and imminent (USFWS 2008, p. 34).

Habitat fragmentation and degradation are likely the most limiting factors for bull trout throughout the Hells Canyon Complex RU. Thief Valley Dam and Mason Dam on the Powder River are impassable fish barriers and restrict access to fish in the lower 70 miles of the Powder River Basin. Mason Dam isolates bull trout in the upper Powder River from bull trout in downstream tributaries of the Powder River above Thief Valley Dam and the upper North Powder River. Other major factors include forest management practices, livestock grazing, agricultural practices, mining, roads, residential development, and fisheries management.

2.3.1.5 Previous Consultations

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a biological opinion. These effects are an important component of objectively characterizing the current condition of the species. To assess consulted-on effects to bull trout, we analyzed all of the biological opinions received by the Region 1 and Region 6 Service Offices from the time of bull trout's listing until August 2003; this sums to 137 biological opinions. Of these, 124 biological opinions (91 percent) applied to activities affecting bull trout in the Columbia Basin population segment, 12 biological opinions (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound population segment, 7 biological opinions (5 percent) applied to activities affecting bull trout in the Klamath Basin population segment, and one biological opinion (< 1 percent) applied to activities affecting the Jarbidge and St. Mary-

Belly population segments (Note: These percentages do not add to 100, because several biological opinions applied to more than one population segment). The geographic scale of these consultations varied from individual actions (e.g., construction of a bridge or pipeline) within one basin to multiple-project actions occurring across several basins.

Our analysis showed that we consulted on a wide array of actions which had varying levels of effect. Many of the actions resulted in only short-term adverse effects, some with long-term beneficial effects. Some of the actions resulted in long-term adverse effects. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery of the bull trout. Furthermore, no actions that have undergone consultation were anticipated to result in the loss of local populations of bull trout.

2.3.1.6 Conservation Needs

The recovery planning process for the bull trout (USFWS 2002a, p. 49) has identified the following conservation needs (goals) for bull trout recovery: (1) Maintain the current distribution of bull trout within core areas as described in recovery unit chapters, (2) maintain stable or increasing trends in abundance of bull trout as defined for individual recovery units, (3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and (4) conserve genetic diversity and provide opportunity for genetic exchange.

The draft bull trout Recovery Plan (USFWS 2002a, p. 62) identifies the following tasks needed for achieving recovery: (1) Protect, restore, and maintain suitable habitat conditions for bull trout, (2) prevent and reduce negative effects of nonnative fishes, such as brook trout, and other nonnative taxa on bull trout, (3) establish fisheries management goals and objectives compatible with bull trout recovery, (4) characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout, (5) conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, (6) use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats, (7) assess the implementation of bull trout recovery by management units, and (8) revise management unit plans based on evaluations.

Another threat now facing bull trout is warming temperature regimes associated with global climate change. Because air temperature affects water temperature, species at the southern margin of their range that are associated with cold water patches, such as bull trout, may become restricted to smaller, more disjunct patches or become extirpated as the climate warms (Rieman et al. 2007, p. 1560). Rieman et al. (2007, pp. 1558, 1562) concluded that climate is a primary determining factor in bull trout distribution. Some populations already at high risk, such as the Jarbidge, may require “aggressive measures in habitat conservation or restoration” to persist (Rieman et al. 2007, p. 1560). Conservation and restoration measures that would benefit bull trout include protecting high quality habitat, reconnecting watersheds, restoring flood plains, and increasing site-specific habitat features important for bull trout, such as deep pools or large woody debris (Kinsella 2005, entire).

2.3.1.7 Climate Change

Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007, p. 1; Battin et al. 2007, p. 6720), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, p. 22; Hari et al. 2006, p. 10; Rieman et al. 2007, p. 1552). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (WWF 2003, p. 184). The range of many species has shifted poleward and upward in elevation. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006, p. 16).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007, p. iii). For example, stream gauge data from western Washington over the past 5 to 25 years indicate a marked increasing trend in water temperatures in most major rivers (ISAB 2007, p. 23).

Climate change has the potential to profoundly alter the aquatic ecosystems upon which the bull trout depends via alterations in water yield, peak flows, and stream temperature, and an increase in the frequency and magnitude of catastrophic wildfires in adjacent terrestrial habitats (Bisson et al. 2003, p. 216).

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature, and has been shown to strongly influence the distribution of other chars. Ground water temperature is linked to bull trout selection of spawning sites, and has been shown to influence the survival of embryos and early juvenile rearing of bull trout. Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer drier areas such as are found on the eastside of the Cascade Mountains. Bisson et al. (2003, p. 216) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate. In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. 2003, p.213).

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-warming impacts to lakes will likely lead to longer periods of thermal stratification and cold-water fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (WWF 2003, p. 191).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007, p. 6724). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species. Although lower elevation river reaches are not expected to experience as severe an impact from alterations in stream hydrology, they are unlikely to provide suitably cold temperatures for bull trout spawning, incubation and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations. Thermal refugia are important for providing bull trout with patches of suitable habitat during migration through or to make feeding forays into areas with greater than optimal temperatures.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region although the scale of that variation may exceed that of States. For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (ISAB 2007 entire; Battin et al. 2007, p. 6725; Rieman et al. 2007, entire). In streams and rivers with temperatures approaching or at the upper limit of allowable water temperatures, there is little if any likelihood that bull trout will be able to adapt to or avoid the effects of climate change/warming. There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As its distribution contracts, patch size decreases and connectivity is truncated, bull trout populations that may be currently connected may face increasing isolation, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007, p. 1560). Due to variations in land form and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently degraded water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

2.3.2 Bull Trout Critical Habitat

2.3.2.1 Legal Status

Ongoing litigation resulted in the U.S. District Court for the District of Oregon granting the Service a voluntary remand of the 2005 critical habitat designation. Subsequently the Service published a proposed critical habitat rule on January 14, 2010 (75 FR 2260) and a final rule on October 18, 2010 (75 FR 63898). The rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Jarbidge River, Klamath River, Coastal-Puget Sound, St. Mary-Belly River, and Columbia River population segments (also considered as interim recovery units)[7].

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles in 32 critical habitat units (CHU) as bull trout critical habitat (see Table 1). Designated bull trout critical habitat is of two primary use types: (1) Spawning and rearing; and (2) foraging, migrating, and overwintering (FMO).

Table 7. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir/ Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	**19,729.0**	**31,750.8**	**488,251.7**	**197,589.2**

Compared to the 2005 critical habitat designation (remanded), the final rule increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower mainstem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: (1) Waters adjacent to non-Federal lands covered by legally operative incidental take permits for

[7] The Service's 5 year review (USFWS 2008, p. 9) identifies six draft recovery units. Until the bull trout draft recovery plan is finalized, the current five interim recovery units are in affect for purposes of section 7 jeopardy analysis and recovery. The adverse modification analysis does not rely on recovery units.

habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended, in which bull trout is a covered species on or before the publication of this final rule; (2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or (3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant CHU text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

2.3.2.2 Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63943). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

As previously noted, 32 CHUs within the geographical area occupied by the species at the time of listing are designated under the final rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical and biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat (see list below).

The primary function of individual CHUs is to maintain and support core areas, which (1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); (2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); (3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and (4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, migrating, and overwintering.

In determining which areas to propose as critical habitat, the Service considered the physical and biological features that are essential to the conservation of bull trout and that may require special management considerations or protection. These features are the PCEs laid out in the appropriate quantity and spatial arrangement for conservation of the species. The PCEs of designated critical habitat are:

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including, but not limited to, permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departures from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

2.3.2.3 Current Rangewide Condition of Bull Trout Critical Habitat

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat.

The primary land and water management activities impacting the physical and biological features essential to the conservation of bull trout include timber harvest and road building, agriculture and agricultural diversions, livestock grazing, dams, mining, urbanization and residential development, and nonnative species presence or introduction (75 FR 2282).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows:

1. Fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7).

2. Degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45).

3. The introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76).

4. In the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development.

5. Degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

The bull trout critical habitat final rule also aimed to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with nonnative fishes).

2.4 Environmental Baseline of the Action Area

This section assesses the effects of past and ongoing human and natural factors that have led to the current status of the species, its habitat and ecosystem in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have already undergone section 7 consultations, and the impacts of state and private actions which are contemporaneous with this consultation.

The following baseline sections discuss current flow conditions, historic flow conditions, and modelled future flows. Current flow conditions are consistent with those modeled for the 2007 assessment and are extensively discussed in Chapter 3 of that document (USBR 2007, pp. 25-47). As in the 2007 analyses, the model output data for this biological assessment were sorted and categorized into wet (10 percent exceedence), average (50 percent exceedence), and dry (90 percent exceedence) water year types based on the modeled total annual volume into Brownlee Reservoir for the MODSIM (model simulation software used to model projections) proposed action scenario. The wet and dry water year types each constitute 10 percent of the years, whereas the average group of water year types comprises the remaining 80 percent. For each of these categories, the data were averaged for use in the analyses for each river basin considered in the Assessment.

An extensive discussion of the historical flow conditions as it relates to the upper Snake River project facilities and action area can be found in the 2004 biological assessment (USBR 2004a, pp. 29-34). The Assessment provides detailed information regarding River Management Joint Operating Committee (RMJOC) Climate Change Study (USBR 2011a, pp. 10-17) and water quality (Appendix B) for the action area.

2.4.1 Bull Trout

2.4.1.1 Status of the Bull Trout in the Action Area

2.4.1.1.1 Powder River Basin

Bull trout in the Powder River system are part of the Mid-Columbia Recovery Unit (USFWS 2002b). Current distribution of bull trout in the Powder River basin is in the headwater tributaries of the Powder River 8.0 to 17.0 miles (12.9 to 27.4 kilometers) upstream from Phillips Reservoir and upstream of the Thief Valley Reservoir 20.0 to 25.0 miles (32.2 to 40.2 kilometers) in the Elkhorn Range. Figure 4 shows current distribution of known bull trout populations in the Powder River basin (headwater tributaries only).

In 1998, ten local populations of bull trout in the Powder River core area were identified, but the status of most of these populations is unknown (USFWS 2002b, pp. 11-14). Nine streams are currently occupied by bull trout: Lake Creek, Upper Powder River, Big Muddy Creek, Salmon Creek, Pine Creek, North Powder River, Anthony Creek, Indian Creek, and Wolf Creek. The current status of the tenth local population Rock Creek is unknown. Populations in these tributaries exhibit a resident life history, but passage barriers and habitat fragmentation limit the potential to migrate to the reservoir or return to their natal water except during periods of high water (USFWS 2002b, pp. 15-16).

There is very little information on existing bull trout populations for the Powder River core area. Much of the data that exists was collected more than 20 years ago (USFWS 2002b, pp. 11-12). According to Nowak (2004, p. 48), bull trout in the Powder River basin are thought to be resident fish, as there were no documented observations of migratory bull trout in the reservoirs, including Phillips Reservoir, as well as the Powder River downstream of Mason Dam. However, Oregon Department of Fish and Wildlife (ODFW) documented two bull trout in Phillips Reservoir during perch removal operations in April 2011. It is unknown at this time whether bull trout in Phillips Reservoir exhibited migratory tendencies or were moved downstream into the reservoir during spring runoff periods.

The recent documentation of two bull trout above Phillips Reservoir might suggest that these local populations (i.e. Lake Creek and Upper Powder River populations which include Silver Creek and Little Cracker Creek) could develop a migratory life history over time if habitat conditions and connectivity were improved. Lake Creek is a tributary to Deer Creek; the confluence of the two is approximately 5.0 miles (8.0 kilometers) upstream of where Deer Creek enters Phillips Reservoir. Bull trout are known to occur in Lake Creek approximately 1.5 miles (2.4 kilometers) upstream from the confluence with Deer Creek (about 6.5 miles [10.5 kilometers] upstream of Phillips Reservoir) (USFWS 2009, p. 253). Suitable spawning and juvenile rearing habitat generally occurs farther upstream and outside of waters affected by the Vale Project.

In the Upper Powder River, the majority of bull trout are thought to occur in Silver Creek and bull trout in Silver Creek and Little Cracker Creek are thought to form one local population, although the degree of movement between these areas is limited by a physical barrier near the mouth of Silver Creek. Bull trout also occur in tributaries of the Powder River below Phillips Reservoir (North Powder River, Big Muddy Creek, Salmon Creek, Pine Creek, Anthony Creek, North Fork Anthony Creek, Indian Creek, and Wolf Creek) (Buchanan et al. 1997, p. 1). For tributaries of the Lower Powder River like Eagle Creek (i.e. downstream of Thief Valley Dam), bull trout are probably extirpated. Habitat fragmentation, nonnative fish species introductions, and habitat degradation have resulted in a significant reduction in bull trout habitat in the Powder River Basin.

2.4.1.2 Factors Affecting the Bull Trout in the Action Area

2.4.1.2.1 Powder River Basin

In general, both historical and current population data are sparse to nonexistent across much of the species range in the Powder River Basin so that the degree of decline can only be qualitatively estimated. The 5-year bull trout status review found that the Powder River population was a population at high risk because of the geographical isolation of watershed subpopulations from each other, the low overall estimated population size, the limited amount of suitable habitat, and the presence of a single primary life history strategy (i.e., resident) (USFWS 2008, pp. 23, 26, 28, 30, 32). It is generally thought that at least 50 spawners are required in a local population to prevent inbreeding depression and 500 to 1,000 adults to prevent population loss through genetic drift (Rieman and McIntyre 1993, p. 10). Presence of the migratory life history strategy provides a mechanism for the species to avoid catastrophic loss through adverse changes in any one habitat; however, there is no documentation of a current or historic migratory population in the Powder River basin (USFWS 2010a, p. 513)

The USFWS (FERC 2009, p. 28) identified the primary factors for the bull trout decline in the Powder River basin: 1) Habitat fragmentation through dams, other physical impediments to passage such as roads, water withdrawals/diversions, and thermal or flow barriers to movements, noting that improperly constructed stream crossings may act as barriers to bull trout movement either constantly or under certain conditions, which prevents bull trout access to suitable habitats and increases isolation of bull trout populations. Habitat fragmentation has occurred at both a large scale within the Hells Canyon Complex, isolating local populations from each other and, at a smaller scale, within local populations; 2) non-native fish species introductions such as lake and brook trout which can compete with or hybridize with bull trout and predatory fish such as yellow perch and brown trout; and 3) habitat degradation through increased water temperature, sedimentation, and loss of stream and floodplain complexity.

2.4.1.3 Current Conditions

2.4.1.3.1 Phillips Reservoir

Fish species in Phillips Reservoir include rainbow trout, crappie, smallmouth and largemouth bass, yellow perch, walleye, and tiger trout (Nowak 2004, p. 38), and most recently tiger muskie (ODFW 2012). Yellow perch and walleye were introduced in the 1980s and yellow perch have dominated the lake fishery. ODFW has sampled nonnative yellow perch in Phillips Reservoir since 1991 (ODFW 2000, p. ii). Sampling occurred in 1991, 1994, and 1999 to investigate the impact of yellow perch on zooplankton and game fish (smallmouth bass, black crappie, and rainbow trout). ODFW (2000, p. ii) concluded from the 1994 investigation that "if yellow perch became abundant, they could potentially cause a shift in the zooplankton community structure and size distribution and reduce warm-water game fish production." ODFW (2000, p. 15) later concluded that the zooplankton population experienced a marked change following the 1994 study. The selection of larger zooplankton by yellow perch drove the zooplankton towards smaller species and individuals that cannot be utilized by young-of-year and juvenile bass and crappie. This change in food web structure complicated management of the Phillips Reservoir fishery.

ODFW began trapping yellow perch to reduce its population (Bailey 2012a, p. 1) and with the objectives of increasing trout growth and survival and increasing yellow perch growth. Trapping operations took place in 2009 (51,574 perch removed), 2010 (360,629), 2011 (354,468), and 2012 (343,000) (Bailey 2012a, p. 5). The estimated yellow perch abundance in the reservoir at the time of the 2011 removal effort was 1,636,575 (Bailey 2012a, p. 6). Annual yellow perch removals are scheduled to continue through 2013.

In spring 2011, ODFW sampled two bull trout in Phillips Reservoir for the first time during yellow perch removal operations. It is unknown whether these fish were adfluvial in nature or had simply been flushed downstream from upper reaches of the Powder River. No bull trout were observed during similar perch removal operations conducted at Phillips Reservoir in 2012 (Bailey 2012b).

In September 2011, ODFW released about 1,600 sterile tiger trout into Phillips Reservoir in an effort to control yellow perch (USBR 2013, p. 154). Tiger trout are known to be highly piscivorous and long lived (12 to 17 years). ODFW believe they will be a good control against perch populations in Phillips Reservoir. In spring 2013, ODFW started a tiger muskie stocking plan, calling for 36,000 fingerling size tiger muskie to be released annually for a period of at least 5 years to control against the expanding perch population (ODFW 2012).

2.4.1.3.2 Upstream of Phillips Reservoir

Nearly all streams in the upper Powder River drainage upstream of Phillips Reservoir contain signs of past mining activities. The most noticeable area is the 6-mile reach of the Powder River between Sumpter and Phillips Reservoir that was dredged, resulting in straightened stream channels and the destruction of meadow areas and riparian vegetation (Nowak 2004, chapter 3.1.1.6). The dredge operations turned the riparian area and floodplain over which created tailings piles, many of which cross the valley floor (Assessment Figure 46). Some riparian vegetation has reestablished, but the tailings piles have constricted the river channel and simplified the channel, disconnecting the river from its floodplain. Dredging activities caused damage to the floodplain function, habitat complexity, pool quality and quantity, riparian vegetation, stream shading, and in-stream channel function.

2.4.1.3.3 Powder River below Mason Dam

Habitat conditions in the Powder River below Mason Dam are poor from Baker City to Thief Valley Dam. Loss of habitat diversity is due to a number of factors including confinement by roads and railroads, diking, straightening, and the loss of riparian vegetation due to agricultural activities (Nowak 2004, chapter 3.1.3.4). Many riparian areas along the mainstem Powder River have been reduced or removed due to agricultural/grazing practices. These practices have resulted in reduced in-stream and stream bank cover, reduced stream bank stability, and increased stream temperatures (USFWS 2002b, p. iv). In an attempt to improve these degraded conditions, the Oregon Watershed Enhancement Board funded projects, including riparian restoration, on 10.0 miles (16.1 kilometers) of the Powder River below Baker City (USFWS 2010a, p. 514). Although this habitat is identified as potential FMO habitat, the functional value may be limited to a seasonal migration corridor between headwater populations.

2.4.2 Bull Trout Critical Habitat

The Service published a final rule designating critical habitat for bull trout rangewide on October 18, 2010 (75 FR 63898). In the final critical habitat justification (USFWS 2010a), the USFWS identified six draft recovery units (RU). Three RUs are affected by the Upper Snake River projects: The Upper Snake River RU, the Mid-Columbia River RU and the lower portion of the action area includes the Coastal RU. Critical habitat associated with each project and the downstream mainstems is discussed below.

The baseline discussion that follows is based on information provided in the Assessment, the RMJOC climate change study, published and unpublished studies and reports, and previous biological assessments and opinions.

2.4.2.1 Boise River Critical Habitat

2.4.2.1.1 Status of Boise River Critical Habitat

The Boise Project in the Boise River system action area overlaps with the Anderson Ranch and Arrowrock Reservoir Critical Habitat Subunits (CHSU [Table 8]). The CHSUs are part of the Southwest Idaho River Basins Critical Habitat Unit (CHU 26) which is one of 32 CHUs in the

Upper Snake River RU. The Southwest Idaho River Basin CHU includes approximately 1,336.0 miles (2,149.6 kilometers) of streams and 10,652.5 acres (4,311.0 hectares) of lake and reservoirs designated as critical habitat. The Southwest Idaho River Basins CHU includes eight CHSUs: Anderson Ranch Reservoir, Arrowrock Reservoir, South Fork Payette River, Deadwood River, Middle Fork Payette River, North Fork Payette River, Squaw Creek, and Weiser River. These subunits are considered essential to bull trout conservation because of the presence of populations exhibiting rare adfluvial life history expressions, a moderate number of local populations, moderate to large numbers of individuals, a moderate amount of habitat, and few threats (USFWS 2010a, p. 613).

Table 8. Critical habitat stream miles, surface area, and storage volumes within the Southwest Idaho River Basin Critical Habitat Unit (CHU) and Critical Habitat Subunits (CHSUs).

Critical Habitat Unit	Critical Habitat Stream Miles (kilometers)	Critical Habitat Surface Area - Acres (hectares)	Critical Habitat Storage - Acre-feet
Southwest Idaho River Basins 26 - 4,158.3 total stream miles (6,692.2 kilometers)	**1,335.2 (2,149.0)**	**10,652.5 (4,311.0)**	**901,100**
Southwest Idaho River Basins CHU Subunits (CHSUs)			
Weiser River	70.4 (113.3)	0	0
Squaw Creek	44.9 (72.3)	0	0
NF Payette River	19.3 (31.1)	0	0
MF Payette River	122.7 (197.6)	0	0
Upper South Fork Payette River	278.0 (447.4)	0	0
Deadwood River	77.0 (123.9)	2,957.8 (1,197.0)	154,000
Arrowrock Reservoir	447.4 (720.0)	3,093.7 (1,252.0)	272,200
Anderson Ranch Reservoir	275.5 (443.4)	4,601.0 (1,862.0)	474,900

Figure 1 (p. 6) shows the Boise River basin bull trout core areas coincident with the CHSUs, CHU boundaries, designated critical habitat streams and reservoirs, and action area for the Boise River basin projects. The action area includes 4,601 acres of FMO habitat in Anderson Ranch Reservoir; 22.7 miles of FMO habitat in the South Fork Boise River from Anderson Ranch Reservoir to Arrowrock Reservoir; and 3,093.7 acres of FMO habitat in Arrowrock Reservoir.

Operation of the Boise River system also contributes to the aggregate effect of upper Snake River projects on designated critical habitat located on the mainstem Snake and Columbia rivers. Designated critical habitat on the mainstem Snake and Columbia rivers are part of Mainstem

Snake River CHU (CHU 23), Mainstem Columbia River CHU (CHU 22), and Lower Columbia CHU (CHU 8) and these effects are analyzed Section 2.5.2.5.

2.4.2.1.2 Baseline Condition and Factors Affecting the Boise River Critical Habitat

Detailed information regarding Boise River system water quality can be found in Appendix B (pp. 6-28) of the Assessment. The following baseline hydrology information is from the Assessment (USBR 2013, pp. 35-42).

Baseline Hydrology

Anderson Ranch Dam is located on the South Fork Boise River. At full pool, Anderson Ranch Reservoir stores nearly 475,000 acre-feet of water with a surface elevation of 4,196 feet and a surface area of 4,743 acres (4,601 acres are designated as critical habitat; 75 FR 63898). Slightly more than 413,000 acre-feet of the full volume is active storage.

Arrowrock Dam is located downstream of Anderson Ranch Dam on the Boise River. At full pool, Arrowrock Reservoir stores 271,700 acre-feet of water with a surface elevation of 3,216 feet and a surface area of 3,141 acres.

Reclamation operates the Boise River system as a unified storage system for joint irrigation and flood control. To the extent possible, water is stored in the uppermost reservoir (Anderson Ranch) to maximize refill capabilities of the system. Flood control operations generally run from November 1 through May 31 and the attempt to fill reservoirs occurs in May or early June. From April to October, Reclamation drafts Arrowrock Reservoir for irrigation. The lowest reservoir volumes occur October through March. In wet years, volumes may drop in early spring to meet flood control criteria. See USBR 2004b, pp. 79-117, for more detailed description of the operations.

The 2005 opinion (USFWS 2005a, pp. 258-259) identified operational indicators for both reservoirs to minimize take of bull trout. For Anderson Ranch Dam, Reclamation identified a reservoir storage volume below 62,000 acre-feet (this volume includes powerhead and dead space) by the end of September as an operational indicator to minimize impacts to water quality in dry water years (USFWS 2005a, pp. 259). For Arrowrock Dam, Reclamation identified the mean daily reservoir operation below a surface water elevation of 3100 feet (37,912 acre-feet storage volume) from September 15 to October 31 as an operational indicator to minimize impact to the migration corridor and predation (USFWS 2005a, pp. 258). There is also a reservoir volume target of 200,000 acre-feet by June 30 to minimize impacts on reservoir productivity.

The Assessment (pp. 37-39) includes information on monthly summary hydrograph for wet, average, and dry exceedances, and end of month storage volumes. In general, during the largest exceedance events, storage volume reaches maximum capacity in May and June for Anderson Ranch Reservoir and April and May for Arrowrock Reservoir. Generally, drafting for irrigation initiates in June or July in both reservoirs. During the lowest storage exceedance levels, storage volume remains above 150,000 acre-feet in Anderson Ranch Reservoir and generally above 50,000 acre-feet in Arrowrock Reservoir, with the exception of August when the volume is less than 50,000 acre-feet.

Future Hydrology with Climate Change

The following is from the Assessment pp. 39-42.

Figure 6 and Figure 7 illustrate future hydrology obtained from the RMJOC Climate Change Study that was completed in 2011 (USBR 2011a, p. 146). Figure 6 shows the end-of-month storage volume for Anderson Ranch Dam comparing the results of the University of Washington Climate Impacts Group (UW CIG) simulated historical record to the simulated future period. The Hybrid-Delta 2020 (HD 2020) future dataset was used for comparison because it best represented the period for which this biological assessment is being developed. As shown in Figure 6, both the 10- and 50-percent exceedance level storage volumes have increased from November through April likely due to increased snowmelt and liquid precipitation and higher temperatures due to climate change. The 10-percent exceedance receding limb (July through September) is projected to decrease at a faster rate than has historically occurred due to drier late summer conditions.

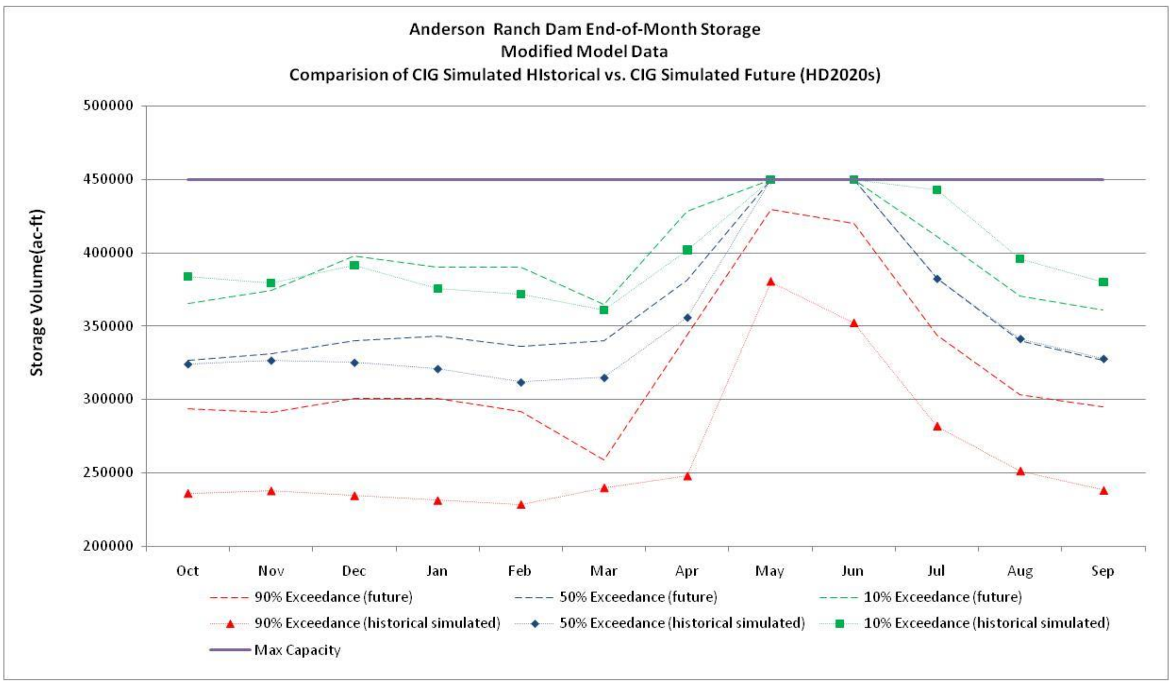

Figure 6. Anderson Ranch Dam end-of-month storage volume comparing UW CIG generated simulated historical (1928 to 2008) to the UW CIG HD 2020 simulated future climate change storage volume.

Hydrographs for dry (90%), average (50%), and wet (10%) exceedances are shown. The UW CIG simulated storage is the average monthly discharge exceedances of the median of six future HD 2020 projections. Maximum capacity of 450,030 acre-feet is active storage volume and powerhead pool volume only.

A significant increase in available stored water is projected to occur in the 90-percent exceedance storage when the simulated future results are compared to simulated historical conditions. This projected increase in the lower exceedance level storage volume may be an artifact of selecting projections based on average changes in climate determined at the larger Columbia River Basin scale (USBR 2011b, p. 131) that were not retained when applied to the upper Snake River basin. Most of the climate change projections, excluding the warmer/drier future, used in the upper Snake River basin analysis generally showed wetter futures with larger inflow volumes.

Figure 7 reflects the discharge from the Anderson Ranch Dam for both the simulated historical period and the future climate change projection. In general, the discharges for all exceedence levels are generally higher during the spring when inflows are shown to be increasing. Other than higher discharges in March through June (approximately), Anderson Ranch Dam discharge patterns is anticipated to remain similar to current conditions.

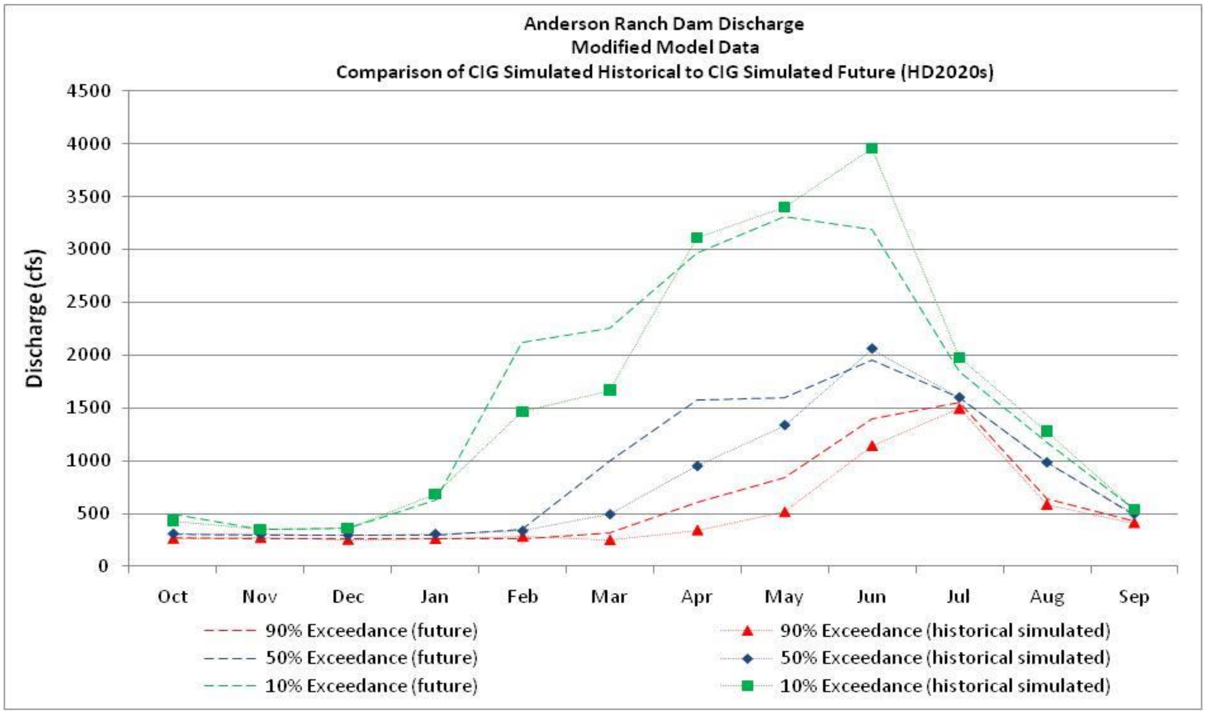

Figure 7. Anderson Reservoir discharge using UW CIG generated simulated historical and future datasets.

Hydrographs for dry (90%), average (50%), and wet (10%) exceedances are shown. UW CIG simulated future flows were generated using the median of six future HD projections and then calculating the average monthly discharge exceedances.

Figure 8 and Figure 9 show Arrowrock Reservoir end-of-month storage volume and reservoir discharge, respectively, comparing water years 1928 to 2008 to the future period of 2020 to 2039 (HD 2020s). As with Anderson Ranch Dam, the end-of-month storage pattern of spring volume exceeding historical volume in Arrowrock Reservoir can be observed. In the low water (90-percent exceedance level) periods when compared to historical conditions, a significant increase in storage volume appears in the spring months and again in the early summer (June, July, and August). This again is likely attributable to the projection method and projected changes in climate change described in the Anderson Ranch Dam discussion.

Figure 9 reflects the discharge from Arrowrock Reservoir for both the simulated historical period and the future climate change projection. In general, the discharges for all exceedence levels are generally higher during the spring when inflows are expected to be greater than historical rates.

Even with higher discharges projected for January through April (approximately), future Arrowrock Dam discharge patterns are anticipated to remain generally similar to current conditions.

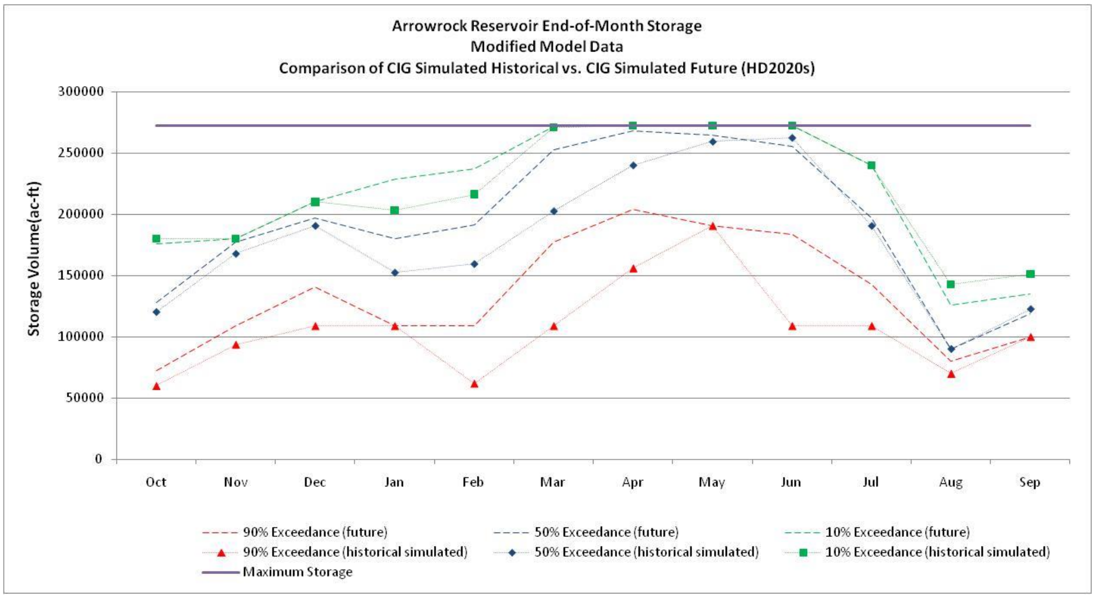

Figure 8. Arrowrock Reservoir end-of-month storage volume comparing UW CIG generated simulated historical (1928 to 2008) to the UW CIG HD 2020 simulated future climate change storage volume.

Hydrographs for dry (90%), average (50%), and wet (10%) exceedances are shown. The UW CIG simulated storage is the average monthly discharge exceedances of the median of six future HD 2020 projections. Maximum capacity of 272,224 acre-feet is active storage volume only.

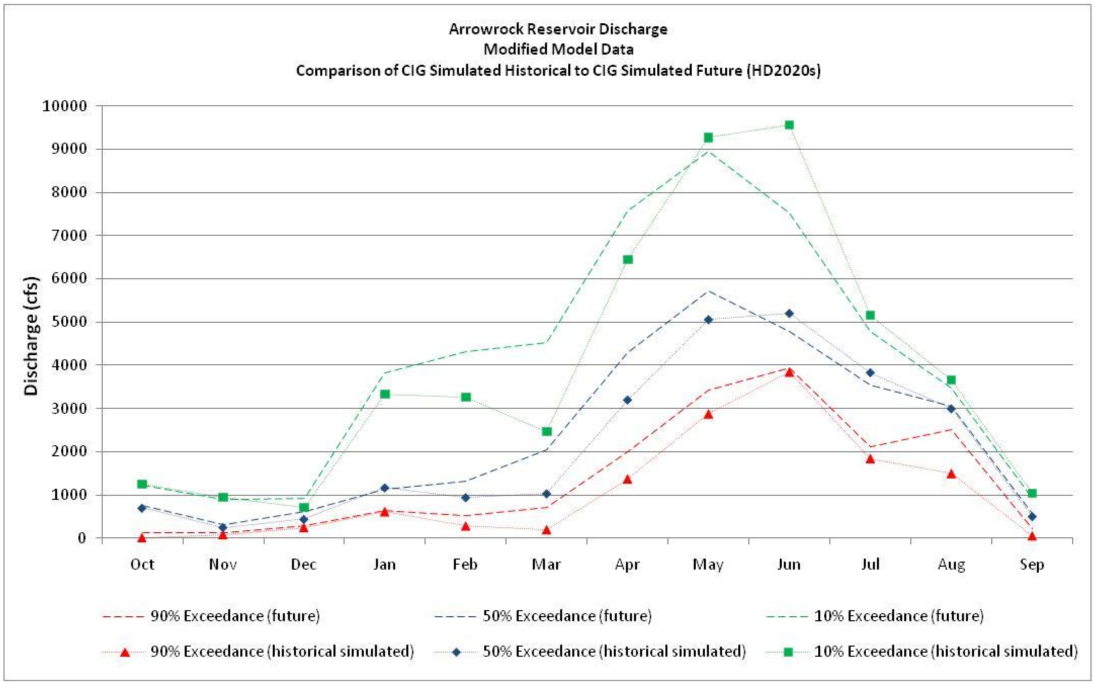

Figure 9. Arrowrock Reservoir discharge using UW CIG generated simulated historical and future datasets.

Hydrographs for dry (90%), average (50%), and wet (10%) exceedances are shown. UW CIG simulated future flows were generated using the median of six future HD projections and then calculating the average monthly discharge exceedances.

Critical Habitat PCEs

More detailed baseline information can be found in the Assessment (USBR 2013, pp. 44-58).

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Anderson Ranch Reservoir

In reservoir environments, subsurface connectivity and thermal refugia are a function of several factors including thermal stratification within the reservoir, tributary inflow, wetland influence, and groundwater recharge. In deep reservoirs such as Anderson Ranch, the process of thermal stratification tends to be the primary driver of thermal refugia rather than seeps, springs, or groundwater influence which does not appear to provide a significant contribution to FMO habitat in the reservoir. The topography along both sides of the reservoir is steep which limits the influence of off-channel habitat; however, there are small areas of wetlands associated with the mouth of the South Fork Boise River. High to full pool levels in the reservoir result in groundwater storage (recharge) that is later released as reservoir levels drop during irrigation water withdrawals. Generally, this groundwater release does not play a significant role in contributing to cold water refugia within the reservoir.

South Fork Boise River

There are 24 tributaries in the South Fork Boise River between Anderson Ranch and Arrowrock reservoirs that contribute an approximate annual average of 108 cubic feet per second (cfs) or 18 percent of the annual flow of the mainstem South Fork Boise River. In addition to hyporheic exchange, there are multiple areas of riparian springs and seeps that contribute to cold water refugia in the South Fork Boise River (USBR 2013, p. 44).

Arrowrock Reservoir

Like Anderson Ranch Reservoir, thermal refugia in Arrowrock Reservoir are primarily a function of thermal regimes within the reservoir. From June through September, the lower strata of the reservoir warm, limiting the function of thermal refugia. Most adult and subadult bull trout migrate to tributary habitats at these times (Salow 2005, p. 1; Maret and Schultz 2013, p. 10). Groundwater influence, on the other hand, does not appear to provide a significant contribution to FMO habitat in Arrowrock Reservoir. The topography along both sides of the reservoir is steep which limits the influence of off-channel habitat. High to full pool levels in the reservoir result in groundwater storage (recharge) that is later released as reservoir levels drop during irrigation water withdrawals. Generally, this groundwater release does not play a significant role in contributing to cold water refugia within the reservoir.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including, but not limited to, permanent, partial, intermittent, or seasonal barriers.

Anderson Ranch Reservoir

Migratory habitat is present between Anderson Ranch Reservoir and its tributaries. Adult and subadult bull trout are present in the reservoir year-round, although the majority leaves during May and June and returns in November (Partridge et al. 2001, p. 4). The South Fork Boise River is the only tributary to Anderson Ranch Reservoir that migratory bull trout are known to use. Migration habitat in the spring is in good condition with no known impediments for fish migrating out of the reservoir to upstream spawning or FMO habitats. Migration habitat in the fall experiences a reduction of diversity, but remains functional when bull trout return after spawning. In most years, the length of the varial zone during the fall migration period will vary from 0.7 to 2.9 miles (1.06 to 4.61 kilometers), depending on the pool elevation.

PCE 2 in Anderson Ranch may be affected by upstream conditions outside of the action area. Approximately 25 percent of tributaries in the basin have barriers to migration due to culverts and land management activities (USFWS 2005c[8], p. 432). As a result, only the South Fork Boise River is likely to be used by adfluvial bull trout from Anderson Ranch Reservoir (USFWS 2005c, p. 430; Partridge et al. 2001, p. 2).

[8] USFWS 2005c, the Bull Trout Core Area Templates, compiled by the Service in 2005, was cited as USFWS 2008b,c,and d in the Assessment.

South Fork Boise River

Migratory habitat is present within the South Fork Boise River below Anderson Ranch Dam. The dam is a barrier, isolating populations of bull trout above and below the dam. Both populations have access to adequate spawning and rearing habitat. Downstream of Anderson Ranch and in the South Fork Boise River, the migration corridor remains functional. These populations spawn in the Middle Fork Boise River (see discussion under Arrowrock Reservoir).

Outside of the Boise River system action area, seasonal impediments may exist between tributaries and the South Fork Boise River due to land management practices such as livestock grazing, road sedimentation, irrigation withdrawals on private lands, and road culverts (USFWS 2005c, p. 430-431; IDEQ 2008, p. 12).

Arrowrock Reservoir

Migratory habitat exists between the reservoir and its tributaries. Adult and subadult bull trout over-winter in the reservoir, although the majority leaves between February and June toward their spawning locations and returns to the reservoir in November (Salow 2004a, p. 7). An estimated 2 percent of the adfluvial population (subadult sized fish) remain in Arrowrock Reservoir during the summer months (USFWS 2005a, p. 252); however, the U.S. Geological Survey (USGS) conducted an acoustic telemetry study on subadult sized bull trout in 2012 and documented that all tagged fish left the reservoir during the summer season (Maret and Schultz 2013, p. 10).

The Arrowrock Reservoir adfluvial population of bull trout spawns in headwater tributaries of the North Fork and Middle Fork Boise rivers, but exhibits a diversity of over-wintering behaviors. A portion of the population over-winters in the reservoir while others use the South Fork Boise River, and some fish use both habitats. Fish that over-winter in the South Fork Boise River will spawn in the North Fork and Middle Fork Boise rivers because migration to spawning habitat in the South Fork Boise River is blocked by the presence of Anderson Ranch Dam.

The migration habitat in the spring is in good condition with no migration impediments occurring during the spring migration period for fish migrating out of the reservoir to spawning habitat. The migration zone experiences a reduction of structural diversity in the fall, but remains functional when bull trout return to FMO habitat after spawning. In most years, the length of the varial zone during the fall migration period will vary between 3.2 and 5.6 miles (5.11 and 9.00 kilometers) in length for the Middle Fork Boise and between 4.0 and 6.8 miles (6.47 and 10.88 kilometers) in the South Fork Boise River. Telemetry data confirms that bull trout migrate over the course of several months during which time the habitat complexity (PCE 4) is increasing as the reservoir is continuously refilling. While there is often physical connectivity in varial zones, these areas often lack the complexity of upstream habitats, exposing migrating bull trout to an increased risk of predation (Salow 2005, p. 68). In the 2005 opinion (USFWS 2005a, p. 252), USFWS identified that when reservoir elevation is below 3100 feet, migrating bull trout may be more susceptible to predation.

Arrowrock Dam isolates a population of adfluvial bull trout and is a barrier to upstream migration. For bull trout entrained out of the reservoir, the dam is not equipped with fish passage facilities. Bull trout that may be present in Lucky Peak Reservoir are believed to have been entrained from Arrowrock Reservoir. To mitigate for entrainment of bull trout from Arrowrock Reservoir (USFWS 2005a, p. 258), Reclamation traps these bull trout in Lucky Peak

Reservoir and hauls them around the dam, releasing them back into the adfluvial population in Arrowrock Reservoir. Since 2005, additional studies have documented lower entrainment rates than previously suspected.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Anderson Ranch Reservoir

The species composition of Anderson Ranch Reservoir indicates a diversity of fish species and age classes including at least seven species of native fishes and five nonnative species that are commonly captured during sampling events (IDFG 2013a). In the reservoir, the nitrogen and phosphorus ratio (TN:TP) is well balanced at 15:15, indicating suitable forage zooplankton and other aquatic invertebrates as food sources (see Appendix B of the Assessment). Based on the most recent fish sampling conducted by IDFG and water quality conditions an abundant food base is available for migratory bull trout that use Anderson Ranch Reservoir for FMO habitat.

South Fork Boise River

Species composition encountered during IDFG monitoring includes a diversity of age classes of sculpins, dace, kokanee, and rainbow trout, all of which provide forage for bull trout. Young-of-year rainbow trout surveys conducted by IDFG show good recruitment and a good diversity of prey fishes within the Boise River system action area. Anderson Ranch Reservoir limits the recruitment of some nutrients into the South Fork Boise River (Assessment Appendix B, p. 6); however, tributaries provide a source of nutrients at levels sufficient to support a food base for bull trout and prey fishes.

Reclamation is conducting studies in the Boise River system action area to determine effects of ramping on aquatic habitat and stranding. The general health (condition factor) of bull trout from the Arrowrock Reservoir metapopulation shows average or above average health, indicating suitable prey availability (USBR internal data). The Arrowrock Reservoir adfluvial population is considered a metapopulation comprised of fish from different spawning locations that mix within Arrowrock Reservoir and the South Fork Boise River action areas.

Arrowrock Reservoir

Fish species composition encountered during IDFG monitoring indicates a diversity of fish species and age classes, including over seven species of native fishes and five nonnative species that are commonly captured during sampling events. These provide an abundance of forage fish for bull trout. A condition factor analysis was performed for all fish species sampled in the Reservoir in 2011 and the four most abundant fish species and bull trout all showed positive growth while in the reservoir (Seo 2013 in draft). Although water quality conditions were thought to seasonally limit the prey base for bull trout in Arrowrock Reservoir (USFWS 2005a, p. 258), recent data for water quality (Assessment Appendix B) and fish sampling (USBR internal data) suggests that the prey base for all species of fishes is sufficient to maintain an average or above condition factor for bull trout that use the reservoir for FMO habitat.

Operational indicators (Table 2) for Arrowrock Reservoir (USFWS 2005a, p. 258) were developed to monitor incidental take of bull trout associated with the proposed action and minimize take of bull trout by slowing the rate of drawdown during late June after the reservoir has refilled. The criteria aim to keep Arrowrock Reservoir storage at or above 200,000 acre-feet at the end of June in 90 percent of the years. This period corresponds with the longest duration of daylight and higher reservoir volumes. During this time, there are suitable conditions for zooplankton production in the shallower warmer parts of the reservoir.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes, that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths gradients velocities and structure.

Anderson Ranch Reservoir

Reservoir depth and shallow shoreline habitat provides the most significant habitat complexity and contribution toward FMO habitat. Depth allows temperature (PCE 5) and water quality conditions (PCE 8) to support bull trout use most of the time when they are known to be present. Shallow shoreline habitat allows increased primary productivity (PCE 3) that supports a diversity of prey fishes.

Habitat conditions of the watersheds that enter Anderson Ranch Reservoir have been impacted by wildfire, floods, and multiple land uses (USFWS 2005c, pp. 429-431), all contributing to a decreased complexity of reservoir habitat during drawdown conditions. Drawdowns expose the varial zone of the tributaries within Anderson Ranch Reservoir. Habitat complexity is affected by changing the habitat features from a reservoir environment to a river type environment. Although the river habitats in the varial zone are different from those in the reservoir and degraded from unregulated systems, they still offer a variety of environments that could be used by bull trout.

South Fork Boise River

A wide range of habitats occur in the 26.0 miles (41.8 kilometers) of the South Fork Boise River. Bull trout are known to select the South Fork Boise River for over-wintering (Salow and Hostetler 2002, p. 1) while some individuals reside in the river throughout the year only leaving to migrate to spawning locations. The river lacks recruitment of sediment and large woody material from sources upstream of Anderson Ranch Dam, but recruits sediment and large woody material from sources within the action area. Preliminary data being collected to address T&Cs (USFWS 2005a, p. 261) suggests that diverse aquatic habitats are present within the Boise River system action area. The hydrograph is regulated, but produces a spring season high water peak that redistribute materials transported from unregulated tributaries throughout the Boise River system action area. Consistent summer flows have allowed a riparian area to become well established. The established riparian zone provides a number of benefits including, but not limited to, shading (thermal refugia), overhead cover, recruitment of large woody material, input of terrestrial prey, bank stability, and undercut banks.

Arrowrock Reservoir

Reservoir depth and shallow shoreline habitat (maximized at higher storage volumes) provides the most significant contribution toward FMO habitat. Depth allows temperature (PCE 5) and water quality conditions (PCE 8) to support PCE criteria during most of the year. Shallow shoreline habitat allows increased primary productivity (PCE 3) that supports a diversity of prey fishes. Habitat conditions of the watersheds that enter Arrowrock Reservoir have been impacted by wildfire, floods, and multiple land uses (USFWS 2005c, pp. 440-442), all contributing to a decreased complexity of reservoir habitat during drawdown conditions.

Drawdowns expose the varial zone of the tributaries within Arrowrock Reservoir. Habitat complexity is affected by changing the habitat features from a reservoir environment to a river type environment. A habitat survey was conducted in 2011 to quantify habitat variables in the varial zone within the reservoir and found that although the river habitats in the varial zone are different from those in the reservoir and degraded from unregulated systems, they still offer a variety of environments that could be used by bull trout (USBR 2013, p. 50).

Bull trout may reside in Arrowrock Reservoir throughout the year, but often leave during the summer months as indicated by recent telemetry data and acoustic data (Maret and Schultz 2013, p. 9-11).

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Anderson Ranch Reservoir

Bull trout typically over-winter in Anderson Ranch Reservoir, migrating out in late spring and returning to the reservoir in November to over-winter. Water temperatures between 2° and 15° C are available throughout the year. Summer temperatures at the surface can be as high as 22° C while the temperatures near the bottom of the reservoir remain relatively constant between 4° and 5° C. As the water warms and the reservoir becomes stratified, the deeper portions of the water column become depleted of oxygen, particularly below 10 meters (Assessment Appendix B, p. B-8), but water temperatures are cooler at depth. This is illustrated with the monthly average temperature profiles for Anderson Ranch Reservoir from April through August (Figure 10) and August through December (Figure 11).

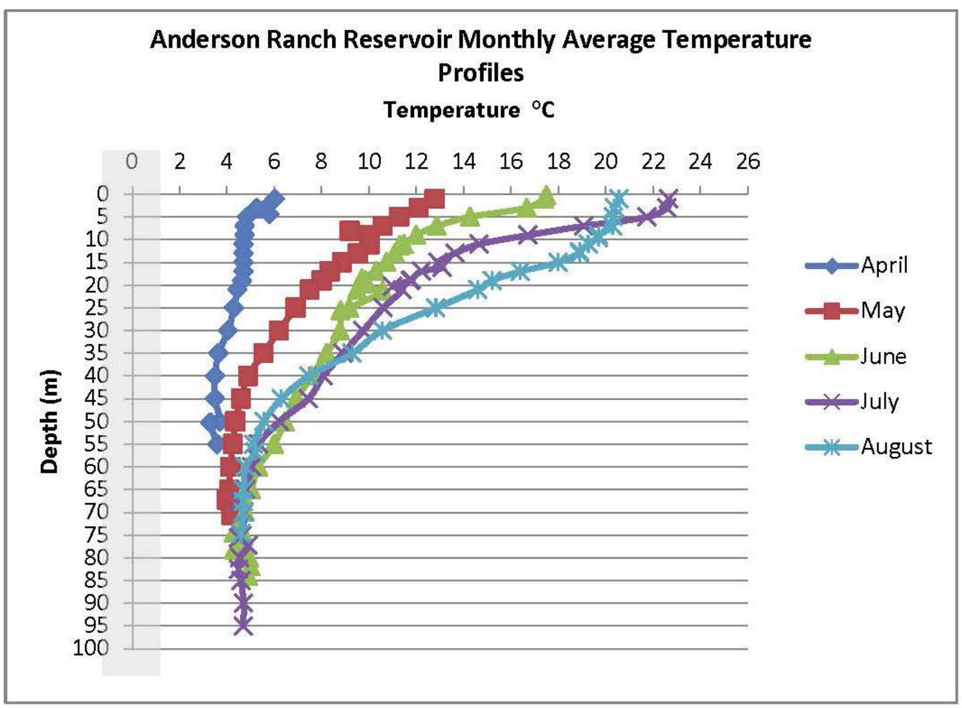

Figure 10. Monthly average temperature profiles of Anderson Ranch Reservoir, April through August.

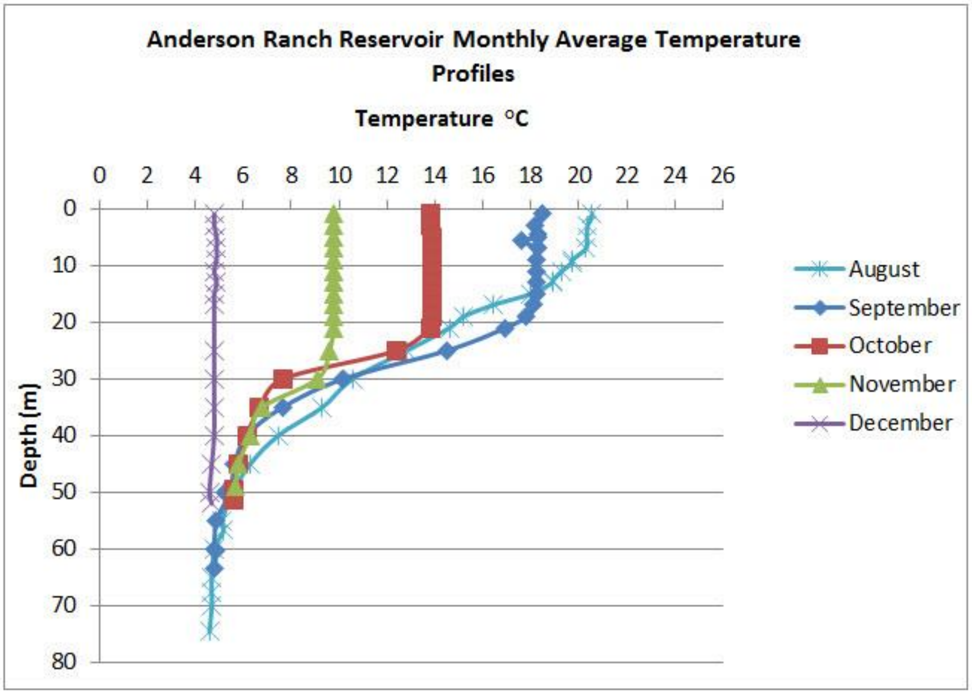

Figure 11. Monthly average temperature profiles of Anderson Ranch Reservoir, August through December.

Operational indicators for Anderson Ranch Reservoir were developed to monitor incidental take of bull trout associated with the proposed action and minimize take of bull trout by minimizing the frequency of drawdown below 62,000 acre-feet to 2 of 30 years (Table 2). These criteria aim to protect water quality (including water temperature) during periods of hot and dry weather. Deeper water habitat in the reservoir helps to maintain cold water refugia during periods when thermal refugia are not otherwise available (Figure 10 and Figure 11).

South Fork Boise River

Water releases at Anderson Ranch Dam occur from the middle/lower water column in the reservoir except when spilling occurs occasionally in the spring. The South Fork Boise River temperatures at the top of the action area are directly related to the temperatures in the middle/lower water column of the reservoir. The midline of the intake structures to the dam ranges from 85 feet deep (26 meters) at 62,000 acre-feet to 196 feet deep (60 meters) at full pool. Generally the reservoir keeps the river temperature warmer in the winter and cooler in summer compared to unregulated tributaries above the dam. Releases from Anderson Ranch Reservoir remain at a relatively constant temperature between 4° and 6° C from January through June. By early June, the reservoir stratification breaks down and water begins to mix, resulting in river release temperatures slowly increasing until early September when it reaches its average maximum temperature of 13° C. The reservoir attenuates the daily and seasonal fluctuations in temperatures as compared to the South Fork Boise River above the reservoir.

Figure 12 illustrates the daily maximum temperatures of the South Fork Boise River in the Boise River system action area below Anderson Ranch Dam as well as the modulating effect of the reservoir.

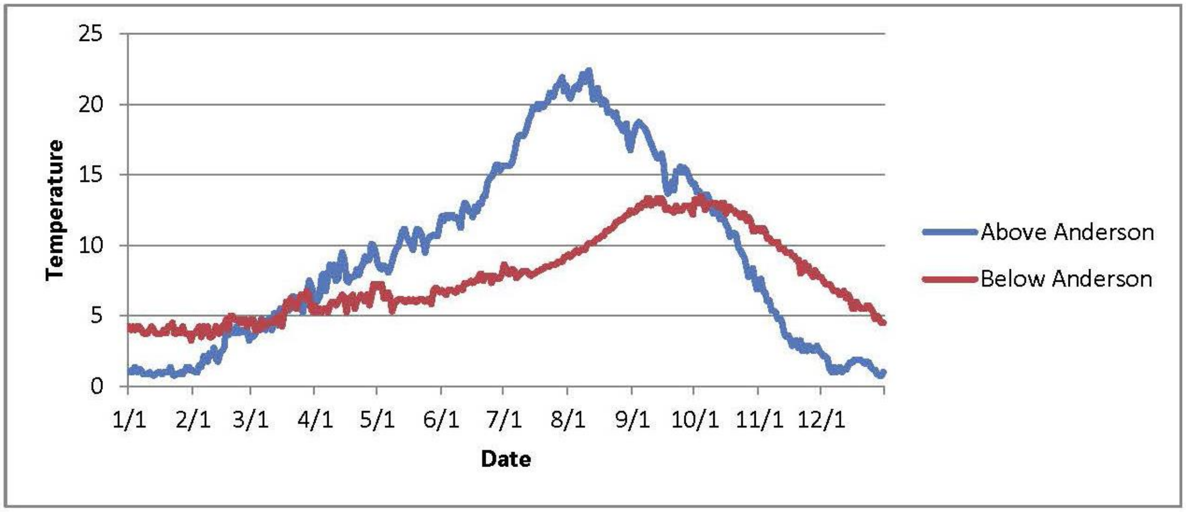

Figure 12. Daily maximum temperatures of the South Fork Boise River above and below Anderson Ranch Dam.

The regulating effect of the reservoir appears to extend downstream, as indicated by recent monitoring at Neal Bridge near the inflow to Arrowrock Reservoir, but is dependent on shade and groundwater mediating the impacts from solar loading. At Neal Bridge (28.1 miles [45.2 kilometers] downstream from Anderson Ranch Dam), stream temperatures fluctuate between 4° and 6° C from January through early March. By early June, the reservoir discharge keeps the river cool, below 15° C until late August. Maximum temperatures are reached in early September and peak near 16° C, above the PCE criterion for just a few days. In comparison, the Middle Fork Boise River without an upstream impoundment exceeds 15° C by the end of June and reaches maximum temperatures of over 21° C near the end of July. Table 13 illustrates the daily maximum temperatures of the South Fork Boise River at Neal Bridge as well as the comparison to the Middle Fork Boise River near Twin Springs, a similar unregulated stream nearby.

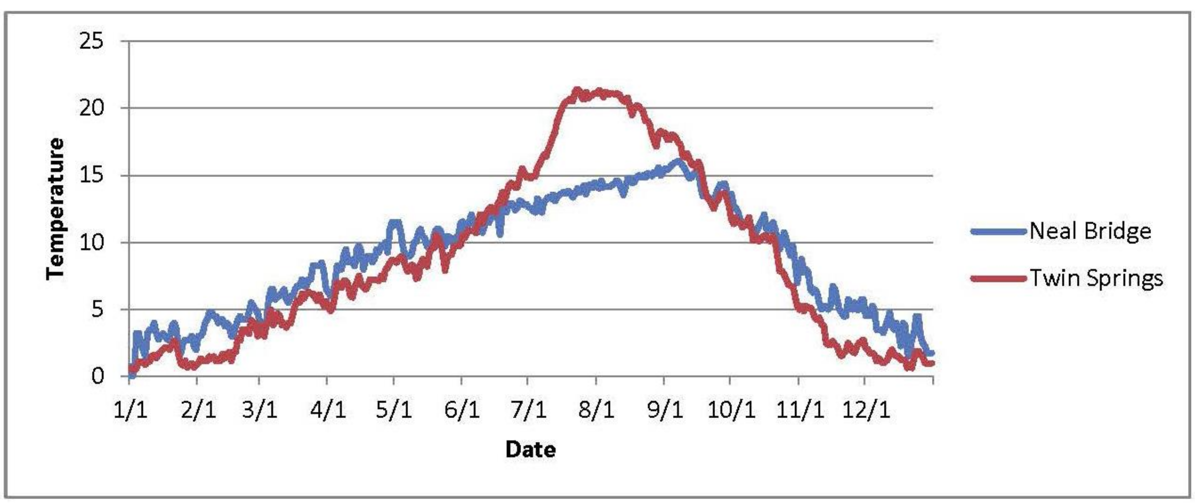

Figure 13. Daily maximum temperatures of the South Fork Boise River .

Arrowrock Reservoir

Bull trout over-winter in Arrowrock Reservoir and typically move out of the reservoir January through June. January through April profiles indicate that the reservoir is isothermal with temperatures between 2° and 7° C after which it gradually warms and begins to stratify, exceeding the PCE criteria of 15° C by the end of June. In August and September, the reservoir begins cooling and becomes isothermal with water temperatures below 14° C by October and down to about 4° C by December.

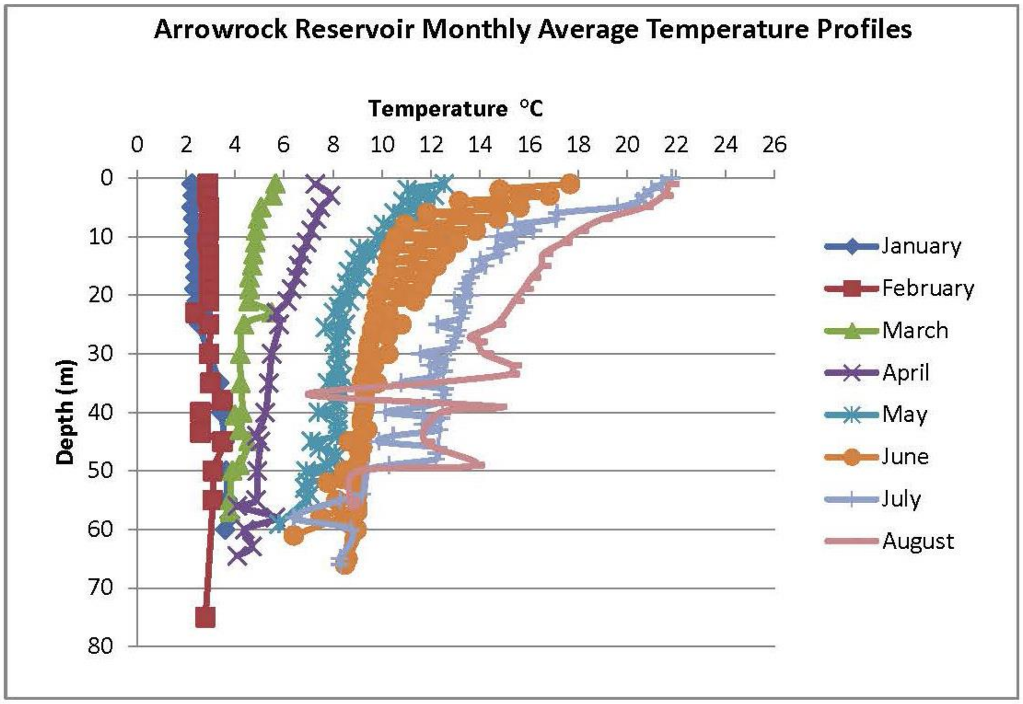

Figure 14. Monthly average temperature profiles of Arrowrock Reservoir, January through August.

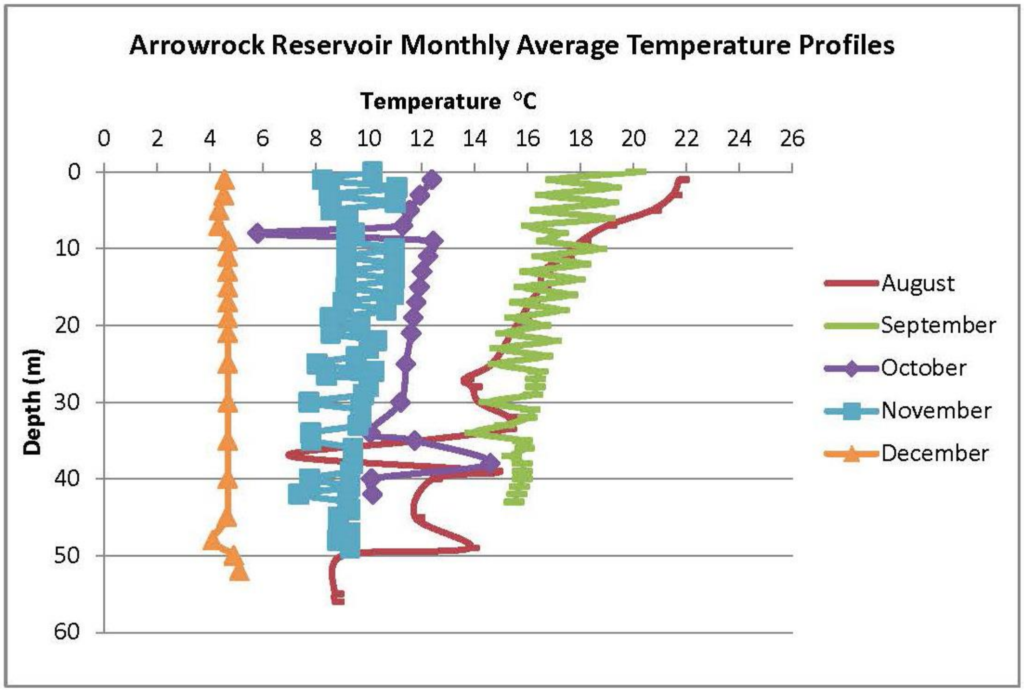

Figure 15. Monthly average temperature profiles of Arrowrock Reservoir, August through December.

An estimated 2 percent of the adfluvial population (subadult sized fish) remain in Arrowrock Reservoir during the summer months (USFWS 2005a, page 252); however, USGS conducted an acoustic telemetry study on subadult sized bull trout in 2012 and documented that all tagged fish left the reservoir by the end of June (Maret and Schultz 2013, pp. 10-11). The average summer temperature near the surface was over 21° C, with temperatures near the bottom relatively constant between 6° and 8° C. Oxygen was depleted below 16 feet (5 meters) in August and 26 feet (8 meters) in September (Assessment Appendix B, p. 18). Migration corridors are open throughout the year for fish to move between the reservoir and riverine environments; however, water temperatures in tributaries also exceed thermal targets except for the South Fork Boise River. Deep water releases from Anderson Ranch Dam provide thermal refugia in the South Fork Boise River, a part of the Arrowrock CHSU, during summer months.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Spawning and rearing critical habitat was not designated in this portion of the action area, therefore PCE 6 is not present (75 FR 63898).

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

PCE 7 is a natural hydrograph including peak, high, low, and base flows, or if flows are controlled, minimal flow departure from a natural hydrograph. PCE 7 addresses the amount and timing of stream flow, a characteristic that is by definition not present in a reservoir environment. As a result, PCE 7 is not present in Anderson Ranch or Arrowrock reservoirs.

South Fork Boise River

Generally, there is an altered hydrograph characterized by flows that are higher in the winter, generally lower during the spring peak, and higher during the summer when flows are held artificially high from irrigation deliveries. The effects of lower spring releases on stream discharge are attenuated by tributary inflows from 24 separate tributaries, starting with Dixie Creek located 1.8 miles (2.9 kilometers) from the base of the dam.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Anderson Ranch Reservoir

The water quality and quantity in Anderson Ranch Reservoir is generally good, but may show seasonal limitations when severe drawdowns (below 62,000 acre-feet) occur, and during late July through September when dissolved oxygen is depleted deeper in the reservoir and water temperatures in the upper levels of the reservoir are elevated. The reservoir is classified as oligotrophic, indicating that a nutrient loading from the watershed is balanced with the nutrient cycling within the reservoir. Although suitable water temperatures (PCE 5) and dissolved oxygen levels exist in the reservoir throughout the year (Assessment Appendix B, pp. 7-8), the two indicators may not coincide. Sediment and turbidity levels are typically very low and should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Water quality and quantity is adequate to allow the prey base (fish, aquatic invertebrates, and zooplankton) to remain at sufficient levels to support bull trout. The TN:TP ratios indicate that blue green algae and other unpalatable forms of nitrogen-fixing algae should not dominate the reservoir as nitrogen is common. Furthermore, the types of algae that are often associated with the observed TN:TP ratios should provide suitable forage for zooplankton and other aquatic invertebrates.

South Fork Boise River

Water quality and quantity allows bull trout to use the South Fork Boise River as FMO habitat throughout the year. The water quality and quantity in the South Fork Boise River meets targets for Idaho water quality standards for cold water biota throughout the year. Nutrients are retained in Anderson Ranch Reservoir during most of the year, but nutrient levels are within the range expected in the intermountain xeric west. Suitable water temperatures and dissolved oxygen levels exist throughout the year. Sediment and turbidity levels are typically very low and should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Water quality and quantity is adequate to allow the prey base (fish, aquatic invertebrates, and zooplankton) to remain at sufficient levels to support bull trout.

Bull trout in the South Fork Boise River action area are part of the Arrowrock Reservoir metapopulation and show an average or above average condition factor (Seo 2013 cited in the Assessment, p. 56), suggesting suitable water quality and quantity for bull trout and the bull trout prey base (PCE 3). Reclamation is conducting work in the Boise River system action area to determine effects of ramping on aquatic habitat and stranding; work is expected to be completed in fiscal year (FY) 2015.

Arrowrock Reservoir

Water quality and quantity allow adult and subadult bull trout to over-winter in Arrowrock Reservoir, but does show seasonal limitations during the summer months. The reservoir is classified as oligotrophic, indicating that a nutrient loading from the watershed is balanced with the nutrient cycling within the reservoir. Water temperatures and dissolved oxygen levels may also show seasonal limitations in August and September (Assessment Appendix B, p.15-17). Sediment and turbidity data is limited, but shows seasonal limitations typically in September; however, not at levels that should impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Water quality and quantity is adequate to allow the prey base (fish, aquatic invertebrates and zooplankton) to remain at sufficient levels to support bull trout. The TN:TP ratios indicate that blue-green algae and other unpalatable forms of nitrogen-fixing algae should not dominate the reservoir as nitrogen is common; however, they could begin to dominate the reservoir in August when nitrogen is limited. The types of algae that are often associated with TN:TP ratios such as these may not be suitable forage for zooplankton and other aquatic invertebrates.

An estimated 2 percent of the adfluvial population (subadult-sized fish) remain in Arrowrock Reservoir during the summer months (USFWS 2005a, page 252); however, the USGS conducted an acoustic telemetry study on subadult sized bull trout in 2012 and documented that all tagged fish left the reservoir by the end of June (Maret and Schultz 2013, p. 10). Bull trout return to Arrowrock Reservoir after spawning. For the majority of fish, the post-spawn migration occurs after the water quality conditions described earlier have returned to target levels.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Fish stocking and management of fish populations within the State of Idaho is regulated by the IDFG.

Anderson Ranch Reservoir

Nonnative fishes are currently present in Anderson Ranch Reservoir include rainbow trout, Chinook salmon, smallmouth bass, yellow perch, common carp, and kokanee. Kamloop rainbow trout and kokanee have been stocked annually in Anderson Ranch Reservoir since 2003. Young nonnative fish are prey for bull trout in Anderson Ranch Reservoir; however, adult rainbow trout, smallmouth bass, and Chinook salmon may prey on young bull trout. Kokanee provide a food base for bull trout. There is no evidence that stocked rainbow trout, smallmouth bass, and Chinook salmon are significant competitors with bull trout in the core area.

In the South Fork Boise River drainage, brook trout occur in lower and middle Fall Creek, Salt Creek, Little Smoky Creek, Lick Creek, Five Points Creek, and Paradise Creek and likely occur in other areas. Brook trout in the South Fork Boise River are thought to have originated from fish introduced in alpine lakes and stocked streams by State and Federal resource agencies and private individuals during the 1940s and 1950s.

South Fork Boise River

Fish assemblages in the South Fork Boise River are dominated by native species. Diet overlap occurs with most species present in the Boise River system action area; however, smaller age classes are prey for bull trout. Spawning occurs outside of Boise River system action area, but hybridization with nonnative brook trout has been documented in the river basin (Steed et al. 1998, p. 50).

Arrowrock Reservoir

Nonnative fishes currently present in Arrowrock Reservoir include rainbow trout, smallmouth bass, yellow perch, and kokanee. Stocking of game fishes has occurred annually since 1968 and Kamloop rainbow trout and kokanee have been stocked annually in Arrowrock Reservoir since 2004. Kokanee provide a food base for bull trout. Young nonnative fish are prey for bull trout in Arrowrock Reservoir, but adult rainbow trout may prey on subadult-sized bull trout. There is no evidence that stocked rainbow trout are significant competitors to bull trout in the core area. Spawning occurs outside of Boise River system action area; however, hybridization with nonnative brook trout has been documented in the river basin (Steed et al. 1998, p. 50).

2.4.2.2 Payette River Critical Habitat

2.4.2.2.1 Status of Critical Habitat in the Payette River Basin Action Area

The Deadwood Dam and Reservoir are located on the Deadwood River. The Deadwood River and the South Fork Payette River CHSUs are part of the broader Southwest Idaho River Basins CHU (CHU 26) (75 FR 63898, p. 64043). The Southwest Idaho River Basins CHU is one of six CHUs that comprise the Upper Snake River RU. The Southwest Idaho River Basins CHU includes approximately 1,335.9 miles (2,150.0 kilometers) of streams and 10,651.5 acres (4,310.5 hectares) of lake and reservoir surface area designated as critical habitat and includes eight CHSUs: Anderson Ranch Reservoir, Arrowrock Reservoir, South Fork Payette River, Deadwood River, Middle Fork Payette River, North Fork Payette River, Squaw Creek, and Weiser River. These subunits are considered essential to bull trout conservation because of the presence of populations exhibiting rare adfluvial life history expressions, moderate number of local populations, moderate to large numbers of individuals, moderate amount of habitat, and few threats (USFWS 2010a, p. 629).

Table 9. Critical habitat stream miles, surface area and storage volumes within the Southwest Idaho River Basin Critical Habitat (CHU) 26 and Critical Habitat Subunits (CHSUs).

Critical Habitat Unit or Subunit	Critical Habitat, Stream Miles (kilometers)	Critical Habitat, Surface Area Acres (hectares)	Critical Habitat, Water Storage (in acre-feet)	Critical Habitat within Action Area
CHU 26 - 4,158.3 total stream miles (6,692.2 kilometers)	**1335.2 (2149.0)**	**10,652.5 (4311.0)**	**901,100**	
Weiser River CHSU	70.4 (113.3)	0	0	0
Squaw Creek CHSU	44.9 (72.3)	0	0	0
North Fork Payette River CHSU	19.3 (31.1)	0	0	0
Middle Fork Payette River CHSU	122.7 (197.6)	0	0	0
Upper South Fork Payette River CHSU	**278.0 (447.4)**	**0**	**0**	**47.5 miles**
Deadwood River CHSU	**77.0 (123.9)**	**2,957.8 (1,197.0)**	**154,000**	**2,957.8 acres**
Arrowrock CHSU	447.4 (720.0)	3,093.7 (1,252.0)	272,200	See Section 2.4.2.1.1
Anderson Ranch CHSU	275.5 (443.4)	4,601.0 (1,862.0)	474,900	See Section 2.4.2.1.1

Figure 2 (p. 8) shows the South Fork Payette River basin bull trout core areas coincident with the CHSUs, CHU boundaries, designated critical habitat streams and reservoirs, and the action area boundaries. The action area includes 2,957.8 acres of FMO habitat in Deadwood Reservoir; 23.0 miles of FMO habitat in the lower Deadwood River from the reservoir down to the South Fork Payette River; and 24.5 miles of FMO habitat in a portion of the South Fork Payette River from the confluence with the Middle Fork Payette River upstream to the confluence of the Deadwood River.

Operation of the project also contributes to the aggregate effect of upper Snake River projects on designated critical habitat located on the mainstem Snake and Columbia rivers. Designated critical habitat on the mainstem Snake and Columbia rivers are part of Mainstem Snake River CHU (CHU 23), Mainstem Columbia River CHU (CHU 22), and Lower Columbia CHU (CHU 8) and these effects are analyzed in Section 2.5.2.5.

2.4.2.2.2 Baseline Condition and Factors Affecting Critical Habitat in the Payette River System Action Area

Detailed information regarding Payette River system water quality can be found in Appendix B (pp. 29-46) of the Assessment. The following baseline hydrology information is from the Assessment (USBR 2013, pp. 79-86).

Baseline Hydrology

Deadwood Reservoir

Deadwood Dam stores nearly 153,992 acre-feet (active storage) with a surface area of 3,180 acres. Deadwood Reservoir is a high elevation reservoir located 5,334 feet above sea level and is located in an undeveloped drainage dominated by the highly granitic and exposed Idaho Batholith. The upper Deadwood River is the main source of water and nutrients to the reservoir followed by Trail Creek; however, several smaller tributaries contribute about one-third of the total inflow during each year (USBR et al. 2011, p.79).

Typically, Deadwood Reservoir fills to its maximum storage capacity by May or June (depending on the water year) and maintains a volume above 50,000 acre-feet in most years. The operations analyzed in the 2005 USFWS opinion indicate that Deadwood Reservoir will maintain storage above 50,000 acre-feet August through October in all but 2 years of the 30 years analyzed.

Lower Deadwood River

The lower Deadwood River below Deadwood Dam flows from an elevation of 5,197 feet (1,584 meters) for a distance of approximately 23 miles (38 kilometers) to the confluence with the South Fork Payette River, which is at an elevation of 3,700 feet (1,128 meters). The lower river is a mountainous canyon river that is mostly confined, with limited floodplain features. The relatively steep hill slopes and canyon-like nature of the basin limit the amount and duration of sunlight that is able to reach the river. The total watershed area both above and below the dam is approximately 237 square miles (614 square kilometers). The dominant type of precipitation is snow.

To understand how the operation of Deadwood Dam has affected flows on the lower Deadwood River, regulated and unregulated flow exceedances were compared. Exceedances of the historical observed daily record were determined and are shown in Figure 16. Unregulated flow patterns, shown by solid lines, tend to be higher in the winter and early spring than regulated flows, which are depicted by dashed lines. Only the time period that overlaps the two datasets is shown. Unregulated flows also have a significantly higher peak in late May or early June for all of the exceedances shows.

Regulation of the flows shifts the peak of the flow over a 3- or 4-month period from May to September as opposed to a single peak in May in the unregulated flow. In addition, regulation of flows results in a discharge of 50 cfs during the winter and early spring because flow is being stored for use in the summer.

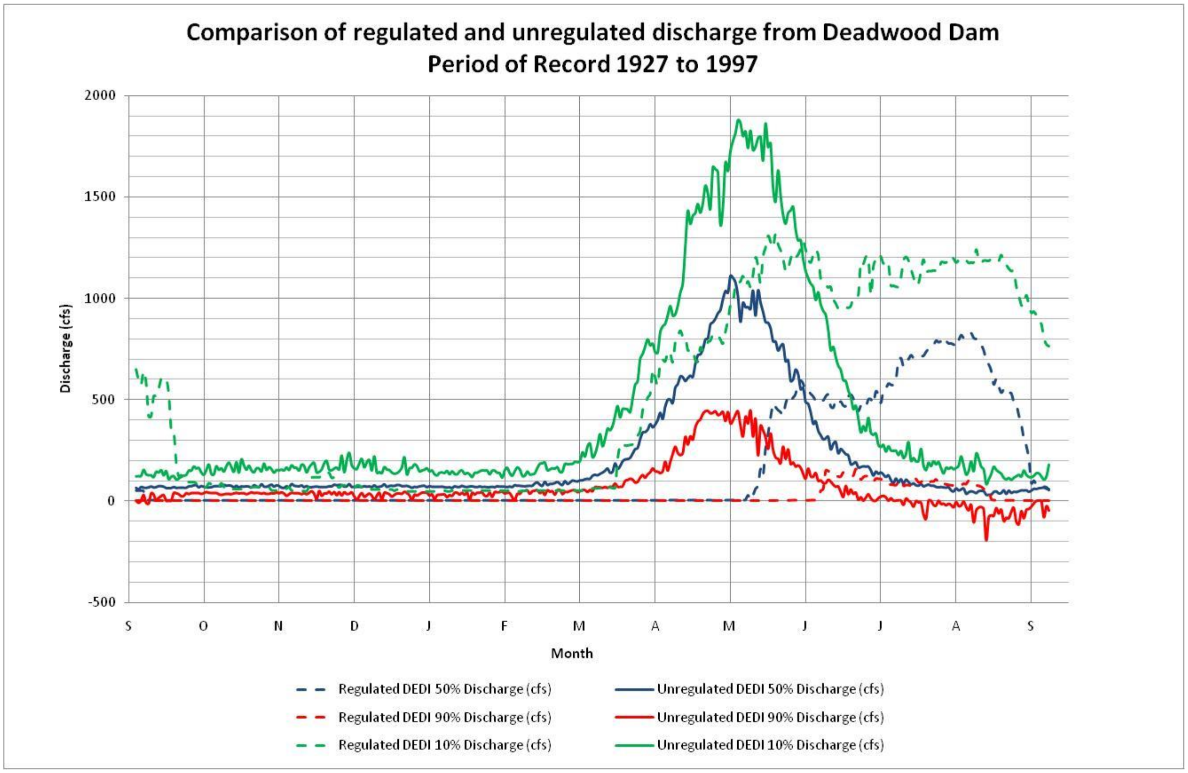

Figure 16. Comparison of regulated and unregulated discharge from Deadwood Dam (DEDI) for period of record (POR) 1927-1997. Daily summary hydrographs of 10%, 50%, and 90% exceedance flows.

South Fork Payette River to Confluence with the Middle Fork Payette River

The reach of river below the confluence of the South Fork Payette River and the Deadwood River is considered critical habitat and both rivers contribute to the hydrology in this reach. The observed flow from the gage on the South Fork Payette River at Lowman, Idaho (PRLI) and discharge from Deadwood Dam is shown in Figure 17. The PRLI gage is located upstream of the confluence between the Deadwood and South Fork Payette rivers where the river is not regulated.

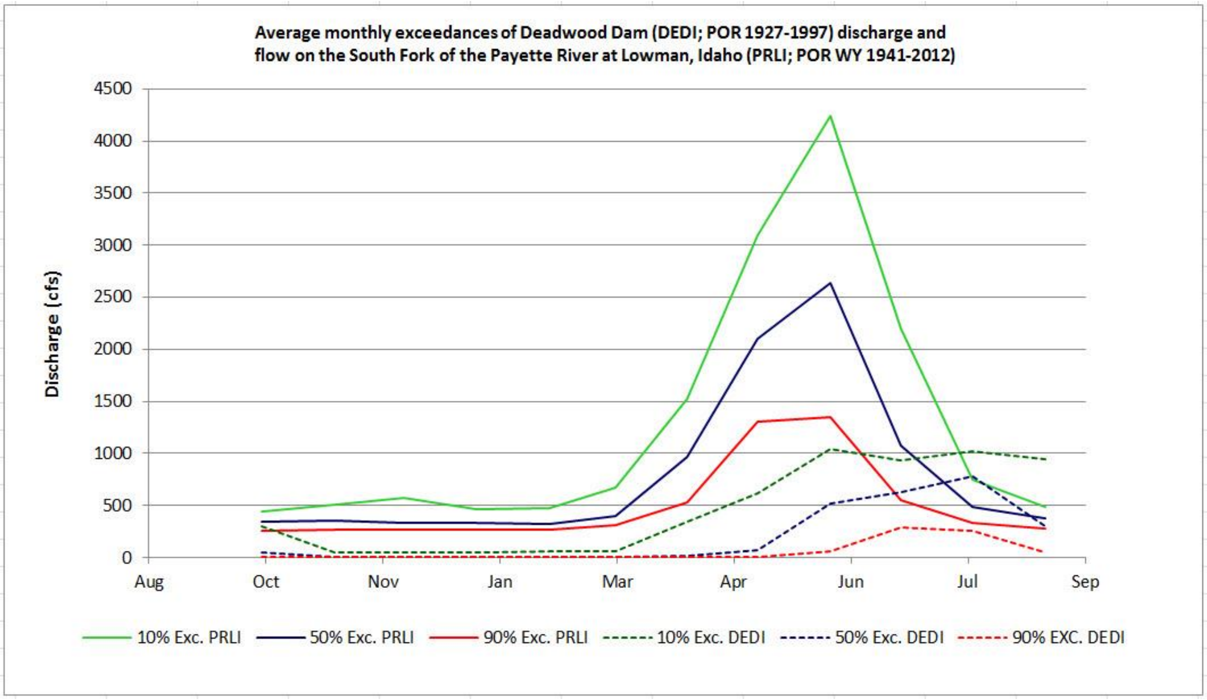

Figure 17. Observed monthly exceedances of Deadwood Dam discharge for the period of record (POR) 1927-1997 and South Fork Payette River at Lowman, Idaho (gage PRLI) flow (POR 1941 to 2011). Monthly summary hydrographs for wet (10%), average (50%), and dry (90%) exceedances are shown. DEDI denotes the Deadwood River below Deadwood Dam.

In Figure 18, the observed monthly average flow for wet (10 percent), average (50 percent), and dry (90 percent) exceedances on the South Fork Payette River near Lowman, Idaho is shown for the period of record from water years 1941 to 2012. The flow in all exceedances shown reaches its peak in the late spring, which is typical of snowmelt dominated systems, and is generally less than 500 cfs throughout most of the year, regardless of the type of water year. Peaks generally occur in May or June with only 10 percent of the flows during that time exceeding 4,200 cfs on average.

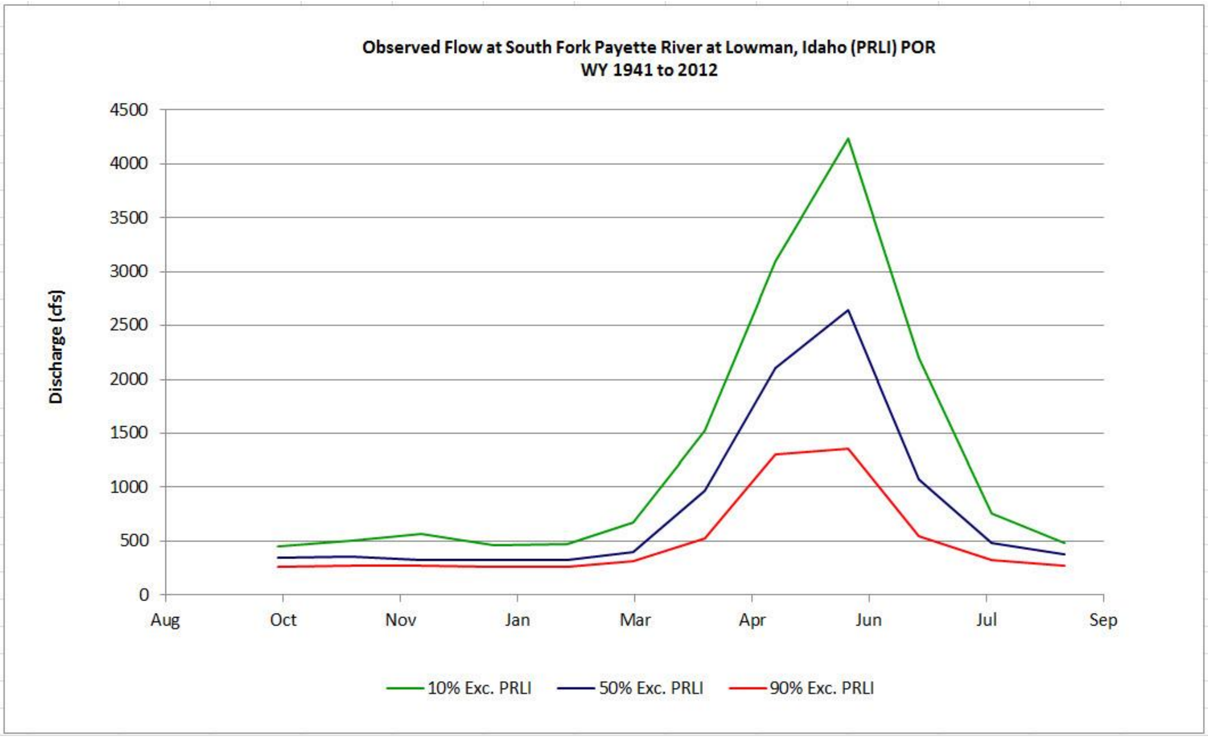

Figure 18. Observed monthly average flow on the South Fork Payette River at Lowman, Idaho (gage PRLI) for the period of record (POR) from water years (WY) 1941 to 2012. Hydrographs for wet (10%), average (50%), and dry (90%) exceedances are shown.

Releases from Deadwood Dam contribute to the hydrograph in the South Fork Payette River. In July and August, the natural hydrograph is reaching summer base flows, but is supplemented with irrigation releases and salmon augmentation flows being made. Regulated flows from Deadwood Reservoir slow the descending limb of the hydrograph in April, May, and June when releases from Deadwood Reservoir are increasing (Figure 18).

During the summer months, flows that enter the lower Deadwood River from local tributaries contribute to the flow at the confluence of the lower Deadwood and South Fork Payette Rivers. In addition, as shown in Figure 17, outflow from the Deadwood Dam during this time are at their maximum. During August, irrigation releases maintain the hydrograph at a higher level than what is observed naturally.

In the winter months (October through February or March depending on the water year), outflow from Deadwood Dam is minimal and as described above, is lower than the natural hydrograph would have been. While studies are ongoing to collect flow volumes at the mouth of the lower Deadwood River, these studies are not complete and cannot be used for this biological assessment; however, initial results indicate that flow from local tributaries during the winter months supplement the flow in the lower Deadwood River to some degree.

Future Hydrology with Climate Change

The following is from the Assessment pp. 84-85.

A revised 2007 MODSIM model was used to simulate reservoir operation in potential climate change conditions. The following figures reflect the projected changes in historical and future flows using this revised MODSIM model adjusted to incorporated climate change flows. As shown in Figure 19 and Figure 20 future climate change inflows to Deadwood Reservoir generate increased end-of-month storage volumes in the cool season and less or similar inflows in the warmer months. Future projections show that during low inflow exceedance levels (90 percent exceedance), conditions in the reservoir are projected to improve above what is currently experienced. While peak end-of-month storage volumes for the average (50 percent exceedance) and large (10 percent exceedance) flow exceedances remain unchanged, the end-of-month storage volume is projected to be more than 20,000 acre-feet higher during the dry years than the historical volume.

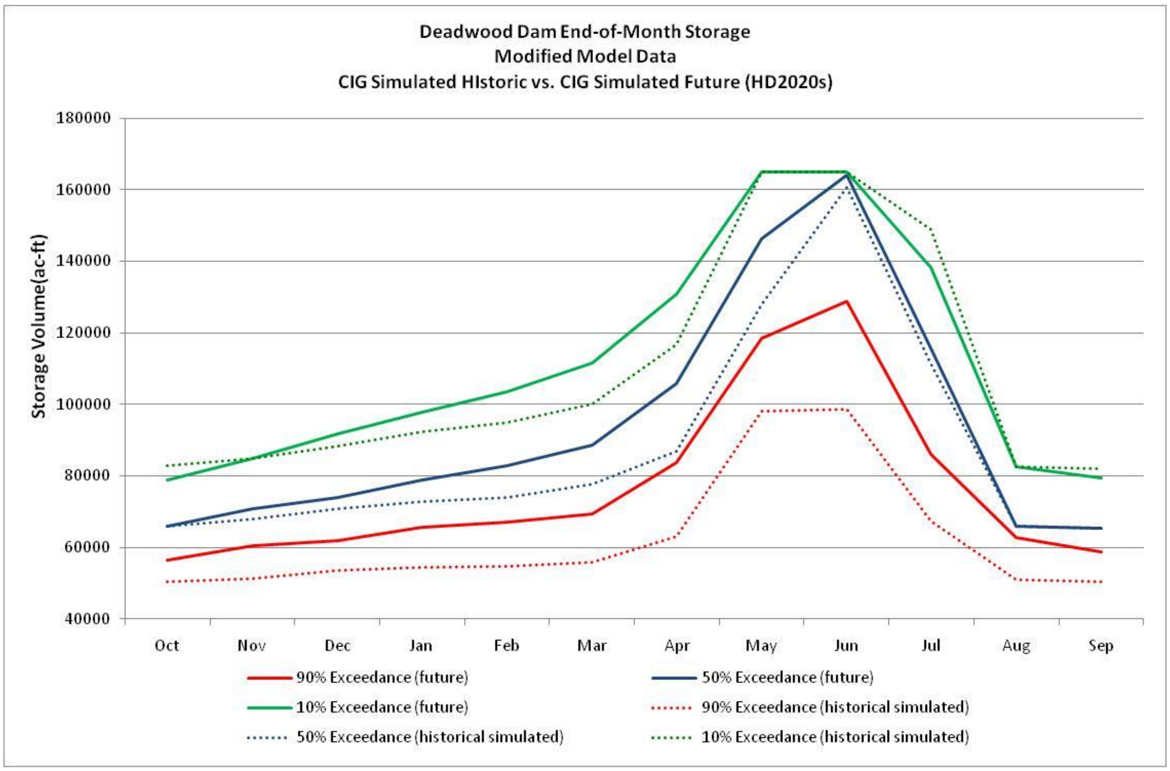

Figure 19. Deadwood Dam end-of-month storage volume using UW CIG generated simulated historical and future datasets.

UW CIG simulated future flows were generated by developing a time series using the median of six future HD projections and then determining the average monthly discharge exceedances using that median time series. Monthly summary hydrographs for wet (10%), average (50%), and dry (90%) exceedances are shown. Solid lines depict future simulated elevations at the end of the month and dashed lines depict historical simulated.

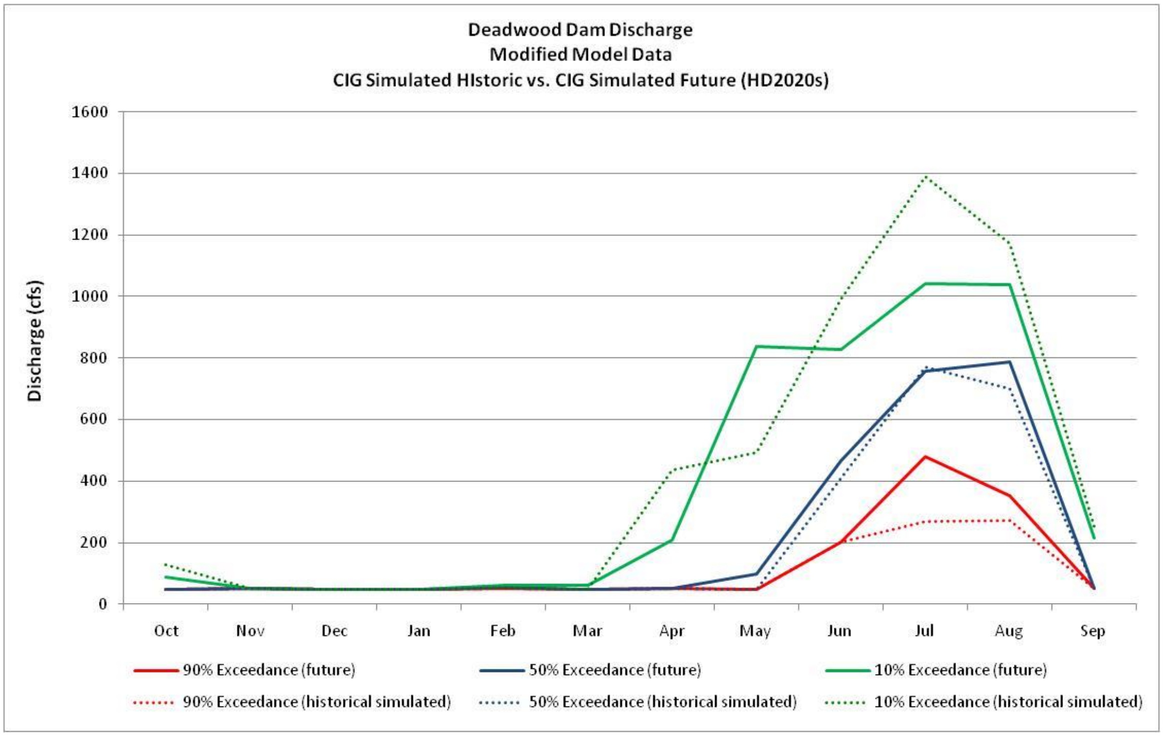

Figure 20. Deadwood Dam discharge using UW CIG generated simulated historical and future datasets.

UW CIG simulated future flows were generated by developing a time series using the median of six future HD projections and then determining the average monthly discharge exceedances using that median time series. Monthly summary hydrographs for wet (10%), average (50%), and dry (90%) exceedances are shown. Solid lines depict future simulated elevations at the end of the month and dashed lines depict historical simulated.

This increase could be due to a couple of reasons. The projected changes could be in the forms and amount of precipitation that are projected to occur in the mountains due to climate change. More precipitation in the form of rain is projected due to climate change in April and May. This, along with snowmelt in the June, could create such an increase. This additional volume at the lower exceedance can be retained in the reservoir, while the 50 percent and 10 percent exceedance volumes already reach their maximum volume even in current conditions.

In the future, a slight increase in projected discharge in the 10 percent and 90 percent exceedance levels is shown during July and August. The increased discharge in the 90 percent exceedance level is indicative of the increase in inflow into the reservoir described above and shown in Figure 20. The decreased discharge in the future when compared to the historical 10 percent exceedance flow reflects the decrease in volume in the falling limb in Figure 20 (not seen in the 50 percent exceedance flow level).

Critical Habitat PCEs

More detailed baseline information can be found in the Assessment (USBR 2013, pp. 87-100).

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Deadwood Reservoir

In reservoir environments, subsurface connectivity and thermal refugia are a function of several factors including thermal stratification within the reservoir, tributary inflow, wetland influence, and groundwater recharge. In deep reservoirs such as Deadwood, thermal stratification tends to be the primary driver of subsurface connectivity and thermal refugia. This relationship is more thoroughly described in the discussion of PCE 5. Tributary inflow may also play a role in providing subsurface connectivity between cold water refugia in the reservoir and tributary habitat.

Groundwater influence does not appear to provide a significant contribution to FMO habitat in Deadwood Reservoir. The topography along both sides of the reservoir is steep, which limits the influence of off-channel habitat and wetlands; however, there are small areas of wetlands associated with the mouths of tributaries predominantly along the west shoreline. High to full pool levels in the reservoir result in shallow groundwater recharge that is later released as reservoir levels drop during irrigation water withdrawals. Generally this groundwater release does not play a significant role in contributing to cold water refugia within the reservoir. Finally, there is no information indicating hyporheic exchange is occurring in the varial zones, but fine material deposited in the reservoir from naturally occurring erosion could reduce the hyporheic flow in the varial zones of the reservoir (Pruitt and Nadeau 1978). On average, the varial zone for the upper Deadwood River is 0.8 mile (1,350 meters) and 0.4 mile (573 meters) for Trail Creek.

Lower Deadwood River

The lower river travels through a narrow and deep canyon with limited alluvium depth. A generally porous substrate naturally affects the upwelling flux, creating multiple areas of riparian springs and seeps which contribute to hyporheic exchange (USBR 2013, p. 87).

South Fork Payette River

Geography of the river is characterized by canyons and large substrate. This type of geography likely contains multiple areas of riparian springs and seeps which contribute to hyporheic exchange.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Deadwood Reservoir

While bull trout are present in Deadwood Reservoir year-round, adult bull trout typically migrate out of the reservoir during the summer (July to September) and return in the fall (September to October). Migratory bull trout are known to use Trail Creek and the mainstem Deadwood River.

In Deadwood Reservoir, tributary flows are sufficient to maintain physical connectivity between the reservoir and tributaries at all times. Migration habitats in the fall experience longer varial zones and lack structural diversity and as such, bull trout may be exposed to a greater risk of predation. The varial zone is longest during August and September when the reservoir levels are lowest. The length of the varial zone will range from 0.5 to 1.7 miles (0.8 to 2.7 kilometers) in length depending on the water year types which correspond to 10-, 50-, and 90-percent exceedence levels. In the very driest years, the varial zone may be longer when reservoir volumes drop below 50,000 acre-feet (anticipated in 2 of 30 years).

Lower Deadwood River

Deadwood Dam is a barrier to bull trout in the Deadwood River, isolating an adfluvial population of bull trout above the dam from those populations below. Below the dam, there are no known physical, water quality, or biological impediments that restrict migration to FMO habitat within the main-stream or to adjacent tributaries. Water temperatures are within the defined targets (see PCE 5). Water quantity is sufficient to maintain connectivity to the migration corridors and access to FMO habitat throughout the year. During winter, temporary and intermittent barriers may form due to the formation of anchor ice.

Currently, FMO habitat is present and functional, but no data exist to show that bull trout use this section of the river. There are two known resident bull trout populations downstream from Deadwood Dam in Scott Creek and Warm Springs Creek. Telemetry data collected from fish tagged in Scott Creek did not indicate any use of or migration to the mainstem Deadwood River. To date, the only portion of Deadwood River where bull trout have been sampled is immediately below Deadwood Dam and these were likely entrained from the reservoir (DeHaan 2012, p. 8; USBR 2012). It is unclear what limits bull trout use of the Deadwood River. The migration corridor has no physical or biological barriers to and from any tributary creek. Tributary flows into the river, as well as releases from Deadwood Dam, are sufficient to maintain connectivity and habitat complexity throughout the year.

South Fork Payette River

There are no known physical or water quality impediments that occur in the South Fork Payette River downstream of the confluence with the Deadwood River. The U.S. Forest Service (USFS) has radio tagged migratory bull trout that spawned in Clear Creek (a tributary of the South Fork Payette River upstream of Deadwood River), some of which over-winter in the South Fork Payette River below the confluence with the Deadwood River, confirming an open migration corridor. Big Falls may present a potential intermittent migration barrier in the South Fork Payette River 5.0 miles (8.0 kilometers) below the confluence of Deadwood River. While likely passable under median flow conditions, very high or very low flow may impede passage at this location.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Deadwood Reservoir

Reclamation is currently conducting a study quantifying food web interactions at each trophic level of the foodweb in Deadwood Reservoir. The Deadwood Flexibility Study summary report is expected to be completed in FY 2014; however, a few qualitative conclusions can be made at this time. Phytoplanktonic primary productivity in Deadwood Reservoir shows increases in the spring and autumn as is common to dimictic temperate lakes and reservoirs. Deadwood Reservoir is efficient in utilizing late-season nutrients to produce additional organic matter prior to onset of winter conditions and ice cover. Zooplankton sampling shows that community composition did not vary spatially between sites on given dates, suggesting that prey is available throughout the reservoir. The diet and stable isotope analysis for bull trout included a variety of prey items from different taxa similar to what is observed in other systems, suggesting that a diversity and density of prey is available for bull trout. Forage fish assemblages include a diversity of native fishes including whitefish, redband trout, sculpin, dace, and nonnative fishes as described in PCE 9.

Lower Deadwood River

Availability of terrestrial organisms of riparian origin are largely limited to the summer months during which time irrigation releases maintain flows to the point that the full channel is wetted. Riparian vegetation can be utilized as cover and provide exposure to terrestrial organisms. Aquatic macroinvertebrate densities and species composition are currently being investigated for a food web modeling analysis under the Deadwood Flexibility Study (USBR in progress). Preliminary results suggest that while the prey base has changed, an abundance of suitable prey is available for bull trout. Forage fish assemblages include a diversity of native fishes including whitefish, redband trout, sculpin, dace, and nonnative fishes as described in PCE 9. Except for the area immediately below the dam where fish were confirmed by genetic analysis to be entrained, bull trout have not yet been found using FMO habitat in the lower Deadwood River despite the presence of PCE 3.

South Fork Payette River

Fluvial bull trout are known to over-winter in the South Fork Payette River and have been tracked, using radio tags, below the confluence of the Deadwood River suggesting that adequate prey and over-wintering habitat is available in that reach to support bull trout. Forage fish assemblages include rainbow trout, dace, whitefish, and sculpin. IDFG fish sampling above the mouth of the Deadwood River found rainbow trout and whitefish to be the predominant species (IDFG 2006, p. 47). Fish densities are limited by the geography of the portion of the South Fork Payette River which is largely characterized by canyons, large substrate, and higher gradient.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

Deadwood Reservoir

Reservoir depth and shallow shoreline habitat provides the most significant habitat complexity and contribution toward FMO habitat. Depth allows temperature (PCE 5) and water quality conditions (PCE 8) to support this PCE in all but the warmest months. Shallow shoreline habitat allows increased primary productivity (PCE 3) that supports a diversity of prey fishes.

Drawdowns expose the varial zone of the tributaries within Deadwood Reservoir. Habitat complexity is affected by changing the habitat features from a reservoir environment to a river type environment. A habitat survey was conducted in 2011 to quantify habitat variables in the varial zone within the reservoir (Prisciandaro 2012, entire). Although the river habitats in the varial zone are different from those in the reservoir and degraded from unregulated systems, they still offer a variety of environments and an open migration corridor (PCE 2) that could be used by bull trout.

Lower Deadwood River

The Deadwood River provides a variety of depth gradient and velocities throughout the year. It predominately has reaches characteristic of plain bed or pool riffle morphology; however, noteworthy step pool features exist, especially higher in the system. The river lacks recruitment of sediment and large woody material from sources upstream of Deadwood Dam, but recruits sediment and large woody material from sources that feed into the action area. Data collected to address T&Cs (USFWS 2005a, p. 258) suggests that diverse aquatic habitats are present within the Deadwood River system action area (USBR in progress). The hydrograph is regulated, but produces a spring season high water peak that redistributes materials transported from unregulated tributaries throughout the Deadwood River system action area. Consistent summer flows have allowed a riparian area to become well established. The established riparian area provides a number of benefits including, but not limited to, shading (thermal refugia), overhead cover, recruitment of large woody material, input of terrestrial prey, bank stability, and undercut banks.

The general substrate of the river below the dam is abnormally large, dominated by boulders and large cobbles and lack of fine sediments. The construction of Deadwood Dam may have contributed to this condition by creating a sediment disconnect between the upper and lower river, with most fine sediment from the upper basin being trapped within the reservoir; however, several tributaries downstream of the dam that feed into the action area contribute sediment. In the lower Deadwood River, fine materials are more common because natural recruitment is occurring through the tributaries that drain into the lower Deadwood River, starting with Wilson Creek that drains into the Deadwood River less than half a mile below the dam.

South Fork Payette River

The natural geography of the reaches of the South Fork Payette River addressed in this analysis is largely characterized by canyons, large substrate, and steep gradient. It is likely these features exhibit a diversity and complexity of habitat types and processes. The river does not lack natural recruitment of sediment and large woody material from sources upstream of the action area. The riparian zone is limited because of the steep gradient, but does provide a number of benefits including, but not limited to, shading (thermal refugia), overhead cover, recruitment of large woody material, input of terrestrial prey, bank stability, and undercut banks.

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Deadwood Reservoir

From October through May, water temperatures in Deadwood Reservoir are generally suitable for bull trout throughout the water column. In early June, stratification begins, isolating cooler water lower in the water column. In wet and median years, cold water refuge is present in the lower portions of the water column and at the mouths of tributaries throughout the year. In August and September of dry years (10 percent of the years) when tributaries feeding into the action area exceed temperature criteria, the reservoir is more likely to mix, causing the cold water stratum to be evacuated. During these conditions, cold water refuge is only present at the tributary locations where sources of cold water are more likely. These areas usually provide thermal refuge when the reservoir temperatures exceed 15° C.

Water temperatures recorded in the reservoir are described in Appendix B of the Assessment (pp. 29-30). Monthly average temperature profiles are representative of conditions in the main reservoir (Figures 21 and 22), but may not accurately depict the conditions at the mouth of tributaries entering the reservoir. Water temperatures at the mouth of tributaries reflect a gradient of temperatures mixing from those in the tributary to those in the reservoir.

Migration corridors to tributaries exist throughout the year (Figure 21 and Figure 22). When water temperatures in the lower portions of tributaries exceed 15° C, the coolest temperatures are either in the reservoir near areas of groundwater influence (usually found to be insignificant) or at higher elevations in the tributaries.

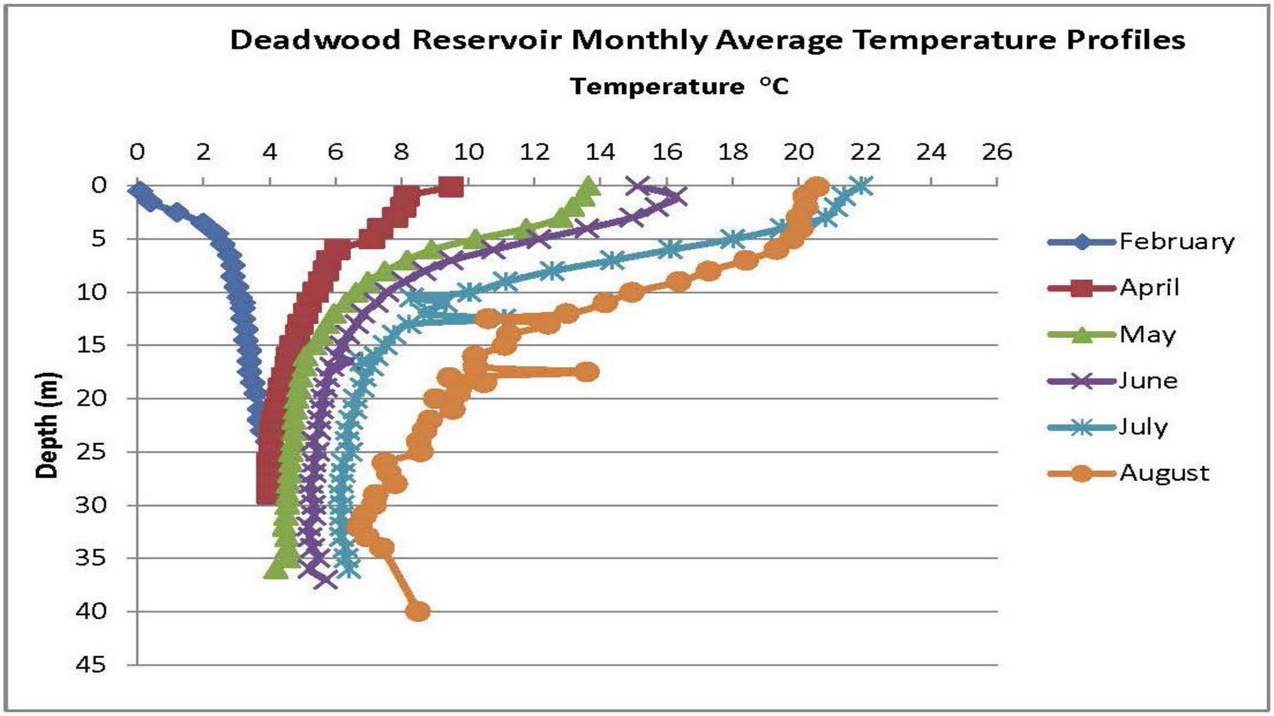

Figure 21. Monthly average temperature profiles for Deadwood Reservoir, February through August.

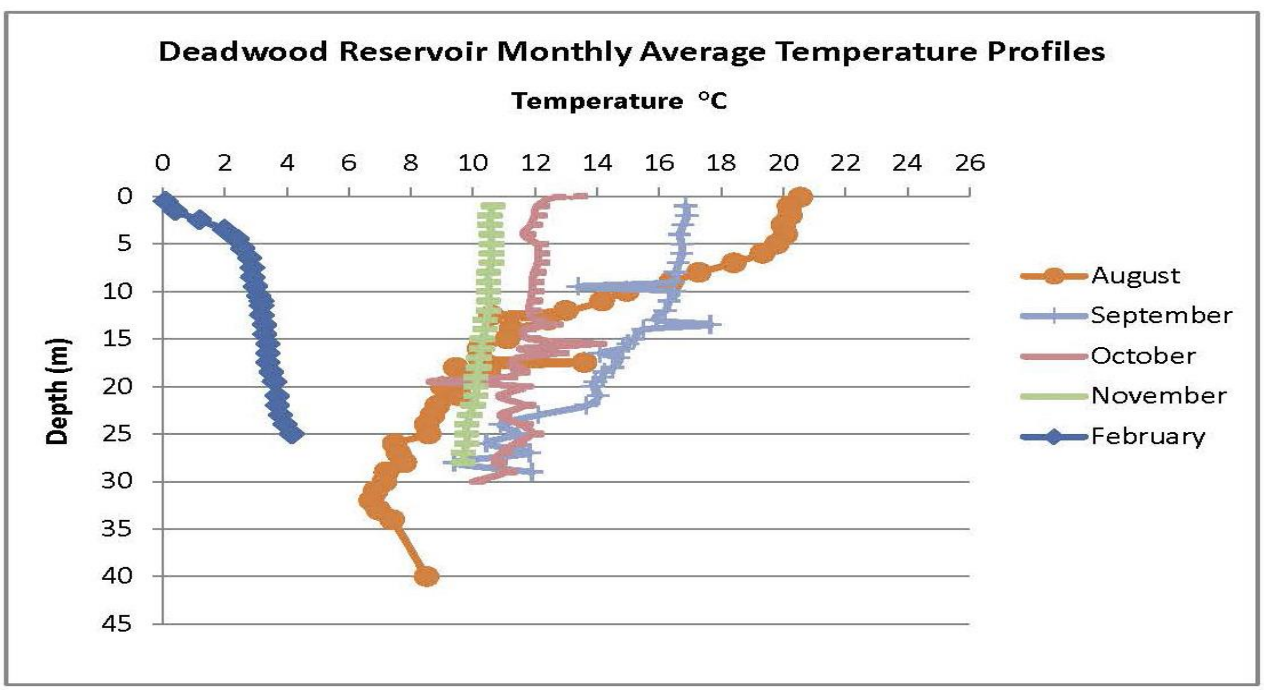

Figure 22. Monthly average temperature profile in Deadwood Reservoir, August through February.

Lower Deadwood River

Water releases from the lower stratum of the reservoir keep the Deadwood River temperature warmer in the winter and cooler in summer compared to unregulated tributaries above the dam. Water released exclusively through the outlet valve of the dam has temperatures between 3° and 12° C year-round except during the driest 10 percent of the years (Figure 23), although tributary inflows may exceed 15° C annually from July through August (Figure 21 through Figure 24). In very dry years or consecutive dry years, when the reservoir evacuates its cold water stratum, releases from Deadwood Dam may reach as high as 18° C for a short period of time in late August and September. These elevated temperatures may continue through October when cooler temperatures from the tributaries begin to influence reservoir and river temperatures. When elevated temperatures exist, cold water refuge is present in the Deadwood River within the main river channel where there is subsurface groundwater flow (PCE 1), in tributaries, or in the South Fork Payette River.

The lower Deadwood River appears to be susceptible to subsurface ice formation during winter months. Operation of Deadwood Dam in the winter may affect this ice development and it is currently being studied as per terms and conditions 3(a) through 3(d) of the 2005 biological opinion (USFWS 2005 pp. 259-260).

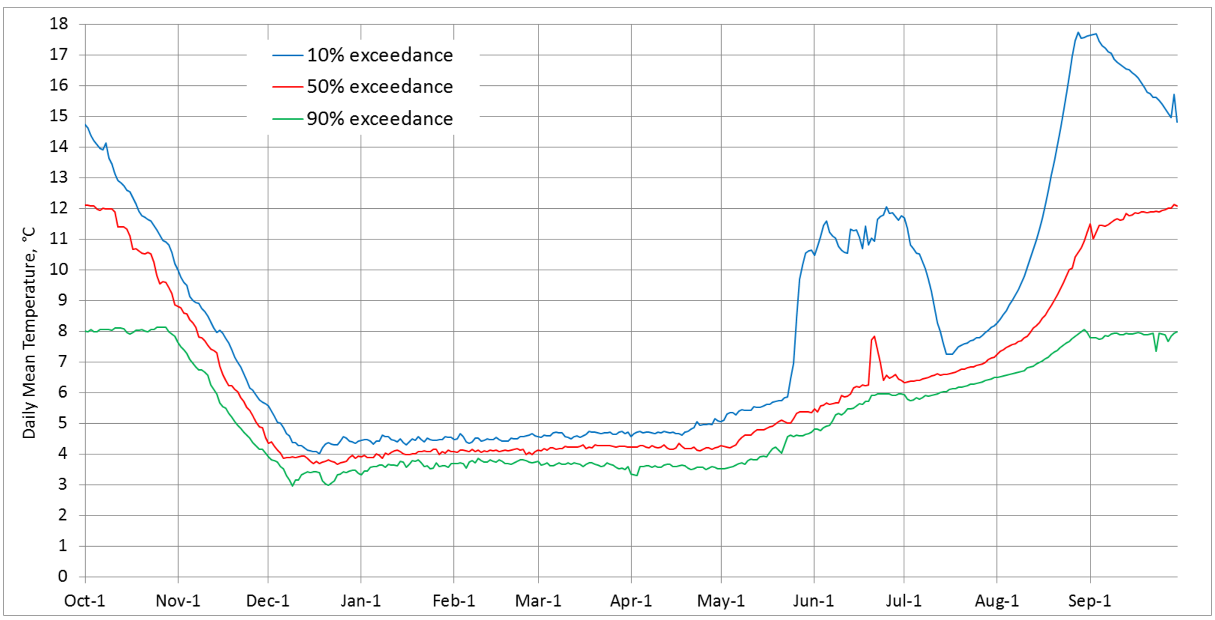

Figure 23. Summary Thermograph of Deadwood Dam Release from 1998-2012 (regulated) (USBR et al. 2011).

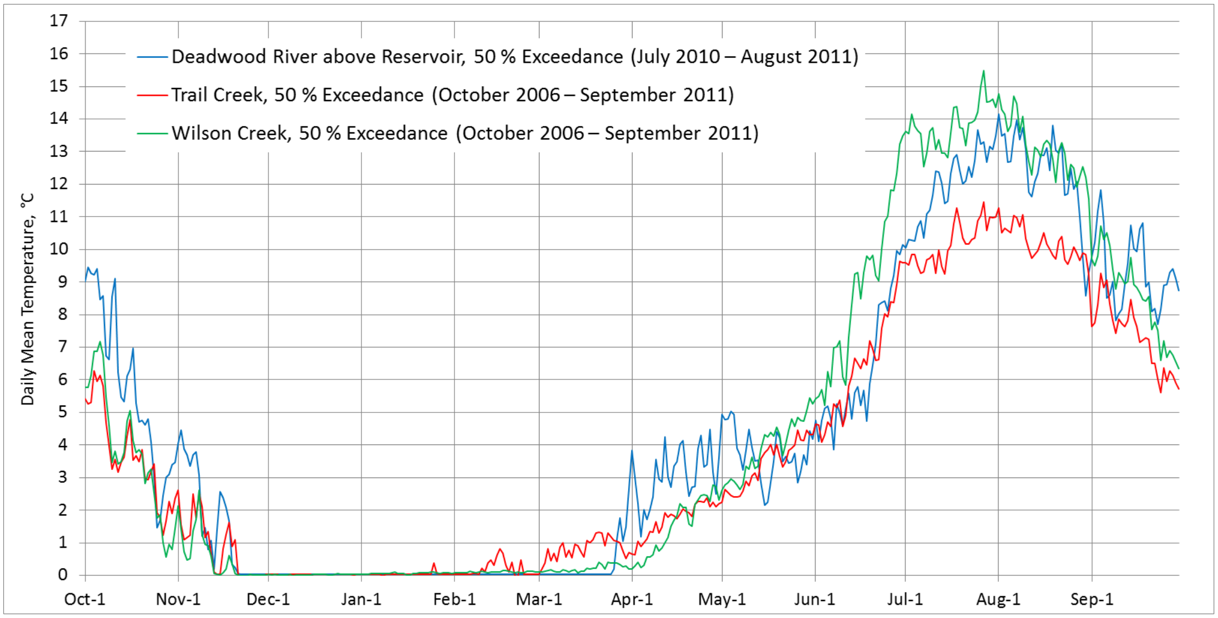

Figure 24. Summary thermograph depicting unregulated thermal regime. Trail Creek is a tributary into Deadwood Reservoir flowing (eastern exposure drainage) and Wilson Creek is a tributary flowing into the Deadwood River downstream of the reservoir (western exposure drainage).

South Fork Payette River

Temperatures in the South Fork Payette River annually exceed 15° C during the summer, reaching a high over 18° C, and fall below 2° C, reaching a low under 1° C despite the temperature influence from the Deadwood River. Thermal refugia may be available in some tributaries; however, the tributary temperatures may exceed 15° C. As noted in PCE 1, there may be groundwater influence that provides thermal refugia, but its contribution may be limited. Bull trout that exhibit a fluvial life history, like the behavior recorded for bull trout that spawn in Clear Creek, likely migrate out of the mainstem South Fork Payette River before the water temperatures reach the summer maximum. Winter temperatures fall below 2° C, but are likely warmer than water entering the South Fork Payette River from tributaries.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

No spawning and rearing habitat has been designated in the Deadwood Reservoir, Deadwood River downstream of the dam, or South Fork Payette River action areas (USFWS 2010a, pages 629, 641).

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Deadwood Reservoir

PCE 7 is a natural hydrograph including peak, high, low, and base flows, or if flows are controlled, minimal flow departure from a natural hydrograph. PCE 7 addresses the amount and timing of stream flow, a characteristic that is by definition not present in a reservoir environment. As a result, PCE 7 is not present in Deadwood Reservoir.

Lower Deadwood River

The hydrograph is altered. A recent study by Reclamation and others (USBR et al. 2011) modeled unregulated flow out of the Deadwood River basin and this modeled hydrograph was compared to the current discharge from Deadwood Reservoir. Generally, there is an altered hydrograph characterized by flows that are lower in the winter and spring when the reservoir is refilling and higher in the summer from irrigation deliveries.

During the winter period, dam-regulated releases are generally 50 percent lower than the unregulated inflow into the reservoir. The effect of dam storage reduces late fall stream flows in the river below the dam and lowers the peak hydrograph during the spring runoff except when water is discharged over the spillway (11 of 30 years). In the summer, flows are artificially high due to irrigation deliveries which generally run through late August.

South Fork Payette River

The South Fork Payette River is not regulated and is characterized by the typical snow melt runoff hydrographs seen in the west. Managed flows from Deadwood Reservoir slow the descending limb of the hydrograph during the month of August (Figure 25). During the August irrigation season, releases maintain the hydrograph at a higher level than what is observed naturally, but are still within the range of the natural hydrograph.

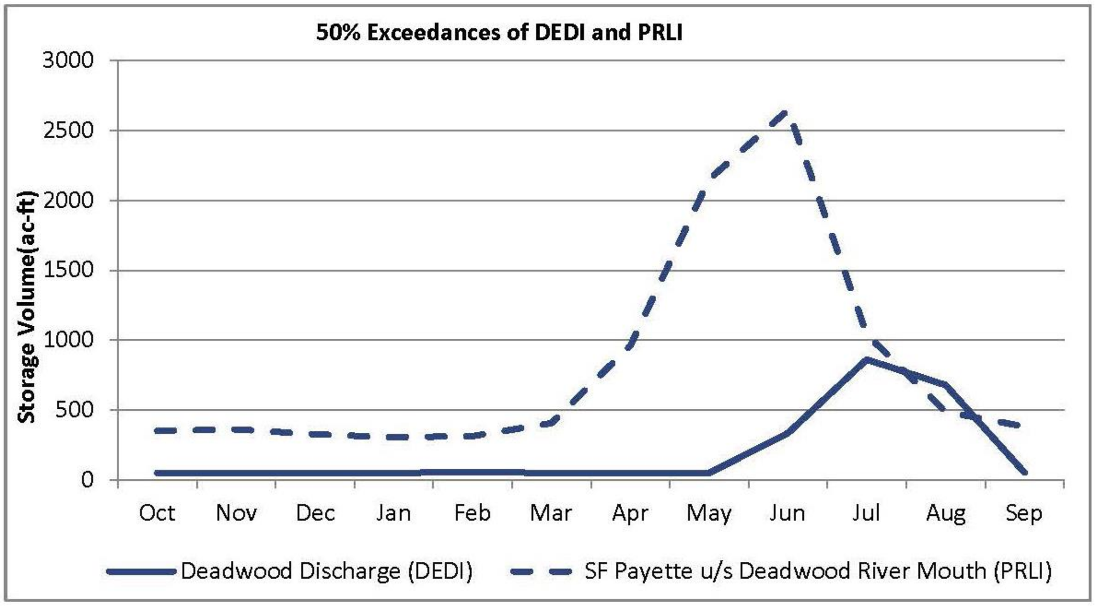

Figure 25. Comparison of 50% exceedance flow from Deadwood Dam (DEDI) and flow in the South Fork Payette River 3.0 miles (4.8 kilometers) upstream of the confluence with the Deadwood River (PRLI gage; USBR 2013).

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Deadwood Reservoir

Water quality and quantity allows adult and subadult bull trout to use Deadwood Reservoir as FMO habitat throughout the year, but shows seasonal limitations during 10 percent of the years when severe drawdowns may occur in combination with warm ambient air temperatures. The water quality and quantity in Deadwood Reservoir is more biologically productive than expected for a high-elevation reservoir situated in a relatively undeveloped drainage basin (USBR et al. 2011, p. 37-42). The reservoir is classified as oligotrophic, indicating that a nutrient loading from the watershed is balanced with the nutrient cycling within the reservoir.

Suitable water temperatures and dissolved oxygen levels typically exist in the reservoir throughout the year. Water temperature and dissolved oxygen conditions annually progress through stratification and thermocline breakdown. These processes will typically leave a thermal and oxygen refugia between 20 feet and 53 feet (6 and 16 meters) in the reservoir during the summer critical period (Assessment Appendix B, pp. 29-32).

Sediment and turbidity levels are typically very low and should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Water quality and quantity are adequate to allow the prey base (fish, aquatic invertebrates and zooplankton) to remain at sufficient levels to support bull trout. The TN:TP ratios indicate that blue green algae and other unpalatable forms of nitrogen-fixing algae should not dominate the reservoir as nitrogen is common. Furthermore, the types of algae that are often associated with the observed TN:TP ratios should provide suitable forage for zooplankton and other aquatic invertebrates.

Lower Deadwood River

Water quality and quantity would allow bull trout to use the lower Deadwood River as FMO habitat throughout the year if bull trout were present. Nutrients are retained in Deadwood Reservoir during most of the year; however, during periods of high flow from tributaries, nutrient inputs occur from natural sources. Nutrients and chlorophyll from the reservoir are important components of riverine productivity, which shift from a phytoplankton-dominated system in the reservoir to a periphyton-dominated one in the river (USBR et al. 2011, p. 8). Water temperatures and dissolved oxygen levels may show seasonal limitations in September and October (Assessment Appendix B, pp.41-44). Sediment and turbidity levels are typically very low and should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Some tributaries, however, appear to contribute significant sediment loads to the lower Deadwood River and may limit the function of PCE 8 at some locations. Water quality and quantity are adequate to allow the prey base (fish, aquatic invertebrates and zooplankton) to remain at sufficient levels to support bull trout if present.

South Fork Payette River

Generally, the water quality in the South Fork Payette River is suitable for bull trout. IDEQ's most recent 5-year review of the South Fork Payette River basin found only suspended sediment, largely a product of forest roads, as a factor that could limit bull trout habitat. Sediment levels exceeded target levels during years of high flow. IDEQ did not recommend developing sediment TMDL because the river appears to adequately transport suspended sediment without excessive aggradation or degradation (IDEQ 2011).

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Fish stocking and management of fish populations within the State of Idaho is regulated by the IDFG.

Deadwood Reservoir

Beginning in 2009, IDFG has stocked nonnative Kamloop rainbow trout and Chinook salmon in Deadwood Reservoir. Kokanee are also present and provide a food base for bull trout, adult rainbow trout, and Chinook salmon. While young nonnative fish are prey for predatory fishes, including bull trout in Deadwood Reservoir, adult rainbow trout and Chinook salmon may also prey on young bull trout. The degree to which nonnative rainbow trout and Chinook salmon compete with bull trout in Deadwood Reservoir is unknown. Their continued presence seems to create a risk of competition to bull trout and limit the presence of PCE 9 in the reservoir. Brook trout are not known to exist in this area.

Lower Deadwood River

In the past, IDFG has stocked fish in the lower Deadwood River, but these programs were discontinued in 2003 (IDFG 2013b). Species composition in the Deadwood River below the dam is dominated by rainbow trout, sculpin, and dace. The most commonly sampled nonnative species in this reach are kokanee and rainbow trout. The only age class of kokanee that has been observed is young-of-year; few of these fish are thought to survive. The kokanee are likely entrained through the outlet works. While most of the entrained kokanee become prey for predators in the lower Deadwood River and do not survive, USFS staff observed four adult kokanee at the Clear Creek migration weir in the fall 2007. These fish could only have come from Deadwood Reservoir because no other populations are known to exist in the basin. The rainbow trout are likely a hybrid of native redband and introduced rainbow trout from past stocking efforts. Young nonnative fish are prey for bull trout and adults are not large enough to prey upon most size classes of bull trout.

South Fork Payette River

No nonnative predatory fishes are known to exist in the South Fork Payette River although brook trout have been documented in the watershed. Brook trout abundance is sufficiently low that PCE 9 is assessed as functioning naturally. Fish stocking has not occurred in the South Fork Payette River since 2007 (IDFG 2013a).

2.4.2.3 Malheur River Critical Habitat

2.4.2.3.1 Status of Critical Habitat in the Malheur River Basin

Bull trout in the Malheur River system are part of the Malheur River Basin CHU (CHU 24). The Malheur River Basin CHU is one of five CHUs that comprise the Upper Snake River RU and is considered essential to bull trout conservation because of the presence of populations exhibiting rare adfluvial life history expressions, moderate number of local populations, moderate to large numbers of individuals, moderate amount of habitat, and few threats (USFWS 2010, p. 601). The Malheur River Basin CHU includes approximately 2,642.9 miles (1,642.3 kilometers) of streams and 716.0 acres (1,769.0 hectares) of reservoir designated as critical habitat. The Malheur CHU has two local populations: The Malheur River and the North Fork Malheur River. The Vale Project is located within the North Fork Malheur River CHSU. The North Fork Malheur CHSU is the only subunit that overlaps with the action area. Table 10 summarizes stream miles, surface area, and critical habitat.

Table 10. Critical habitat stream miles, surface area, and storage within the Malheur River Basin Critical Habitat Unit (CHU);

Critical Habitat Unit	Critical Habitat Stream Miles (kilometers)	Critical Habitat Surface Area Acres (hectares)	Critical Habitat Storage (acre-feet)
Malheur River Basin 24 – 1,642.3 total stream miles (2,642.9 kilometers)	**169.2 (272.4)**	**1,769.0 (716.0)**	**59,212**

Critical Habitat Unit	Critical Habitat Stream Miles (kilometers)	Critical Habitat Surface Area Acres (hectares)	Critical Habitat Storage (acre-feet)
Malheur River Basin CHU Subunits			
Malheur River	109.8 (176.8)	0	0
North Fork Malheur River	59.4 (95.6)	1,769.0 (716.0)	59,212

Figure 3 (p. 9) shows the Malheur River Basin bull trout core areas (coincident with the CHSUs), CHU boundaries, designated critical habitat streams and reservoirs, and the action area boundaries for the Vale Project.

Operation of the Malheur River system also contributes to the aggregate effect of upper Snake River projects on designated critical habitat located on the mainstem Snake and Columbia rivers. Designated critical habitat on the mainstem Snake and Columbia rivers are part of the Mainstem Snake River CHU (CHU 23), Mainstem Columbia River CHU (CHU 22), and Lower Columbia CHU (CHU 8) and these effects are analyzed in Section 2.5.2.5.

2.4.2.3.2 Baseline Condition and Factors Affecting Critical Habitat in the Malheur River Basin

Detailed information regarding Malheur River system water quality can be found in Appendix B (pp. 47-54) of the Assessment. The following baseline hydrology information is from the Assessment (USBR 2013, pp. 119-123).

The Service (2002) identified the construction and operation of dams, livestock grazing, forest management practices, agricultural practices, and some fisheries management practices as factors contributing to the decline of bull trout in the Malheur River Basin. These factors continue to affect bull trout within this basin.

The construction and operation of Agency Valley Dam/Beulah Reservoir has fragmented the bull trout distribution within the Malheur River Basin. The dam was constructed without fish passage facilities. Other effects of this dam includes altered stream temperatures and flow regimes, halted migration of anadromous species and their nutrient inputs, altered forage bases, and entrainment at Agency Valley Dam (Schwabe et al. 2000, entire).

From 1950 to 1987, the North Fork Malheur River (NFMR), its tributaries, and Beulah Reservoir were chemically treated six times (i.e. rotenone). In addition, chemical poisoning projects conducted between 1950 and 1987 on the NFMR may have killed bull trout, but there is no record of bull trout mortalities (USFWS 2004, p. 20).

The NFMR upstream from Beulah Reservoir had three unscreened private diversions that operated during periods when bull trout were migrating through the area (both upstream and downstream), delaying downstream migration of bull trout likely resulting in bull trout mortality through entrainment into an unscreened diversion (Schwabe et al. 2000). However, in 2006 and 2007, two of the three diversions were screened and a pipeline was installed under the river to serve the third diversion (the point of diversion was eliminated) (J. Stephenson, pers. comm. 2014).

Naturally low flows and drought conditions have been associated with a decline in the number of redds counted in the NFMR population (R. Perkins, *in litt*., 2005). Snowpack for the 2013 water year was below average (<60%) and it is likely that redd counts during 2014 will continue to be depressed in the NFMR (S. Hurn, *in litt*., 2013). These conditions have likely been exacerbated in recent years due to extreme drought in the basin since 2000.

Baseline Hydrology

Agency Valley Dam that forms Beulah Reservoir provides storage facilities on the North Fork Malheur River as part of the Vale Project. The full pool storage volume is 59,212 acre-feet which equates to about 1,913 surface acres. The facilities are operated solely for irrigation and flood control with no minimum streamflow requirements below the dam.

The reservoir generally starts refilling in mid to late October after irrigation deliveries are turned off. The primary tributary to Beulah Reservoir is the North Fork Malheur River. All inflow into Beulah Reservoir is stored for irrigation unless flood control criteria require some flow to be passed downstream. Inflow is generally greatest during the early spring runoff period with minimum inflows being reached during the late summer and winter months. Inflows are important to understand as they directly affect the habitat for bull trout during the last part of their over-wintering period within the reservoir and they also affect the prey base of fish upon which bull trout feed. Irrigation deliveries generally begin in late spring or early summer and continue through October 15 if water is available.

In their Assessment, Reclamation also examined monthly summary hydrographs for the last 20 years and compared them to the record to better determine if changes in climate have occurred in the basin. Data showed there have been minor changes to the inflow (USBR 2013, pp. 120-121), but these changes are likely to have had minimal effects on fisheries.

In dry years, 100 percent of the storage in Beulah Reservoir is used for irrigation, resulting in a reservoir volume less than 2,000 acre-feet by late summer. This condition has occurred in 20 of the last 42 years. Because Beulah has no inactive storage space, it is generally operated as run-of-river when this occurs, passing all inflow through Agency Valley Dam for irrigation deliveries. These run-of-river periods occurred primarily in late July (4 percent of the total days in July in 42 years), August (17 percent), September (31 percent), and early October (24 percent). The end-of-month storage volume peaks in April and May each year and reaches minimum storage volume in August and September.

The proposed action incorporates the operational indicators and T&Cs set forth in the 2005 USFWS Opinion (USFWS 2005a, p. 255). For Beulah Reservoir, the 2005 USFWS Opinion sets the reservoir storage threshold at less than 2,000 acre-feet. The proposed action indicates these levels are projected to occur in 10 of the next 30 years, based on the historical record. On April 23, 2010, the Service extended T&C 4.c. (Table 12) in order for BOR to complete a minimum conservation pool study. A minimum pool of 2000 acre-feet has been put in place through 2015 in order to identify a biologically-based minimum pool recommendation that will reduce the adverse impacts to the prey base in Beulah Reservoir from periodic drawdowns. As stated in the April 23, 2010 letter, should this study fail to identify a minimum pool, the Service recommended defaulting to a minimum conservation pool equal to approximately 18,500 acre feet starting April 30, 2015.

As shown in Figure 26, outflow from Beulah Reservoir is reduced to 0 cfs from November through March at the 10 and 50 percent exceedance levels; at the 90 percent exceedance level, outflows are reduced to 0 cfs only during the November period. Outflow rates increase consistently through May at which time water is managed for irrigation demands. Though bull trout critical habitat does not occur immediately below Agency Valley Dam, it is evident that any bull trout that pass through the dam will not survive total dewatering. Reclamation has developed mitigation by limiting the amount of spill to avoid/reduce entrainment of both bull trout and prey fish species, as well as conducting trap-and-haul efforts in the event spill does occur. All fish salvaged in the stilling basin below the dam are transported and released either into the reservoir or into the North Fork Malheur River above the reservoir. Currently a PIT-tag array has been installed downstream of the dam to determine if any tagged bull trout are able to pass through the dam outlet during non-spill conditions. It is possible that fish may pass through the dam outlet during drawdowns to run-of-river. Previous entrainment studies of tagged bull trout did not indicate bull trout passage through the dam during non-spill periods.

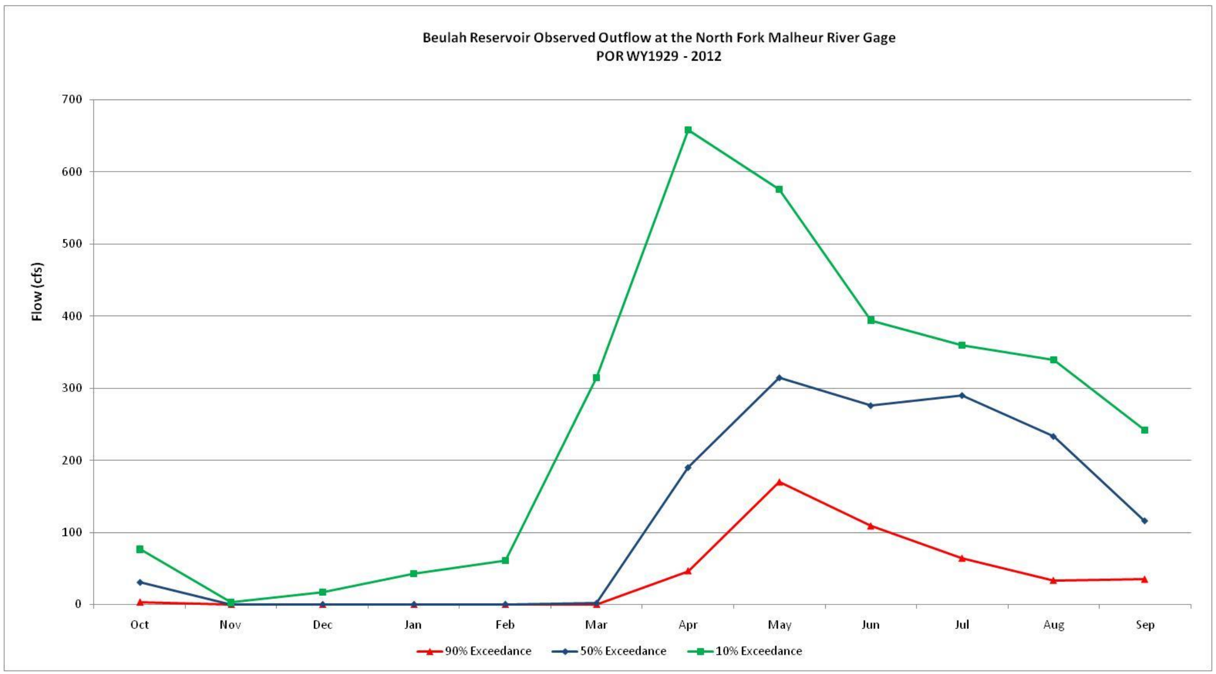

Figure 26. Monthly summary of observed 90%, 50%, and 10% exceedance level outflow from Beulah Reservoir (BEU gage) below Agency Dam for period of record (POR) from water years (WY) 1929 to 2011.

Future Hydrology with Climate Change

The following is from the Assessment pp. 123-124.

Currently there is no reservoir model constructed for the Malheur River system so no modeled data are available. Hydroclimate Data Network sites are not present in the subbasin. Because of the lack of modeled data and processed climate change flow data, a qualitative description of the potential impacts of climate change on a basin with similar attributes as the Malheur River basin is provided.

The attributes of the Malheur River basin are a semi-arid climate with hot, dry summers and cold winters. Precipitation falls between 8 and 40 inches per year, with the higher elevations receiving mostly snow. Short, intense storms are known to occur in the area as well, causing flooding and channel erosion. The basin is also impacted by rain-on-snow events which can occur in the transitional elevation of mountain ranges (ODA 2011, p. 12).

Basins with similar attributes as described above to the Malheur River basin may experience a greater increase in climate variability, which could mean an increase in change between wet and dry periods (USBR 2011a; OCCRI 2010, p. 373). Because flooding can be a result of the rain-on-snow events, flooding events, both in number and size, could increase as the climate changes in the Malheur River basin. Finally, as with many other systems, a shift in the timing of the peak inflow to the reservoir to earlier in the year will likely occur with decreased inflows during the summer months. This may translate into Beulah Reservoir filling earlier in the season. Due to earlier runoff, greater irrigation demand, and warming temperatures, the end-of-month storage volumes will likely be greater in the winter and spring and lower in the summer and fall. Beulah Reservoir is a managed system and as such, it will continue to operate within the ranges previously analyzed in the 2005 USWFS opinion with the exception that fall storage volumes will be maintained at or above 2,000 acre-feet until the results from the studies identify a minimum pool recommendation and agreement is reached.

Critical Habitat PCEs

More detailed baseline information can be found in the Assessment (USBR 2013, pp. 128-133).

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

PCE 1 primarily pertains to bull trout spawning and rearing habitat in a watershed's headwaters where spawning areas are often associated with cold-water springs, snow melt, and groundwater upwelling (75 FR 63898). The North Fork Malheur River is the main source of water for the reservoir. Warm Springs Creek, Spring Creek, and nine other small seasonal creeks flow into the reservoir, with at least three of the seasonal creeks originating from springs. There are wetlands in the interface with the reservoir at full pool associated with the North Fork Malheur River and Warm Springs Creek, as well as some very small wetlands in some of the coves along the shoreline of the reservoir. The topography along both sides of the reservoir is steep, which limits the influence of off-channel habitat.

High to full pool levels in the reservoir result in groundwater storage from recharge that later is released to the North Fork Malheur River as reservoir levels drop during irrigation water withdrawals. This floodplain connectivity is similar to the process that would have occurred to an unmanaged river in this location as seasonally high river levels result in groundwater recharge. The existing wetlands appear to be maintained by flows from the river and Warm Springs Creek and do not rely on groundwater recharge or hyporheic flows from the reservoir.

Hyporheic flow could be reduced in the varial zones due to the deposition of fines from sources outside the action area. Habitat surveys conducted in the varial zone of Beulah Reservoir, reference pool, and riffle habitats indicate that the percent of fines in the varial zone is 45.46 percent compared to reference of 5.6 percent (Prisciandaro 2012). In general, reservoir storage is directly related to flows in the river, with only minor dependence on subsurface water connectivity. The degree to which soil compaction has decreased infiltration has little bearing to the reservoir levels or to the river in the reservoir footprint.

Groundwater is not a significant factor influencing water quality (PCE 8) and availability of thermal refugia (PCE 5) in the reservoir. The primary drivers of water quality, temperature, and the amount of thermal refugia at Beulah Reservoir are derived from inflows of the North Fork Malheur River as well as operation of Agency Valley Dam.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

There are no physical or biological barriers between over-wintering habitat in Beulah Reservoir and the migration corridor out of the reservoir leading to spawning and rearing habitat in the North Fork Malheur River and associated tributaries; however, there is a seasonal water quality barrier that occurs in Beulah Reservoir. Starting usually in mid-May and lasting through October, water temperatures and low dissolved oxygen levels exceed bull trout tolerances (PCE 5); however, the effects of this temperature increase are offset since subadult and adult bull trout migrate out of Beulah Reservoir into the North Fork Malheur River and tributaries to over-summer and to spawn (Rose and Mesa 2009a, p9; 2009b p. 12; Gonzalez et al.1998; Schwabe et al. 2000, pp. 12-14; Best 2012a, p. 45; 2012b). Bull trout remain in the North Fork Malheur River until fall when they migrate back to the reservoir; at this time, water temperature and dissolved oxygen levels have returned to tolerable levels.

Multiple years of drought can worsen the seasonal temperature effects by significantly reducing the reservoir levels, resulting in greater temperature maximums and lower dissolved oxygen levels. Conditions in the North Fork Malheur River may deteriorate somewhat, but adult and subadult bull trout should be able to find thermal refugia in the river and in springs in headwaters areas. In the event of extremely low runoff and subsequent low reservoir pool levels during the bull trout outmigration period, bull trout exhibit flexibility in the actual migration dates. If the conditions become too warm and low, bull trout leave the reservoir earlier in the spring season.

Migration corridors in the spring are in good condition. No migration impediments occur during the spring migration period for fish migrating out of the reservoir to spawning habitat. Reservoir drawdowns can expose varial zones during the fall migration season in most years; however, connectivity is maintained at all times. The migration zone experiences a reduction of structural diversity in the fall which causes the risk of predation to increase; however, depth cover is maintained better than in other action areas because of the more incised stream channel and narrow delta entering the reservoir. The presence of a stream channel and established vegetation within the delta (compared to other action areas) maintains more depth and reduces the risk of predation than a channel that spreads out within a wide delta.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Beulah Reservoir is eutrophic and very productive. Reservoir sampling in 2011 resulted in 17,794 total individuals of 11 fish species caught in fyke nets, gill nets, and a weir during a wet year (USBR 2012, p. 52). Rose and Mesa (2009a) reported similar levels of catch during 2006 during a moderate drawdown. However, Rose and Mesa (2009b) reported a significant decline in forage fish following a drawdown to run-of-river. Petersen and Kofoot (2002) indicate that annual recruitment of prey species from the North Fork Malheur River may ameliorate some of the effects of reservoir drawdowns on the bull trout prey base.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes, that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths gradients velocities and structure.

In general, reservoir operation allows for the development of abundant shoreline vegetation (willows, grass) which in turn provides substrate for terrestrial and aquatic macroinvertebrates as well as cover for juvenile fish of many species (prey for bull trout). During non-drought years, the reservoir provides a variety of depths; however, dry and drought years result in extreme drawdown events. The reservoir has dropped to run-of-river four times in recent history (1988, 2002, 2003, and 2004). Since 1973, the reservoir has also been drawn down to less than 500 acre-feet during 12 years. These extreme drawdowns reduce lacustrine habitat complexity, adversely affecting prey base and cover.

A habitat survey was conducted in 2011 to quantify habitat variables in the river within Beulah Reservoir (Prisciandaro 2012). It was found that within this relatively small area of the North Fork Malheur River, major habitat features consisted of 14 percent pool, 65 percent riffle, and 21 percent run. These habitat features are unlikely to be utilized by bull trout because drawdown occurs during the summer and early fall months when water temperatures exceed tolerance levels and bull trout are not present in the action area. The reservoir begins to refill in October and water temperatures drop significantly, providing suitable over-wintering habitat for bull trout returning to the reservoir.

An extensive area of riparian habitat remains at the North Fork Malheur River inlet to the reservoir. Reservoir operations have eliminated riparian habitat along the North Fork Malheur River channel through the reservoir; however, riparian habitat exists along the edge of Beulah Reservoir in extensive areas of the shoreline. During high and full pool conditions, these areas are partially inundated and fish, including bull trout, utilize these areas for shelter and foraging.

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Beulah Reservoir provides adequate water temperatures for bull trout foraging, rearing, and over-wintering November through mid-May (Figure 27), a period when bull trout are present in the reservoir; however, there are no thermal refugia in Beulah Reservoir June through October. Water temperatures and dissolved oxygen levels become unsuitable for bull trout beginning in mid- to late May and continuing through October. During this time, all adult and subadult bull trout to migrate out of the reservoir into the North Fork Malheur River.

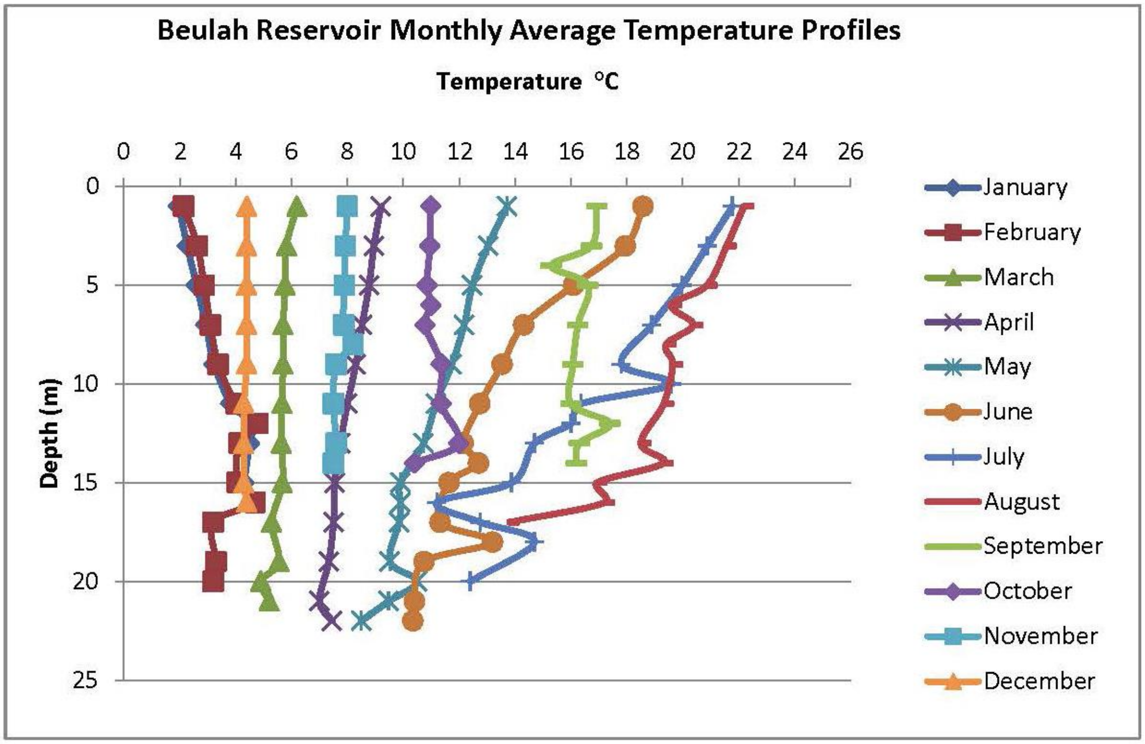

Figure 27. Monthly average temperature profiles in Beulah Reservoir, January through December.

The functionality of PCE 5 in Beulah Reservoir is partially affected by conditions outside of the action area. Water temperatures in the North Fork Malheur River upstream of the action area exceed 15° C from June through October (Figure 28); however, bull trout leave the reservoir early enough in the spring to migrate above the potential thermal barriers in the river. Conditions in the North Fork Malheur River may deteriorate somewhat, but thermal refugia at higher elevations in the river and in springs in headwaters areas are available to adult and subadult bull trout.

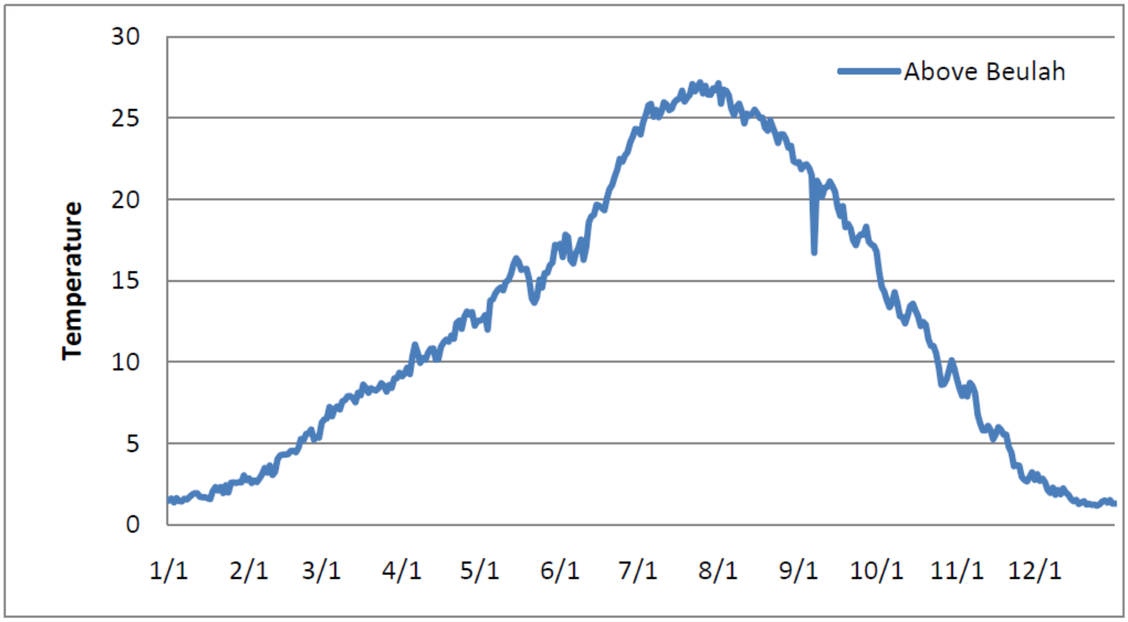

Figure 28. Daily maximum temperature of the North Fork Malheur River entering Beulah Reservoir.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

PCE 6 is not present in the action area.

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

PCE 7 is a natural hydrograph including peak, high, low and base flows, or if flows are controlled minimal flow departure from a natural hydrograph. PCE 7 addresses the amount and timing of stream flow, a characteristic that is by definition not present in a reservoir environment. As a result, PCE 7 is not present in Beulah Reservoir.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Water quality and quantity allows adult and subadult bull trout to over-winter successfully in Beulah Reservoir. The reservoir is classified as eutrophic, indicating that excess nutrients may be impairing the aquatic life of the reservoir. Water temperatures and dissolved oxygen levels show seasonal limitations from mid-May through October; however, bull trout are not present during this time (PCE 2). Sediment and turbidity levels may be seasonally high due to the eutrophic nature of the reservoir, but should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity (Assessment Appendix B, p. 50-51). Water quality is adequate to allow the prey base (fish, aquatic invertebrates and zooplankton) to remain at sufficient levels to support bull trout;

however, no minimum pool has been established. A 4-year study initiated in 2010 as part of the 2005 terms and conditions will be completed in 2014 and will provide a minimum pool recommendation. The establishment of a biologically-based minimum pool recommendation will reduce the adverse impacts to the prey base in Beulah Reservoir from periodic drawdowns below 2,000 acre-feet.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Nonnative fishes are present in Beulah Reservoir (including stocked rainbow trout), but are not a significant source of predation or competition. Bull trout spawning and rearing habitat is in the North Fork Malheur River and associated tributaries, and nonnative predators have not been identified as a factor affecting bull trout survival during these vulnerable larval and juvenile life stages. The nonnative fish themselves become prey for over-wintering bull trout in Beulah Reservoir. There is no evidence that stocked rainbow trout are significant competitors to bull trout, given the large prey base present during non-drought years along with large numbers of rainbow trout (2011 catch: 17,794 all spp., 440 stocked rainbow trout as shown in 2011 reservoir study). Additionally, data shows that bull trout have a good condition factor, which suggests low levels of competition (Best 2012b). White crappie were discovered in the catch at Beulah in 2008 (Rose and Mesa 2009b, p. 43), as well as in the catch in the fall of 2012 along with largemouth bass (USBR 2013,p. 133). Thus far, no brook trout, which are known to interbreed with bull trout, have been identified in either the North Fork Malheur River or Beulah Reservoir.

2.4.2.4 Powder River Critical Habitat

2.4.2.4.1 Status of Critical Habitat in the Powder River Basin

There are 184.2 miles of streams and 2,216.5 acres of lakes and reservoirs (Phillips Reservoir was referred to “Phillips Lake” in the Assessment) in this critical habitat unit, located within Baker, Union, and Wallowa counties in northeastern Oregon. This unit is thought to contain ten local populations of bull trout and one potential local population. Several unoccupied sections of the Powder River mainstem have been included to provide connectivity and recovery opportunities for local populations. This unit provides spawning, rearing, foraging, migratory, connecting, and overwintering habitat.

Figure 4 (p. 11) shows the Powder River basin bull trout critical habitat streams and reservoir, the CHU boundary, and the action area boundaries.

Table 11. Summary of stream miles, surface area, and volumes for Powder River Basin CHU 20. Only Phillips Reservoir and small portions of the Powder River below the Wolf Creek/North Powder River confluence and Eagle Creek confluence are critical habitat. CHU).

Critical Habitat Unit	Critical Habitat Stream Miles (kilometers)	Critical Habitat Surface Area Acres (hectares)	Critical Habitat Storage (acre-feet)	Action Area
Powder River Basin, CHU 20 **1,095.6 total stream miles (1,763.1 kilometers)**	**184.2 (296.5)**	**2,216.5 (897.0)**	**73,000**	
Powder River CHU	19.9 (32.0)	2,216.5 (897.0)	73,000	73,000 acre-feet (reservoir); 19.9 miles (stream)

Operation of the Powder River system also contributes to the aggregate effect of upper Snake River projects on designated critical habitat located on the mainstem Snake and Columbia rivers. Designated critical habitat on the mainstem Snake and Columbia rivers are part of the Mainstem Snake River CHU (CHU 23), Mainstem Upper Columbia River CHU (CHU 22), and the Mainstem Lower Columbia CHU (CHU 8) and these effects are analyzed in 2.5.2.5.

2.4.2.4.2 Baseline Condition and Factors Affecting Critical Habitat

Detailed information regarding Powder River system water quality can be found in Appendix B (pp. 55-62) of the Assessment. The following baseline hydrology information is from the Assessment (USBR 2013, pp. 145-151).

The Service (2002) identified the construction and operation of dams, livestock grazing, forest management practices, agricultural practices, mining, and some fisheries management practices as factors contributing to the decline of bull trout in the Powder River Basin. These factors continue to affect bull trout within this basin.

The construction of the Hells Canyon Complex (Brownlee, Oxbow, and Hells Canyon dams) on the Snake River occurred over an eight year period (1959-1967). The Powder River is a tributary to the Snake River, with the confluence upstream of Brownlee Dam. All three dams are fish passage barriers and have restricted movement of migratory bull trout and eliminated access by natural runs of anadromous fishes to the Snake River and tributaries.

In addition, numerous dams exist in Snake River tributaries within the Hells Canyon Complex. Two such dams, Thief Valley Dam and Mason Dam, were constructed on the Powder River by Reclamation in 1932 and 1968, respectively. Both are impassible fish barriers and are operated by irrigation districts. Thief Valley Dam restricted access of migratory fish to the lower 70 miles of the Powder River Basin, where Eagle Creek was the primary tributary in which bull trout occurred, but now thought to be extirpated (Nowak 2004, p. 87). Mason Dam isolates bull trout in the upper Powder River (Silver Creek, Little Cracker Creek, and Lake Creek) from bull trout in downstream tributaries of the Powder River above Thief Valley Dam (i.e. North Powder River, Wolf Creek, and tributaries).

Baseline Hydrology

Inflow to Phillips Reservoir was determined using daily data for the gage at the Powder River at Hudspeth Lane above Phillips Reservoir (PRHO). Generally, all inflow to Phillips Reservoir is stored for irrigation except for flood control releases and a small 10 cfs release to maintain downstream flows. The Baker Irrigation District has an agreement with the ODFW to release enough water to meet a 10 cfs minimum in-stream flow at Smith Dam, about 10.0 miles (16.1 kilometers) below Mason Dam from October through January. Water is generally stored between October and March and released April through September. In an average year (50 percent exceedance), approximately 10 cfs are discharged from Mason Dam from October through January and approximately 20 to 50 cfs during February and March. From April through September of average years, approximately 100 to 200 cfs are released for irrigation diversions. Under flood control conditions, discharges up to 450 cfs would be released for short periods of time. See the 2004 Operations for a more detailed description of the operations (USBR 2004b, pp. 137-142).

The end-of-month storage volume for Phillips Reservoir was determined by averaging the data on the last day of each month for the entire period of record from January 1968 through November 2011 (WY 1968-2012) (Figure 29). In general, refill begins in January or February depending on the water year type, but drafting normally begins in June. The drafting rate is consistent, regardless of water year type, until August at which time the rate slows. The storage volume in Figure 29 reflects active storage only; dead storage (3,510 acre-feet in Phillips Reservoir) is not reflected in the volume numbers in the figures. This dead storage volume of water may be available for in-reservoir fish use, but cannot be released downstream for in-stream use. Phillips Reservoir is also operated under formal flood control rules which dictate that an exclusive 17,000-acre-foot flood control space must be maintained at all times. The maximum storage line shown on Figure 29 reflects this flood control space; however, this space has never been fully used. If water is retained in the flood control space, it cannot be stored for irrigation and must be released as soon as possible at a rate not to exceed 450 cfs.

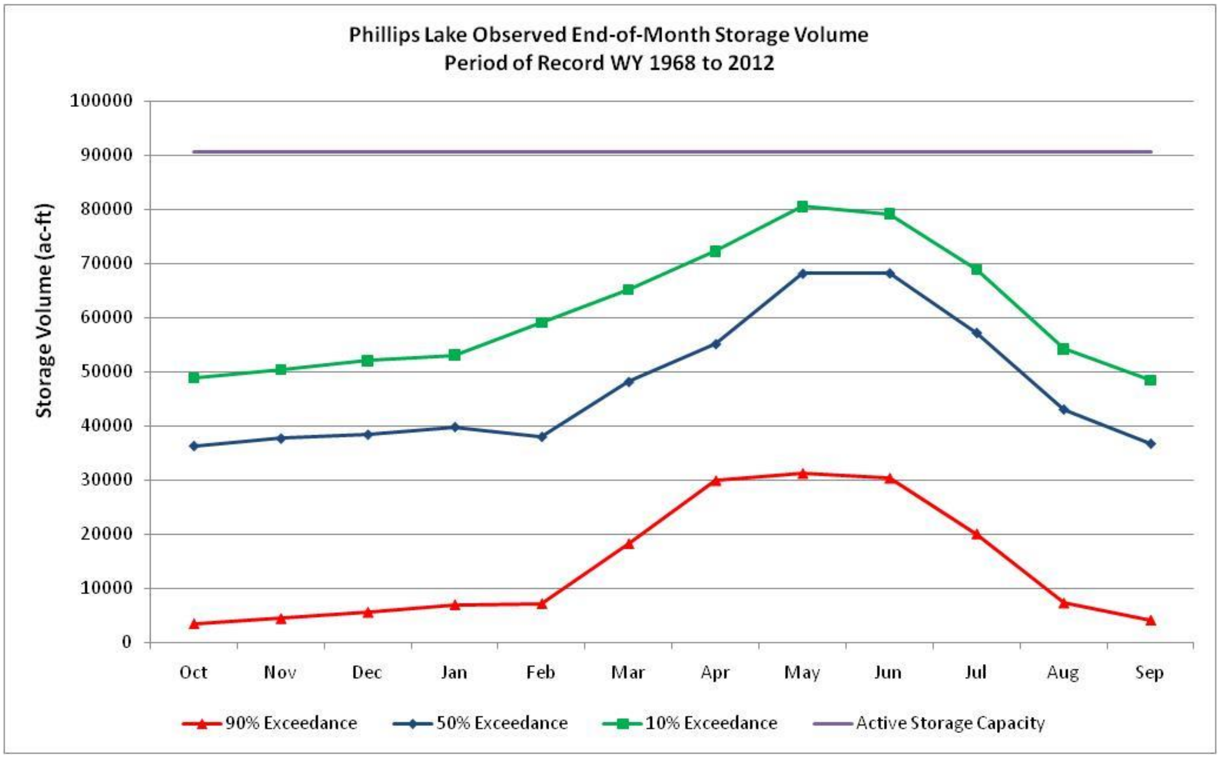

Figure 29. Phillips Reservoir observed 10%, 50%, and 90% end-of-month storage volume exceedance levels for the period of record (water years (WY) 1968 to 2012). Note that the active storage capacity includes 17,000 acre-feet of exclusive flood control space, which has never been fully used.

Mason Dam (Phillips Reservoir) discharge 10-percent, 50-percent, and 90-percent exceedance levels are plotted on Figure 30. Discharges from Mason Dam are less than 20 cfs during October, November, and December in all water year types. At the 10 percent exceedance level, outflow from the reservoir begins to increase in January and continues through June to meet flood control criteria. In average or dry years, outflow generally does not increase until March or April and peaks in May. Outflow generally begins in June and begins to taper off by the end of August.

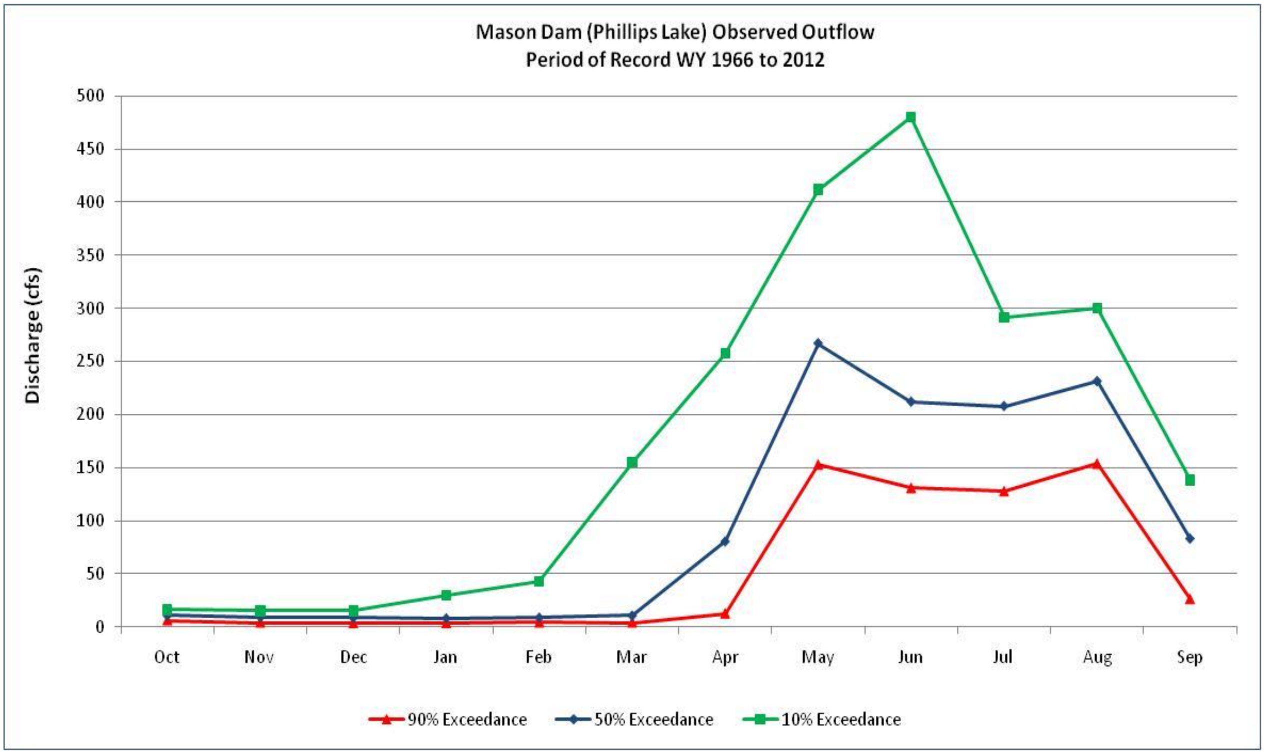

Figure 30. Monthly average observed 10%, 50%, and 90% outflow exceedance levels at Mason Dam (Phillips Reservoir) for period of record water years (WY) 1966 to 2012.

Thief Valley Reservoir exceedance plot of the end-of-month storage values are shown in Figure 31. Storage volume reflects active storage only; dead storage (170 acre-feet in Thief Valley Reservoir) is not shown in the volume numbers on the plots. This dead storage volume of water may be available for in-reservoir fish use, but cannot be released downstream for in-stream use.

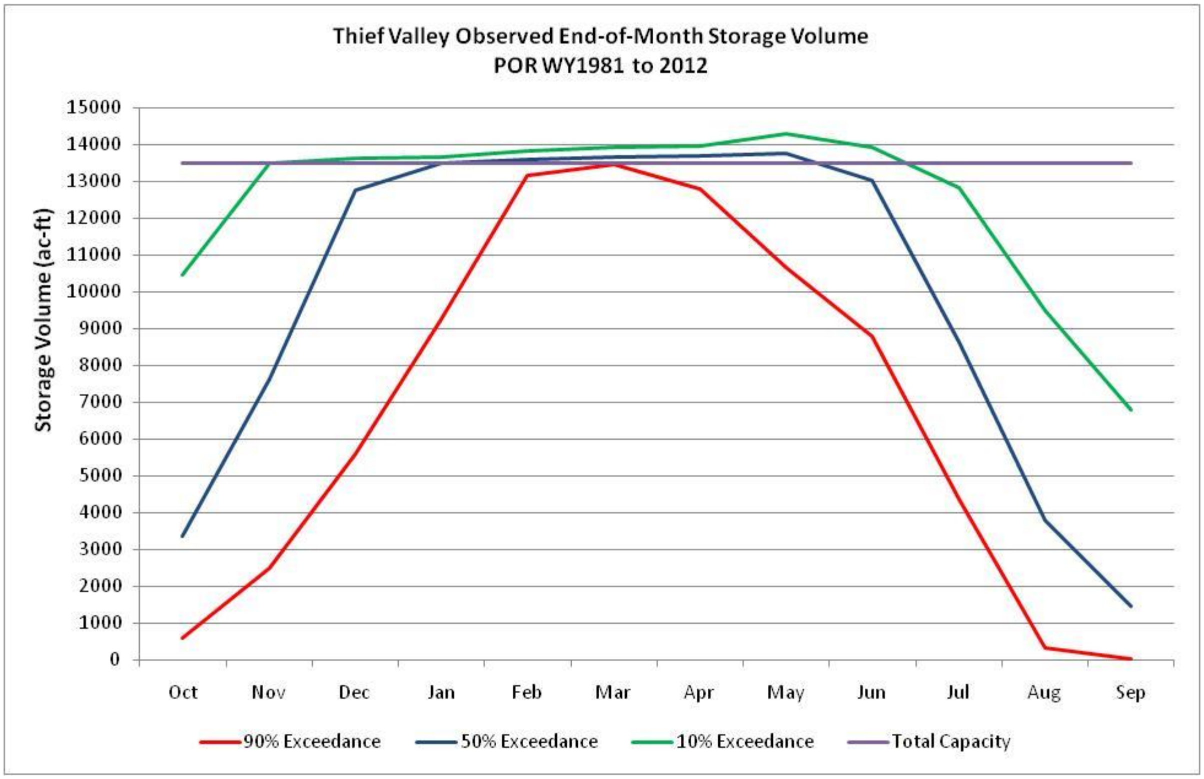

Figure 31. Observed 10%, 50%, 90% end-of-month storage volume exceedance levels for Thief Valley Reservoir for the period of record (POR) water years (WY) 1981 to 2012. Revised maximum storage volume capacity at dam crest (maximum volume revised down roughly 5,000 to 13,477 acre-feet in 2006 after a sediment study).

Thief Valley Reservoir stores all inflow to the reservoir during the late fall and winter primarily for irrigation. In most years, the reservoir fills completely in the late winter or early spring. After the reservoir is full, additional inflows will be discharged over the spillway. Figure 31 shows that at the 50- and 10-percent exceedance levels, the storage is higher than the full storage in the spring and early summer. This is due to the reservoir completely refilling and rising over the crest of the spillway to release the additional inflows. The maximum storage level on the graph is at the crest of the spillway. There are no formal flood control criteria, but some flood control space may be requested before refill in very high runoff years. See 2004 Operations for more details about the operations (USBR 2004b, p. 142).

Figure 32 is the Thief Valley Reservoir observed outflow showing the 10-percent, 50-percent, and 90-percent exceedance levels. It indicates that releases from Thief Valley Reservoir reach almost 900 cfs in June during the wettest years, but generally peak below 400 cfs for the dry and average years. During the driest years, outflow from Thief Valley Reservoir generally does not exceed 100 cfs during any time of the year.

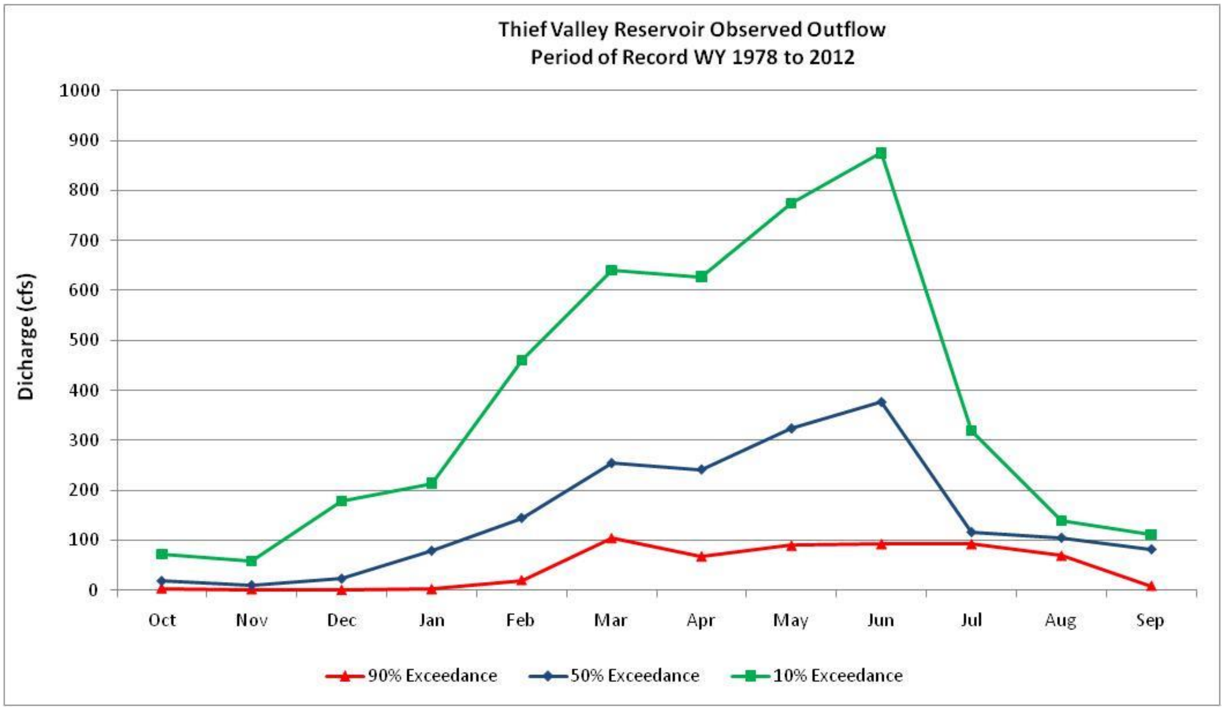

Figure 32. Thief Valley Reservoir 10%, 50%, and 90% observed outflow exceedance levels for period of record, water years (WY) 1978 to 2012.

Figure 33 depicts the exceedance levels for the Powder River near the Richland, Oregon gage (PRRO) just upstream from the mouth of the Powder River and Brownlee Reservoir showing the 10- percent, 50- percent, and 90-percent exceedance flow levels for the period of record from WY 1958 to 2012. This gage is in the Eagle Creek portion of the critical habitat action area and is presented here to show flows at that location and for comparative purposes to demonstrate the scale of effects of releases from Mason Dam and Thief Valley Dam on observed flows 124.1 miles (199.7 kilometers) and 47.8 miles (76.9 kilometers) respectively, downstream. Irrigation deliveries are released into the river channel and are diverted into various canals approximately 8.0 miles (12.9 kilometers) downstream from the dam. These low flow periods generally occur during late summer, with August generally being the lowest. Flows generally increase slowly from September through November. Flows during the summer irrigation season average about 50 cfs (Figure 33).

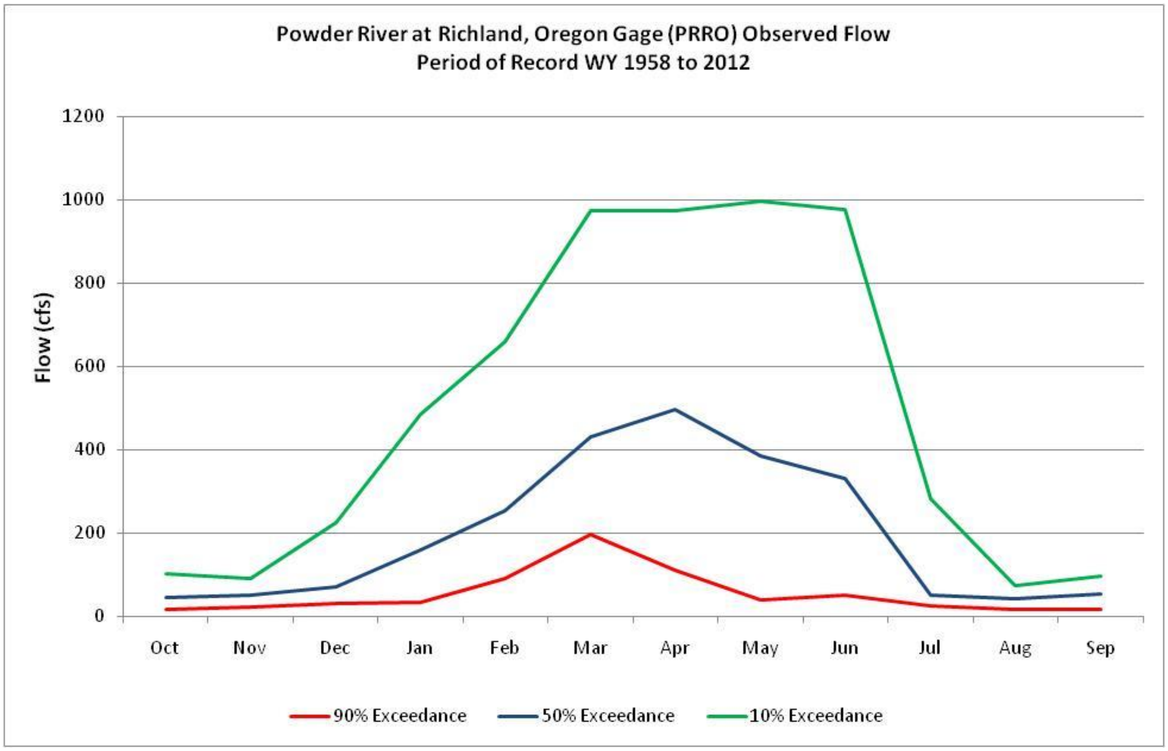

Figure 33. Observed 10%, 50%, and 90% monthly average flow exceedance levels at the Powder River at Richland, Oregon gage (PRRO) for the period of record water years (WY) 1958 to 2012.

Figure 34 shows an exceedance plot of observed flows for the Powder River near North Powder, Oregon (NPDO) for the period of record from WY 1998 to 2012. This gage is upstream of Thief Valley Reservoir and the plotted values reflect 10 percent, 50 percent, and 90 percent exceedance flows. These flows are after most of the water has been diverted for irrigation purposes above the gage. This gage is near the North Powder River portion of the critical habitat action area and is presented here to show flows at that location and for comparative purposes to demonstrate the scale of effects of releases from Mason Dam on observed flows 58.3 miles (93.8 kilometers) downstream. For this period of record, the 90-percent exceedance level flows show that during the months of July, August, and September are below 10 cfs. During August, monthly average flow was 0.8 cfs in 2005, which is the lowest monthly average flow recorded at that site.

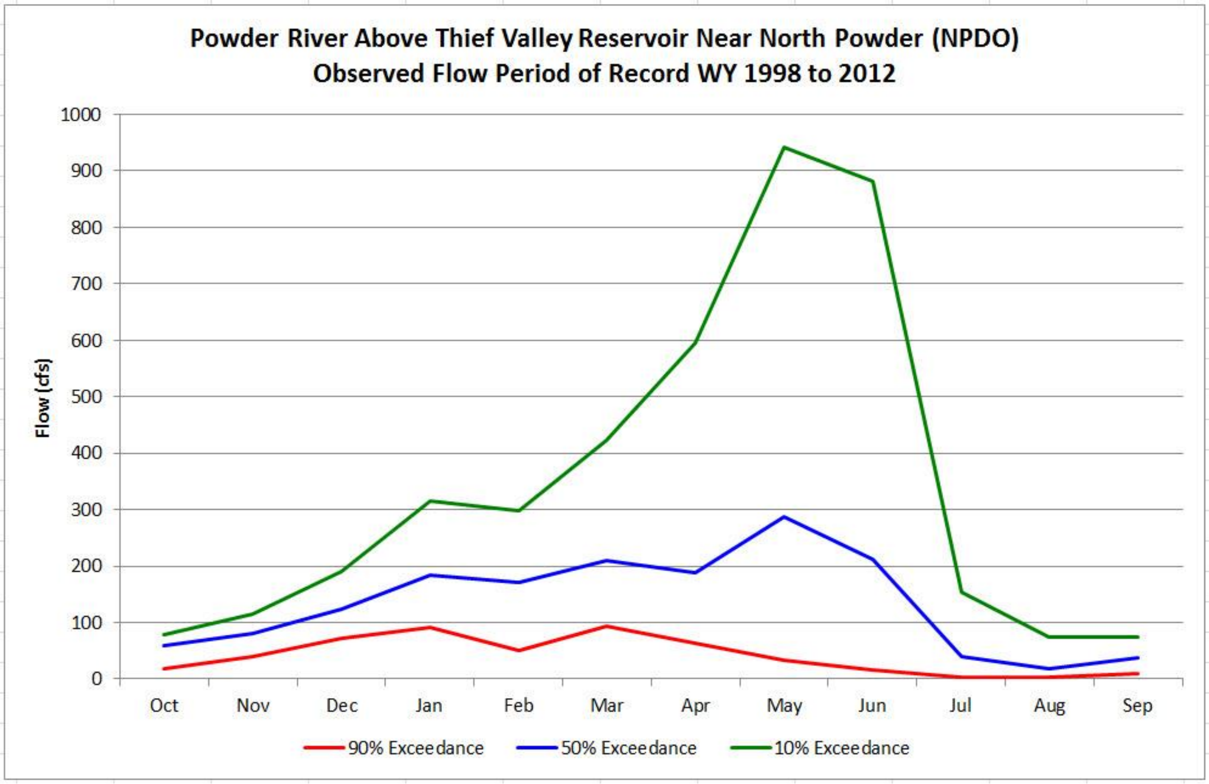

Figure 34. Powder River near North Powder (NPDO) observed 10%, 50%, and 90% monthly average flow exceedance levels (water years [WY] 1998 to 2012).

Future Hydrology with Climate Change

The following is from the Assessment p. 151.

Currently there is no reservoir model constructed for the Powder River system so no modeled data were available. Hydroclimate Data Network sites are not present in the subbasin. Because of the lack of modeled data or processed climate change flow data, a qualitative description of the potential impacts of climate change on a basin with similar attributes as the Powder River basin is provided.

Basins that are similar to the Powder River basin may experience a greater increase in climate variability, which could mean an increase in change between wet and dry periods (USBR 2011d, p. 26, 134; OCCRI 2010, p. 373). It is anticipated that the Powder River will reflect a similar pattern. Accompanied with the higher peaks is a possible shift in peak flow timing, which would indicate a greater likelihood of refill in the reservoirs earlier in the year with decreased inflows during the summer months. The end-of-month storage volume will likely be greater in the winter and spring due to earlier runoff and be lower in the summer and fall due to greater irrigation demand.

Critical Habitat PCEs

More detailed baseline information can be found in the Assessment (USBR 2013, pp. 158-169).

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Phillips Reservoir

The Powder River is the main source of water and nutrients to the reservoir followed by Deer Creek. Phillips Reservoir provides FMO habitat (fall, winter, and spring). The primary drivers of water quality, temperature, and thermal refugia at Phillips are inflows from the Powder River and Deer Creek and the operation of Mason Dam. Groundwater is not a significant factor. Small areas of wetlands and riparian zones are present, associated with the mouth of the Powder River and Deer Creek. These wetlands and riparian areas appear to be maintained by flow from the river and not by groundwater. High to full pool levels in the reservoir result in groundwater recharge that is later released as reservoir levels drop during irrigation water withdrawals. Generally, this groundwater release does not play a significant role in contributing to cold water refugia within the reservoir.

Subsurface connectivity between cold water refugia in the reservoir and tributary habitats may be limited by the condition of tributaries outside the action area rather than the proposed action. Many tributaries in the Powder River basin exceed cold water biota standards during summer months (ODEQ 2013b, p. 98). The role of springs, seeps, or groundwater from these unmanaged tributaries on cold water refugia in the reservoir is unknown. Generally, the significance of spring seeps and groundwater sources are greater in the headwater areas where they have more contribution to the total flow than further downstream (Wehrly et al. 2006).

North Powder River

The presence of PCE 1 in the North Powder portion of the Powder River is unknown, but likely immeasurable. Little or no data regarding groundwater within the North Powder section is available because land bordering this portion of the action area is privately owned and inaccessible. There are multiple land uses identified in both the Core Area Assessment (USFWS 2005b) and the ODEQ Draft Powder Basin Status Report (ODEQ 2013b) that influence the baseline condition in this area including grazing, farming, and water diversions. If PCE 1 is present, it does not have a significant contribution to the function of the PCE.

Eagle Creek

The presence of PCE 1 in the Eagle Creek portion of the Powder River is unknown, but likely immeasurable. A portion of this area (approximately 1 mile) is within the Daly Wildlife Habitat Management Area owned and managed by Idaho Power[9]. Management of the Daly Wildlife Habitat Management Area likely has the most potential to influence the condition of this PCE in this part of the action area. Planned management for the area is expected to include riparian enhancement; these efforts will likely improve the FMO habitat. If PCE 1 is present, it does not have a significant contribution to the function of the PCE.

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[9] See http://www.idahopower.com/OurEnvironment/WildlifeHabitat/Daly/.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Phillips Reservoir

It is difficult to assess this PCE because little is known regarding when bull trout, if present, might migrate to or from the reservoir. Since ODFW began intensive fish sampling in 1991, they have found only two bull trout in Phillips Reservoir, and that occurred in a single year. It is unlikely that bull trout that are present represent a migratory form. If a migratory form were to develop, it is likely they would have similar characteristics to the bull trout in Beulah Reservoir because of the similarities in geography, climate, reservoir operations, and conditions between the two reservoirs. Bull trout in Beulah Reservoir migrate out of the reservoir in mid-May and do not return until late October.

Bull trout migration to and from the reservoir may be limited by three factors: Temperature and dissolved oxygen conditions; an infrequent migration barrier in the varial zone of Deer Creek; and entrainment of fish from the reservoir.

First, seasonal water temperature and dissolved oxygen effects occur in September as a result of thermal loading both in the reservoir and from tributaries outside the action area and bacterial respiration in the hypolimnion. Most streams in the Powder River basin, including the Powder River above Phillips Reservoir, exceed biologically based criteria for cold water biota (ODEQ 2013a). Bull trout are not likely to be present in the reservoir during this time.

Second, a seasonal physical migration barrier exists in the varial zone of Deer Creek due to the presence of two abandoned road beds in close proximity to one another within the full pool margin. Portions of the old highway cause Deer Creek to split and braid within the varial zone. Deer Creek intersects the abandoned road beds at an approximate elevation of 4,009 feet, a point that is reached during most years. Access to Phillips Reservoir on the Powder River is severely impacted by dredge mine tailings upstream from the reservoir. The presence of the dredge mine tailings creates partial physical and biological barriers to migration above the action area between over-wintering habitat in Phillips Reservoir and spawning and rearing habitat in the Powder River. Barriers do not occur when bull trout would be likely to be present in the reservoir.

Third, the extent of entrainment and resulting effects on bull trout is unknown at this time; however, it is unlikely that if bull trout were present they could be entrained at Mason Dam. Releases from Mason Dam occur exclusively through the outlet works located near the bottom of the dam and not the spillway, eliminating the possibility of entraining bull trout in the spring that may be present in the upper water column of Phillips Reservoir. Entrainment has been identified as occurring in other systems mostly associated with spillway releases during the spring season when bull trout are likely to be in the upper water column feeding. No entrainment has been documented from the outlets works close to the bottom of the dam and no recent documentation of bull trout in the Powder River below Mason Dam exists.

North Powder River

Degraded baseline conditions are present in the North Powder portion of the Powder River that could limit migration between resident populations of bull trout that are present in headwater locations. Physical barriers due to dewatering occur in the North Powder River and Wolf Creek (USFWS 2005b, p. 338) causing potential migration limitations out of the action area into these areas. The North Powder River is one of the highest priorities for flow restoration in the Powder River basin (ODEQ 2013a). Wolf Creek also has numerous seasonal impediments including Wolf Creek Dam (a non-Reclamation project). Furthermore, natural thermal loading in most tributaries and the mainstem Powder River exceed biologically-based criteria for cold water biota (ODEQ 2013a). Bull trout use of this area as a migration corridor is unlikely; however, migration to headwater tributary locations does not typically occur during the time when the barriers described above would be present.

Eagle Creek

Degraded baseline conditions (e.g., low flow, lack of screened diversions, high temperatures) are present in the Eagle Creek portion of the Powder River; however, in 2008, Idaho Power purchased the land bordering the upper portion of this area and is currently developing a comprehensive management plan for habitat enhancement in consultation with State and Federal resource agencies. Approximately 1.0 mile (1.6 kilometers) of the action area is owned and managed by Idaho Power as the Daly Wildlife Habitat Management Area. Habitat improvements include re-vegetation projects and irrigation improvements that will maintain more water in the Powder River. These efforts will improve FMO habitat.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Phillips Reservoir

Baseline condition is functional with adequate forage available from native and nonnative prey species in the reservoir (PCE 9). Species encountered during ODFW fish sampling include an abundant prey base of forage fishes for bull trout. An expanding perch population has altered the food web dynamics in the reservoir, potentially limiting the diversity, but not the abundance of prey items for bull trout that could be seasonally present (ODFW 2012).

The proposed action includes inactive storage in Phillips Reservoir; the presence of this pool contributes to the conditions that allow the current abundance of prey fishes that are available to bull trout that could use the reservoir as over-wintering habitat.

North Powder River and Eagle Creek

The function of PCE 3 in the North Powder River and Eagle Creek portions of the Powder River are unknown. Conditions in the North Powder River are generally degraded due to low flow and high water temperatures. Furthermore, natural thermal loading in most tributaries and the mainstem Powder River exceed biologically-based criteria for cold water biota (ODEQ 2013a). Such conditions may result in the reduction of or loss of aquatic habitat and forage organisms such as macroinvertebrates. In the Eagle Creek portion, conditions are similar to those described for the North Powder River reach. However, the management plan being developed for the Daly Wildlife Habitat Management Area (action area) may improve conditions over those currently observed.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes, that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths gradients velocities and structure.

Phillips Reservoir

Reservoir depth and shallow shoreline habitat provides the most significant habitat complexity and contribution toward FMO habitat. Depth allows temperature (PCE 5) and water quality conditions (PCE 8) to support at least minimal benefits throughout the year. Shallow shoreline habitat allows increased primary productivity (PCE 3) that supports a diversity of prey fishes.

Habitat conditions of the watersheds that enter Phillips Reservoir have been impacted by mining, floods, and cattle grazing (USFWS 2005b, pp. 338-339), contributing to a decreased complexity of reservoir habitat during drawdown conditions. Drawdowns expose the varial zone of the Powder River within the Phillips Reservoir pool. Habitat complexity is affected by changing the habitat features from a reservoir environment to a river type environment. A habitat survey (Prisciandaro 2012) was conducted in 2011 to quantify habitat variables in the varial zone within the reservoir. Although the river habitats in the varial zone are different from those in the reservoir and degraded from unregulated systems, they still offer a variety of environments that could be used by bull trout.

In dry years, the inactive pool of 3,510 acre-feet prevents the reservoir from going completely empty, protecting the habitat diversity at low pool elevations. Since 1968, Phillips Reservoir has only dropped below 5,000 acre-feet three times.

North Powder River

Conditions in the Powder River are generally degraded. The river lacks recruitment of sediment and large woody material from sources upstream of Mason Dam. Baseline conditions of the watershed have been impacted by multiple land uses including mining, agriculture, and grazing practices (USFWS 2005b, pp. 338-339). These events have caused sediment transport above levels naturally expected into the Powder River and reduced in-stream and riparian cover and streambank stability. The results of these uses have reduced riparian habitat complexity and limited the functional use of the Powder River as potential FMO habitat to periods of higher flow.

Eagle Creek

Conditions are similar to those described for the North Powder River reach. However, the management plan being developed for the Daly Wildlife Habitat Management Area (action area) may improve conditions over those currently observed.

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Phillips Reservoir

Phillips Reservoir provides adequate water temperatures for potential FMO habitat November through July, a period when migratory bull trout, if present in the basin, would likely be in the reservoir (Figure 35). Water temperatures and dissolved oxygen levels become unsuitable for bull trout beginning in mid- to late July through October, forcing any bull trout in the reservoir to migrate into the Upper Powder River or Deer Creek. However, based on the migration of adfluvial adults in other systems, bull trout would typically leave the reservoir during this time anyway for spawning migrations to the headwater tributaries.

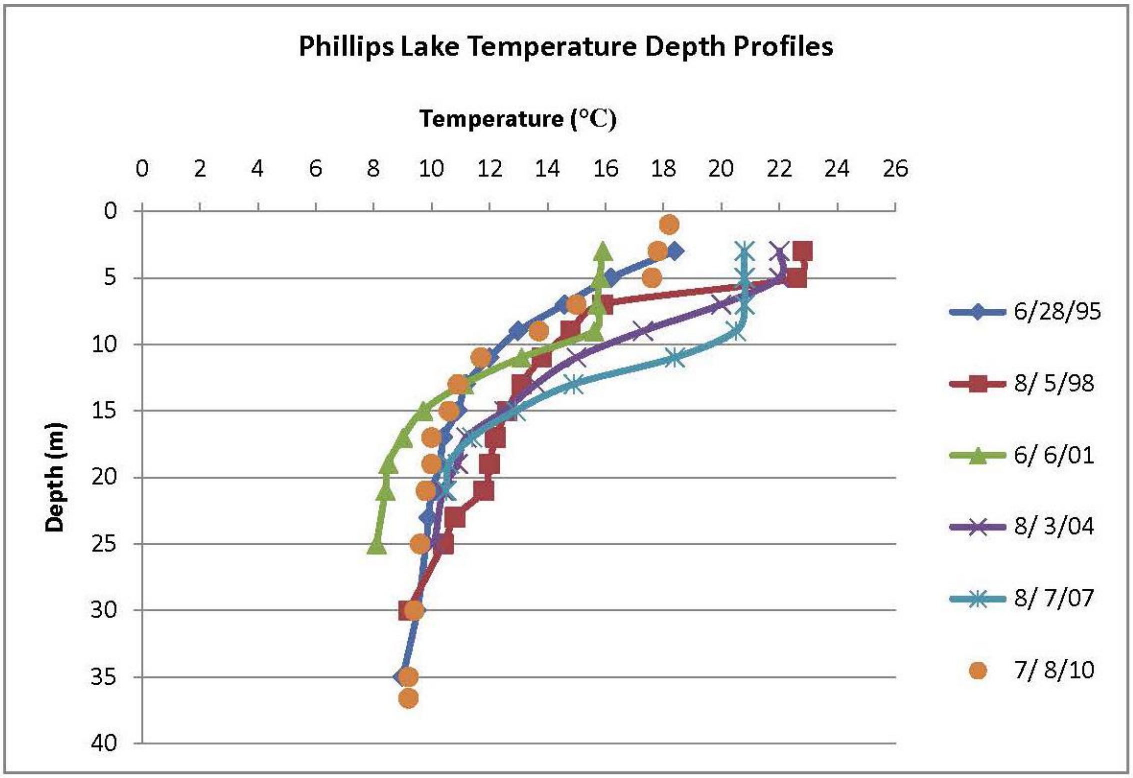

Figure 35. Monthly average temperature profiles in Phillips Reservoir.

The functionality of PCE 5 in Phillips Reservoir is partially affected by conditions outside the action area. Water temperatures in many portions of the Powder River basin including the Powder River upstream of the action area exceed 15° C from July through September exceeding biologically based cold water criteria. According to the USFS, 7-day maximum temperatures exceeding 18° C have been recorded at the Deer Creek temperature gage located near the mouth of Deer Creek and the full pool elevation of Phillips Reservoir (FERC 2009, p. 20). Conditions in the Powder River and tributaries may deteriorate, but thermal refugia at higher elevations and in springs in headwaters tributaries are available to all life stages of bull trout.

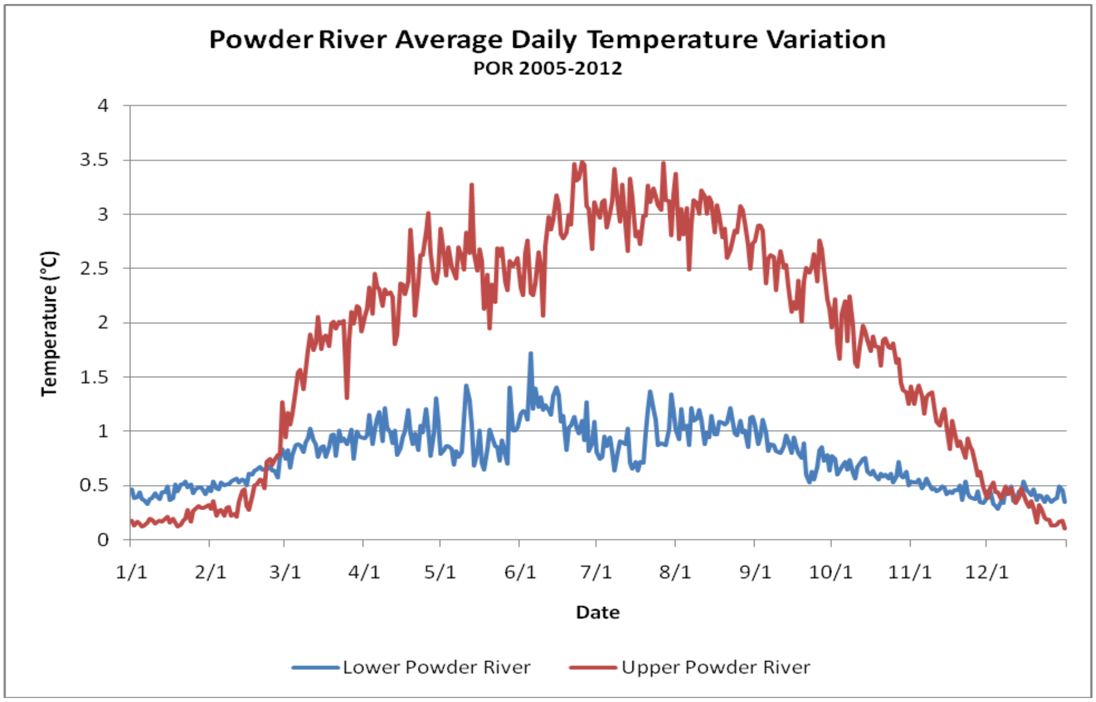

Figure 36. Powder River average daily temperature variation (maximum - minimum) for the period of record (POR) 2005-2012; Upper Powder River (gage PRHO) represents stream temperatures entering Phillips Reservoir and Lower Powder River (gage PHL) represents stream temperatures leaving Phillips Reservoir.

North Powder River

Generally, the water temperature immediately below Phillips Reservoir is within 2° to 15° C in most months (Figure 36). However, water temperature monitoring performed for the Powder/Brownlee Agriculture Water Quality Management Area Plan and ODEQ recorded that water temperatures were influenced by multiple causes and usually exceeded 15° C during the summer throughout the action area in the North Powder River (52.7 miles downstream from Mason Dam) (SWCD 2007, pp. 11-13). Natural thermal loading causes most waters in the basin to exceed biologically based cold water biota standards partially exacerbated by land uses reducing riparian cover. Additionally, wastewater treatment facilities in both Baker City and North Powder are point sources for elevated water temperature and have permits to exceed State standards (ODEQ 2013b, p. 30).

The proposed action has a limited contribution to water temperatures in the North Powder portion of the action area because of the multiple other causes (described earlier) that have a greater effect on this PCE. During most of the year, releases from Mason Dam could help to ameliorate the non-project effects to this PCE by reducing water temperatures in the Powder River, but not enough to reach PCE targets.

The function of the Powder River is primarily to provide a seasonal migration corridor between areas that are capable of supporting bull trout critical habitat year-round. Periods when water temperatures exceed targets are seasonal and do not occur during times when bull trout are expected to be present.

Eagle Creek

Conditions are similar to those described for the North Powder reach above. A wastewater treatment facility in the city of Richland causes the same temperature concerns as described above. The management plan being developed for the Daly Wildlife Habitat Management Area (within the action area) may improve conditions over those currently observed.

The proposed action has a limited contribution to water temperatures in the Eagle Creek portion of the action area (124 miles [199 kilometers] downstream from Mason Dam; and 47.8 miles [76.9 kilometers] downstream of Thief Valley Dam) because of the multiple other causes described earlier that have a greater effect on this PCE.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

PCE 6 is not present in the areas analyzed in this part of the action area. Neither Phillips Reservoir nor the North Powder and Eagle Creek portions of the Powder River were designated as spawning and rearing habitat (USFWS 2010a, pp. 629, 641).

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Phillips Reservoir

PCE 7 is not present in Phillips Reservoir. PCE 7 refers to "a natural hydrograph including peak, high, low and base flows, or if flows are controlled minimal flow departure from a natural hydrograph." Accordingly, PCE 7 addresses the timing and amount and timing of stream flow, a characteristic that is by definition not present in a reservoir environment.

North Powder River

The hydrograph in the Powder River is altered and does not follow the natural daily and seasonal fluctuations of unregulated systems. The hydrograph in this portion of the action area is characterized by flows that are higher in the winter, a lower spring peak, and higher during the summer when flows are held artificially high from irrigation deliveries. A 10-cfs minimum in-stream flow agreement between ODFW and the Baker Irrigation District maintains water in the channel immediately below Mason Dam from October through January; however, benefits of this flow are not noticed in the North Powder River portion of the action area as a result of water withdrawals.

Mason Dam is approximately 40.0 river miles (64.4 kilometers) from the North Powder River portion of the action area. Releases from Mason Dam have little influence on the shape of the hydrograph in this area as a result of the many non-project land management uses including water diversions.

The function of this PCE in the Powder River is to provide a migration corridor between areas that are capable of supporting bull trout critical habitat year-round. Because of the conditions outside the action areas, this function is likely limited to periods of high flow.

Eagle Creek

The hydrograph in the Powder River is altered and does not follow the natural daily and seasonal fluctuations of nearby systems.

Mason Dam is approximately 124.1 river miles from this portion of the action area. Releases from Mason Dam have little influence on the shape of the hydrograph in this area as a result of the many non-project land management uses including water diversions. Management of Thief Valley Reservoir approximately 47.8 river miles (76.9 kilometers) from this portion of the action area has more potential than Mason Dam to affect this area, but even the operation of Thief Valley Dam does not shape the hydrograph at gage PRRO (USBR 2013, p. 150).

The function of this PCE in the Powder River is to provide a migration corridor between areas that are capable of supporting bull trout critical habitat year-round. Because of the conditions (i.e., land management activities, water withdrawals) outside the action areas, this function is likely limited to periods of high flow.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Phillips Reservoir

Water quality and quantity data is limited, but indicate water quality conditions in Phillips Reservoir are good (Nowak 2004, pp. 11-14) and habitat for bull trout would likely be available through most of the year with the exception of July through October, allowing bull trout, if present, to over-winter successfully in Phillips Reservoir. The reservoir is classified as oligotrophic, indicating that a nutrient loading from the watershed is balanced with the nutrient cycling within the reservoir. Water temperatures and dissolved oxygen levels show seasonal limitations in September; however, bull trout are not thought to be present during this time. Sediment and turbidity levels are typically very low and should not impact sight foraging fishes or cause gill abrasions or other secondary or delayed mortality issues associated with high suspended solids or turbidity. Water quality and quantity are adequate to allow the prey base (fish, aquatic invertebrates, and zooplankton) to remain at sufficient levels to support bull trout. The TN:TP ratios indicate that blue green algae and other unpalatable forms of nitrogen-fixing algae should not dominate the reservoir as nitrogen is common. Furthermore, the types of algae that are often associated with the observed TN:TP ratios should provide suitable forage for zooplankton and other aquatic invertebrates.

North Powder River

Degraded baseline conditions exist seasonally as a result of both point and nonpoint sources. Water quality is limited from Mason Dam to Brownlee Reservoir pool with some water quality standards being exceeded during both irrigation and non-irrigation seasons (ODEQ 2013b, p. 74). Wastewater treatment facilities in both Baker City and North Powder are point sources for temperature and nutrients into the Powder River, including a permit to exceed State standards (ODEQ 2013b, p. 30). Additionally groundwater contamination occurs from nonpoint sources including arsenic, nitrate, *E. coli*, and sodium (ODEQ 2013b, p. 17).

The proposed action has a limited contribution to water quality in the North Powder River portion of the action area because of the multiple other causes described earlier that have greater effects on this PCE.

Eagle Creek

Conditions are similar to those described for the North Powder River reach. A wastewater treatment facility in the city of Richland causes the same water quality concerns as previously described. The management plan being developed for the Daly Wildlife Habitat Management Area (within the action area) may improve conditions over those currently observed.

The proposed action has a limited contribution to water quality in the Eagle Creek portion of the action area because of the multiple other causes described earlier that have greater effects on this PCE.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Phillips Reservoir

The proposed action provides an environment that allows the survival of nonnative fishes; however, ODFW exclusively manages the fisheries including stocking and regulations that favor the presence of individual species.

Nonnative fish are present in Phillips Reservoir (stocked rainbow trout, crappie, smallmouth and largemouth bass, yellow perch, walleye, tiger trout, and tiger muskie). Juvenile nonnative fish may comprise part of the bull trout prey base in Phillips Reservoir. Tiger trout and tiger muskie could prey on smaller-sized bull trout.

North Powder River and Eagle Creek

Because of the proximity to Thief Valley and Brownlee reservoirs, the fish assemblages in each reservoir are also likely to use portions of the action area that are upstream of the reservoirs. Altered flow and temperature regimes below the dams and irrigation diversions have likely increased the abundance and productivity of nonnative predatory and competing fish species in bull trout critical habitat.

2.4.2.5 Mainstem Snake/Columbia River System Critical Habitat

2.4.2.5.1 Status of Critical Habitat in the Mainstem Snake/Columbia River

The mainstem Snake River and Upper Columbia River CHUs provide FMO habitat and connectivity. The mainstem Snake River provides connectivity for bull trout in the Hells Canyon Complex CHU and tributaries to the Snake River (i.e., Sheep and Granite creeks). It includes the mainstem Snake River CHU (CHU 23) and extends from Brownlee Dam downstream 280.6 miles (451.7 kilometers) to the confluence with the Columbia River.

The mainstem Upper Columbia River CHU provides only connectivity between the mainstem CHUs and to numerous CHSUs associated with tributary systems of the Columbia River. The mainstem Columbia River includes portions of the upper mainstem Columbia River CHU (323.3miles [520.1 kilometers]; CHU 22) from the confluence of the Snake and Columbia rivers to John Day Dam, and the entire Lower Columbia CHU (211.5 miles [340.4 kilometers]; CHU 8) from John Day Dam to the mouth of the Columbia River.

None of the units addressed in this section support spawning and rearing habitat.

Table 12. Critical habitat stream miles, surface area and storage within the Middle Columbia Critical Habitat Unit (CHU) 22 and CHU 23 and Coastal Critical Habitat Unit (CHU) 8.

Critical Habitat Unit or Subunit	Total Stream Miles (kilometers)	Critical Habitat, Stream Miles (kilometers)	Critical Habitat, Surface Area Acres (hectares)	Critical Habitat, Water Storage (in acre-feet)	Action Area in Miles (in kilometers)
Mainstem Columbia River CHU 22	323.2 (520.1)	323.3 (520.1)	0	0	103 (165.8)
Mainstem Columbia River CHU 8	215.6 (347.0)	211.5 (340.4)	0	0	211.5 (340.4)
Snake River CHU 23	280.6 (451.7)	280.6 (451.7)	0	0	280.6 (451.7)

Bull trout in the mainstem Snake and Columbia rivers are part of the Middle Columbia River RU and Coastal RU. Figure 5 shows the RUs coincident with the designated habitat rivers and reservoirs.

2.4.2.5.2 Baseline Condition and Factors Affecting Critical Habitat

Detailed information regarding the Snake and Columbia river systems water quality can be found in Appendix B (pp. 63-74) of the Assessment. The following baseline hydrology information is from the Assessment (USBR 2013, pp. 185-191).

<u>Baseline Hydrology</u>

The Assessment (USBR 2013, pp. 185-192) provides an informative discussion of the hydrology of the Snake River and Columbia River: It is copied and, where appropriate summarized, here.

Current hydrologic conditions in the mainstem Snake and Columbia rivers are the result of numerous upstream water development activities including, but not limited to, hydropower development; private and Federal irrigation and flood control projects; and municipal and industrial diversions and discharges. Reclamation's O&M activities have influenced the hydrologic conditions in the Snake River for over a century beginning with the construction of the Minidoka Project. All facilities associated with the proposed actions have been operating for at least 40 years. Current flow conditions are consistent with those modeled in the analyses for the 2007 biological assessment and are extensively discussed in Chapter 3 of that document (USBR 2007, pp. 25-47). The hydrologic effect of the upper Snake River projects is discussed thoroughly in Chapter 5 of the 2008 NOAA Fisheries Service biological opinion (USNOAA 2008b).

In addition, salmon flow augmentation is described in detail on pages 35-39 of the 2007 biological assessment, incorporated by reference (USBR 2007). Generally, these salmon flow augmentation activities can be delivered from April through August, augmenting natural flows to meet flow targets for salmon at Lower Granite Dam.

The 2008 NOAA Fisheries Service opinion hydrologic analysis illustrates the relative influence of the upper Snake River projects on the hydrology of the lower Snake and Columbia rivers. Under this analysis, Reclamation compared current hydrologic conditions with upper Snake River operations, including salmon flow augmentation, to a “without projects” case where Reclamation projects pass all inflow downstream. While this method effectively illustrates the causal influence and scale of upper Snake River operations on mainstem hydrology, it should not be used as a quantitative indicator of effects to bull trout or critical habitat. There are two reasons for this. First, this method assumes downstream hydropower operators would adjust operations in proportion to the influence of the upper Snake River projects. In reality, this overstates Reclamation’s ability to influence flows at particular times without the cooperation of downstream operators. Second, because operations are ongoing, future biological conditions are a function of changes in operations or changes in species or habitat response under future conditions. Nonetheless, a with/without comparison remains a useful tool in understanding the scale and ability of Reclamation to influence biological and habitat conditions downstream.

Generally, Reclamation's operations have reduced the inflows to Brownlee Reservoir by about 2.2 million acre-feet annually. Due to tributary inflows and systematic Federal Columbia River Power System (FCRPS) operations, the hydrologic effects of the upper Snake River projects are greatest immediately below Hells Canyon Dam and diminish farther downstream. The critical habitat units addressed in this section all occur downstream of Brownlee Dam. The remainder of this section discusses the influence of upper Snake River projects operations in sections of the mainstem Snake and Columbia rivers.

Mainstem Snake River

This section evaluates the relative influence of upper Snake River projects operations at two locations in the mainstem Snake River: Below Brownlee Dam in the Hells Canyon Complex, and below Lower Granite Dam. Figures 37 and 38 illustrate the inflows to Brownlee Reservoir with and without Reclamation projects and the proportional influence of the upper Snake River projects. In the Hells Canyon Complex, Reclamation generally decreases inflow from October through June, with the greatest decreases in May and June (-30 to -31 percent). Upper Snake River projects operations and salmon flow augmentation increase flows from July through September by between 40 and 88 percent. Discharge at Hells Canyon Dam runs a very similar pattern and magnitude of influence.

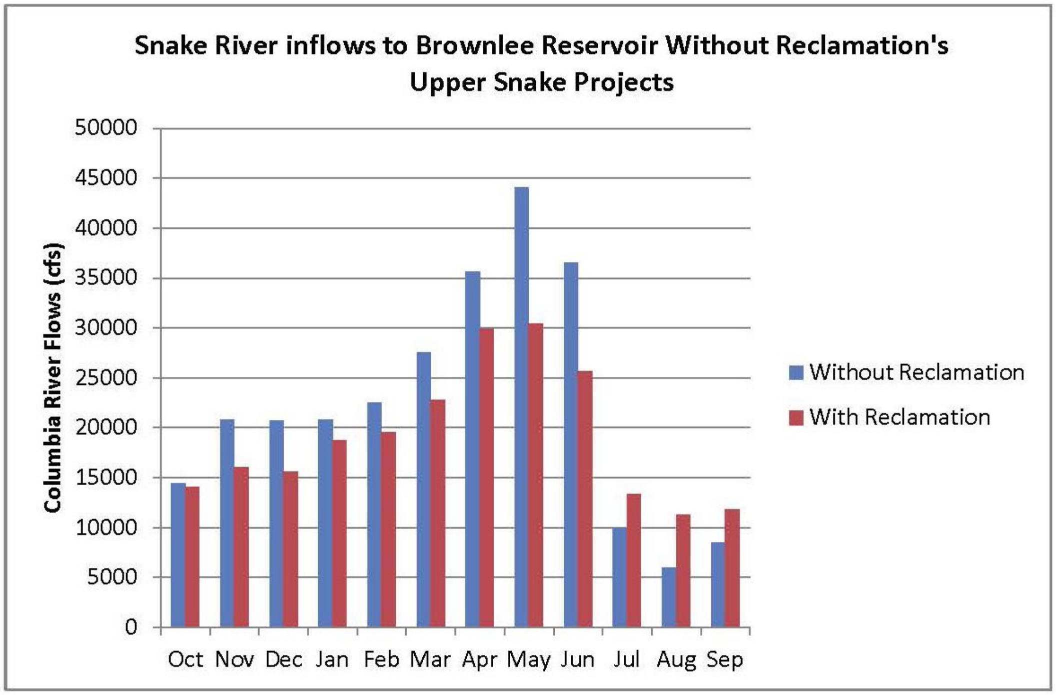

Figure 37. Snake River inflows into Brownlee Reservoir with and without Reclamation's Upper Snake projects for the period of record of 1928-2000. July through September flows include Salmon Augmentation contributions as required in USNOAA 2008b.

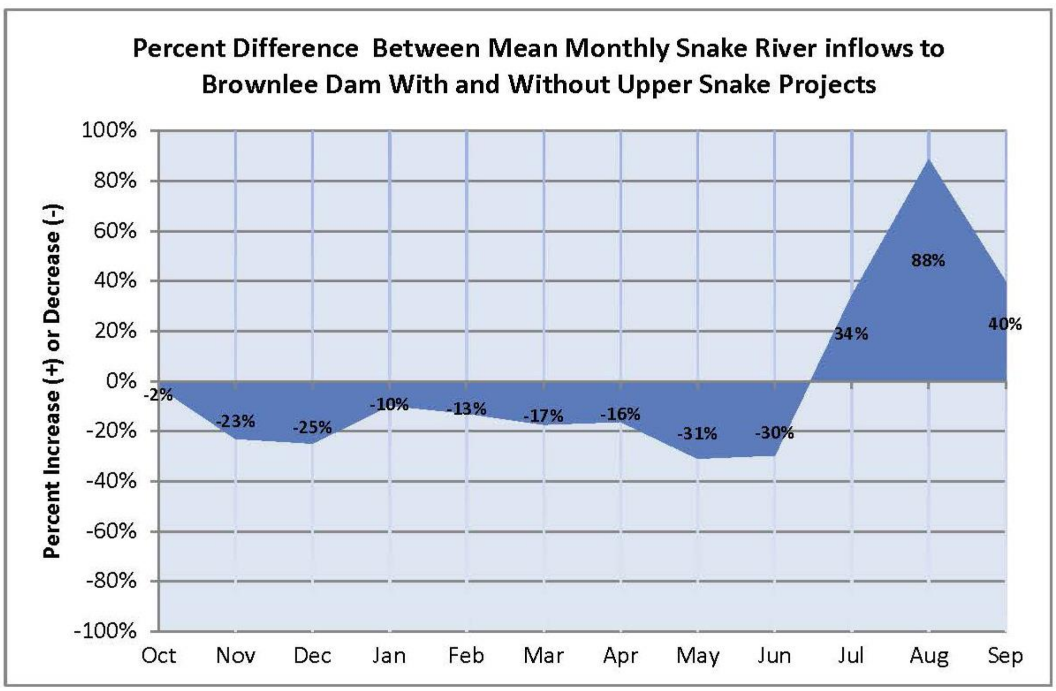

Figure 38. Percent difference between mean monthly Snake River inflows to Brownlee Dam with and without Upper Snake projects expressed as a percentage of the baseline flows.

Inflow to Lower Granite Dam (Figures 39 and 40) shows that the influences of the upper Snake River projects follow a similar pattern as observed at Brownlee Reservoir, but on a smaller scale due to the attenuating effect of additional inflow. Again, upper Snake River projects operations generally decrease flows from October through June and increase flows from July through September. The timing of the greatest influence, however, shifts towards November and December (-14 to -15 percent) with lesser influence during the spring runoff in May and June (-10 to -11 percent) than observed upstream. The relative influence of salmon flow augmentation releases in August and September falls to between 15 and 21 percent.

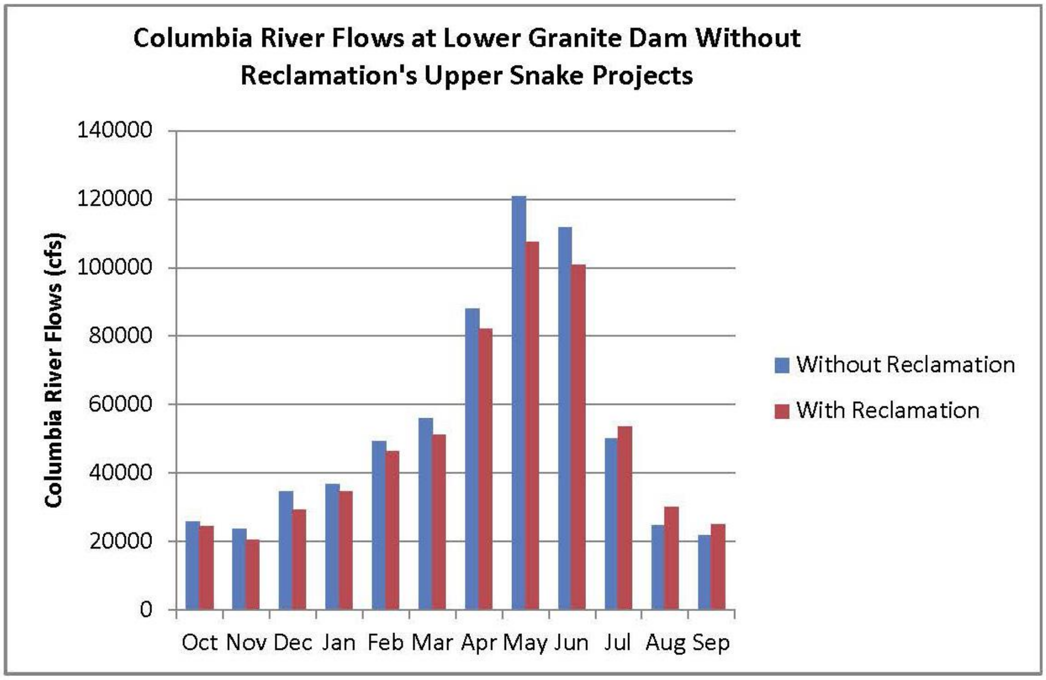

Figure 39. Columbia River flows at Lower Granite Dam with and without Reclamation's Upper Snake projects for the period of record of 1928-2000.

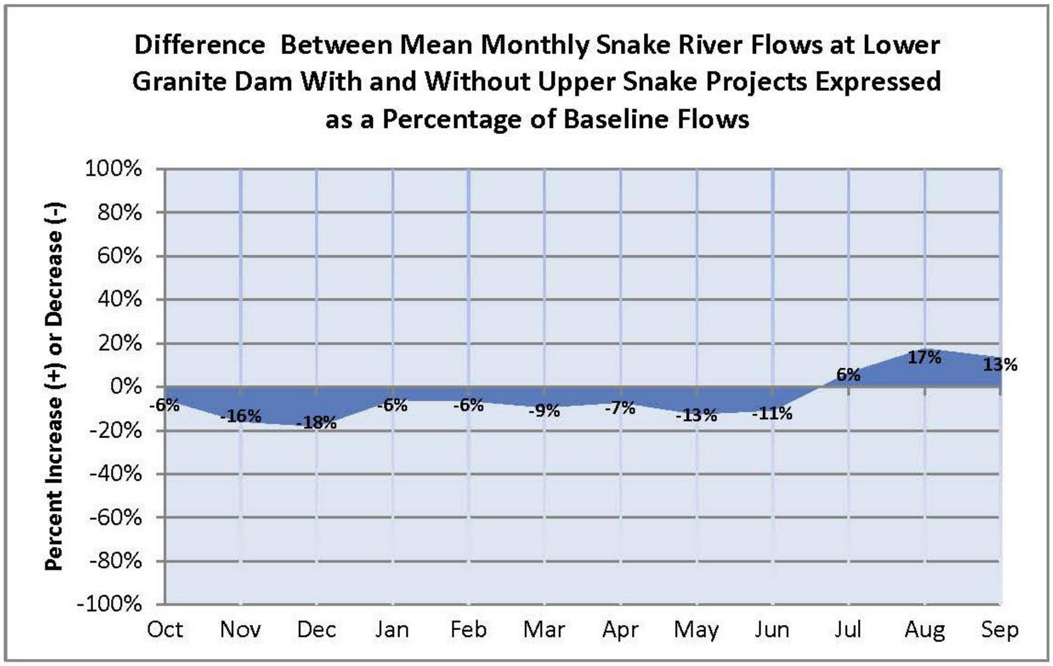

Figure 40. Percent difference between mean monthly Snake River flows at Lower Granite Dam with and without Reclamation's Upper Snake projects expressed as a percentage of baseline flows.

Mainstem Columbia River

This section describes the influence of upper Snake River projects operations on two sections in the mainstem Columbia River as measured by the inflow to McNary and Bonneville dams (Figure 41through 44). Generally, both reaches reflect a similar timing and degree of influence, with generally small decreases from October through June and similarly small increases from July through September. In most months, this influence is very small (less than 5 percent). In December and August, the upper Snake River projects have a greater, yet still slight, degree of influence. This influence diminishes substantially farther downstream due to inflows from Willamette River about 101.0 miles (162.5 kilometers) above the mouth of the Columbia River. Consequently, influence of upper Snake project operations in the lower 100.0 miles (160.9 kilometers) of the Columbia River, the estuary, and the plume are an even smaller portion of the overall comprehensive effects on those species found in this section of the Columbia River.

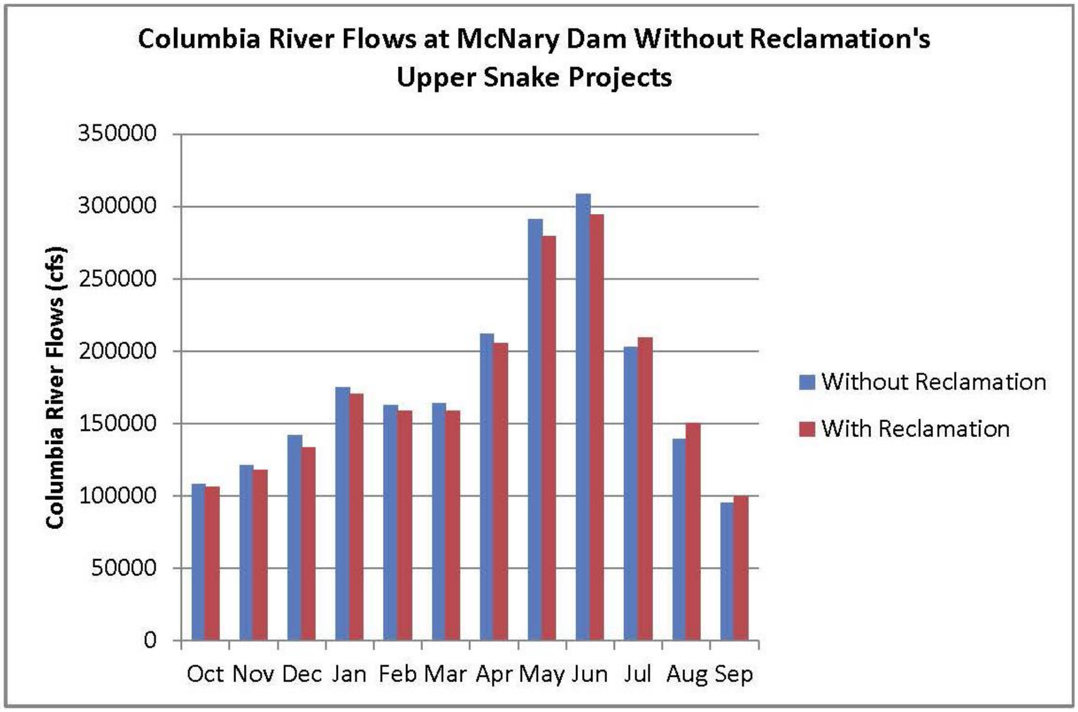

Figure 41. Columbia River flows at McNary Dam with and without Reclamation's Upper Snake projects for the period of record of 1928-2000.

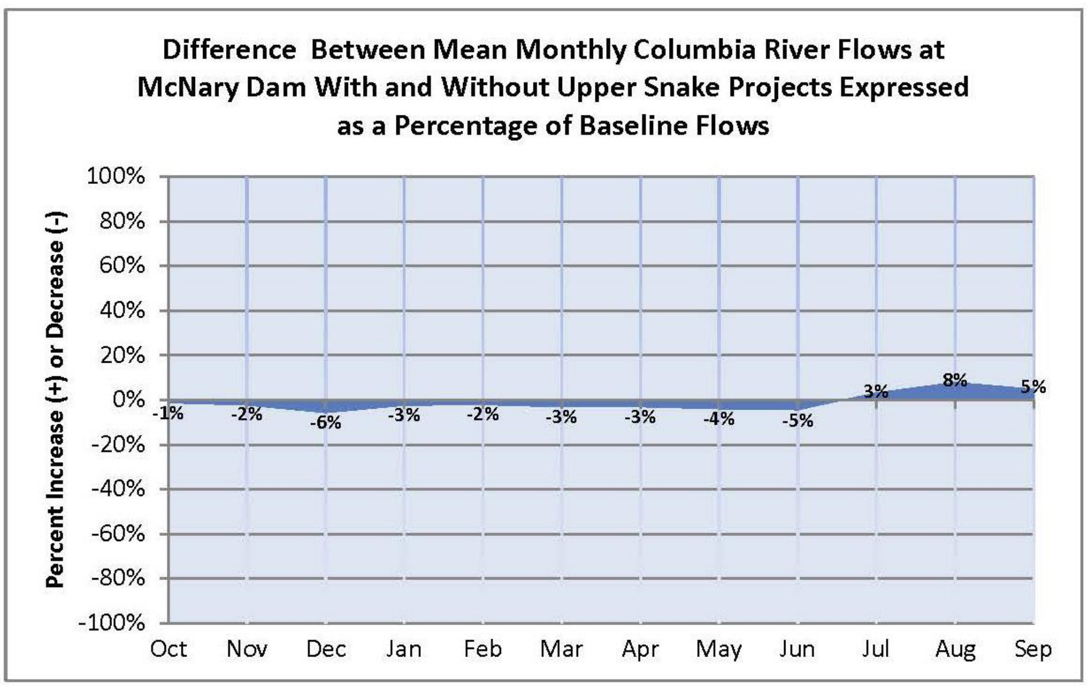

Figure 42. Percent difference between mean monthly Columbia River flows at McNary Dam with and without Reclamation's Upper Snake River projects.

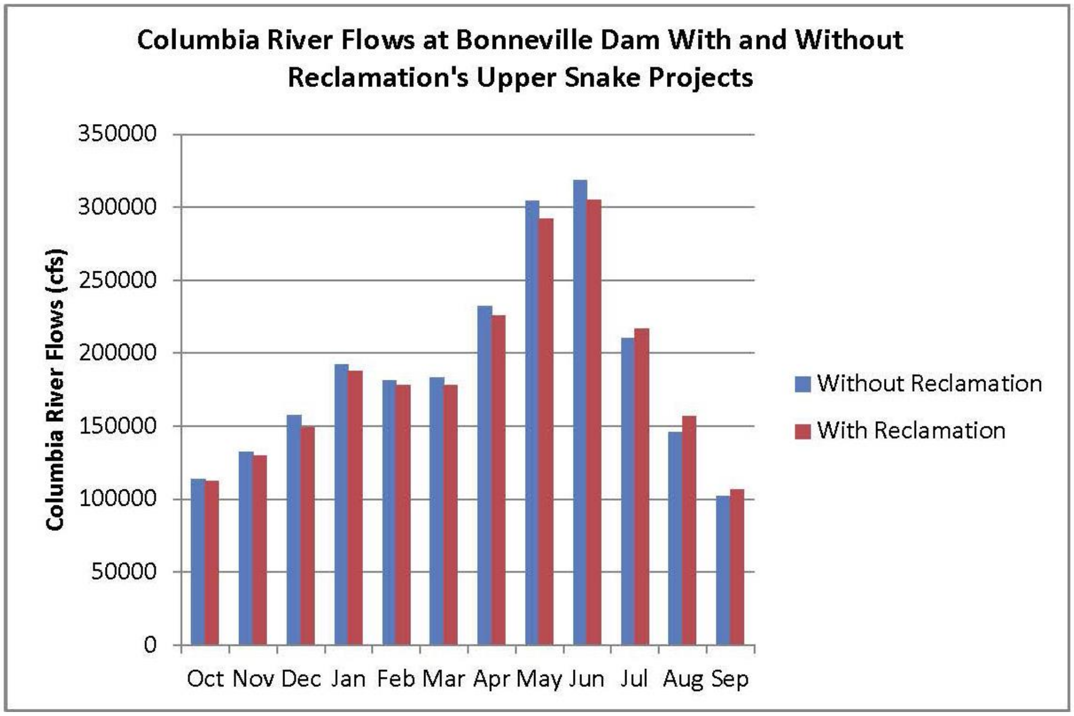

Figure 43. Columbia River flows at Bonneville Dam with and without Reclamation's Upper Snake projects for the period of record of 1928-2000.

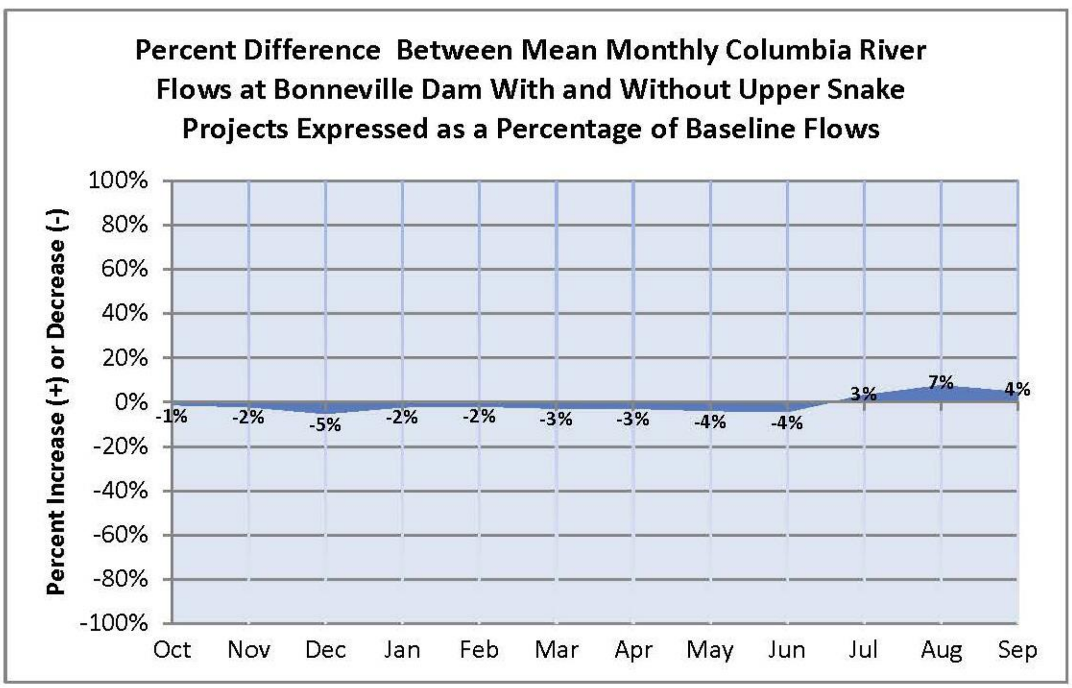

Figure 44. Percent difference between mean monthly Columbia River flows at Bonneville Dam with and without Reclamation's Upper Snake projects.

In summary, the hydrologic effects of the Upper Snake projects have a moderate influence on the flows in the mainstem Snake River, and a very minor effect on Columbia River flows. This influence varies throughout the year and from year-to-year with varying water conditions. Analysis in the 2007 biological assessment (USBR 2007) found the influence of the upper Snake River projects on mainstem hydrology was not likely to have any measurable effect on bull trout and their prey base in the Hells Canyon Complex and downstream areas. The influence on Brownlee Reservoir inflows are relatively minor compared to existing inflows, and Brownlee Reservoir elevations (as well as Oxbow and Hells Canyon) are not likely to be affected at all since salmon flow augmentation is passed through the three reservoirs. The project also would not be likely to have a measureable effect on bull trout, their prey base, and bull trout accessibility to critical habitat and spawning tributaries in the reaches below Hells Canyon.

Future Hydrology with Climate Change

In the 2011, RMJOC Climate Change Study, Reclamation evaluated climate change impacts on the upper Snake River basin using MODSIM (USBR et al. 2011b). No additional modeling by Reclamation was conducted below Brownlee Reservoir for this consultation. In general, higher flows during the winter to early spring and lower late summer flows are likely. Reservoirs would likely refill earlier in the spring and be drawn down more in the winters to make room for the increased spring flows (BPA and USCOE 2011, pp. xvii-xxi).

Critical Habitat PCEs

More detailed baseline information can be found in the Assessment (USBR 2013, pp. 194-198).

The mainstem river units do not support the PCEs typically associated with spawning habitats such as water temperatures ranging from 2° to 15° C with adequate thermal refugia (PCE 5), and spawning/rearing areas (PCE 6) (75 FR 63898). Other PCEs (those that refer to FMO habitat) where baseline conditions are typically a function of geography includes springs seeps and groundwater sources (PCE 1) and complex habitats (PCE 4). Reservoirs in the mainstem Snake and Columbia rivers do not support these PCEs (75 FR 63898, page 63934), and they are typically considered "degraded" for bull trout critical habitat PCE definitions in the riverine environments, although in some cases of these mainstem rivers, this is the natural condition and can be either exacerbated or improved by hydrologic effects of dam operations. Water temperatures are typically within the range for bull trout in the fall, winter, and spring, while frequently exceeding 15° C in the summer months.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

PCE 1 is not present in lakes and reservoirs in the Snake and Columbia River CHUs per 75 FR 63898, p. 63934.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Physical barriers (dams), water temperature, and water quality (PCE 8) pose impediments to bull trout migration. Generally, the mainstem Snake and Columbia rivers provide limited migration habitat for fluvial bull trout between tributary spawning and rearing habitat and mainstem FMO habitat in the mainstem. Such behaviors have been observed in the lower Columbia River, upper Columbia River (75 FR 63898, p. 63940), and mainstem Snake River (Chandler et al. 2003, pp. 10-12); however, bull trout found in the Oxbow Reach and Hells Canyon Reservoir in the Snake River appear to be extremely low in abundance.

Water temperature impediments may present seasonal barriers to fluvial bull trout migration between the mainstem rivers and tributary habitat; however, bull trout are not likely to be present in the mainstem rivers while impediments exist (Chandler et al. 2003, p. 2, 7). Additionally, if areas of thermal refugia exist, bull trout have been documented using habitat with temperatures that exceed the PCE target within the migration corridor (Howell et al. 2010, p. 96). Average daily winter (January through March) temperatures throughout the Columbia River are relatively low, ranging from 3° to 6° C from the forebay of Grand Coulee Dam to the Camas/Washougal monitoring location below Bonneville Dam. Most of the reservoirs and impoundments are likely isothermal with relatively constant temperatures. The river exceeds bull trout tolerance levels as early as June 5 at the lowermost monitoring location and throughout the whole mainstem Columbia River by July 11. The tributaries entering the Columbia River below Priest Rapids clearly change the temperature regime in the river with much warmer temperatures than the upper reaches of the river.

Connectivity between tributary populations to the Snake and Columbia rivers is more limited. Although many mainstem dams below Brownlee Dam have adult fish passage, physical or water quality impediments to inter-tributary connectivity persist. Within the mainstem Columbia River, connectivity may occur in isolated reaches including the upper Columbia between the Yakima and John Day rivers (75 FR 63898, p. 63940) and the lower Columbia River between the Hood River and portions of the lower Columbia River Basins CHU (USFWS 2002b). In the mainstem Snake River, only five bull trout have been observed passing lower Granite Dam since 1998 (FPC 2012). Likewise, the three dams of the Hells Canyon Complex limit connectivity between tributaries to the complex and tributaries downstream (USFWS 2002b, pp. 15-16)

Upstream of Lower Granite Dam, fluvial bull trout have been observed using the mainstem of the Snake River to migrate between FMO habitat in the Snake River and spawning and rearing habitat in tributaries (Chandler et al. 2003, p. 1). Chandler et al. (2003), however, reported that bull trout found in the Oxbow Bypass reach and Hells Canyon Reservoir of the Snake River appeared to be extremely low in abundance.

Reclamation delivers salmon flow augmentation (increased flows) from April through August, augmenting natural flows to meet flow targets for salmon at Lower Granite Dam. Increased flows also provide a small benefit to bull trout that could be in these reaches by slightly improving water temperatures, dissolved oxygen levels, and reducing the potential of migration impediments at the mouth of tributaries during the summer months when those parameters could fall below target values. However, it is unlikely that bull trout would be present during these times.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Thirty-four different species of resident fishes have been collected from the lower Snake River reservoirs during fisheries studies conducted from 1979 through 1993 (USFWS 2002b, p. 5). Forage fish such as juvenile salmon and steelhead, whitefish, sculpins, suckers, and minnows, are present throughout the mainstem rivers.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

PCE 4 may provide a limited contribution to FMO habitat in the mainstem Snake and Columbia rivers. Generally, PCE 4 is not present in Snake and Columbia River reservoirs (75 FR 63898, p. 63934). While some portions of the mainstem Snake and Columbia rivers may exhibit complex processes, it is unlikely these processes provide a significant contribution to bull trout use of these habitats.

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

PCE 5 is not present in the mainstem Columbia or Snake River CHUs (75 FR 63898, p. 63934) and will not be discussed further.

PCE 6: In spawning/rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

PCE 6 is not present in the mainstem Columbia or Snake rivers (75 FR 63898, p. 63934) and will not be discussed further.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

PCE 7 is present, but provides a limited contribution to FMO habitat in the mainstem Snake and Columbia rivers. Generally, the hydrograph of the mainstem Snake and Columbia rivers is highly regulated. See the hydrology discussion for a discussion of how much influence the upper Snake River projects has on this PCE.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Generally, water quality in the mainstem Snake and Columbia rivers is limited by several pollutants including sediment, bacteria, dissolved oxygen, nutrients, pH, mercury, pesticides, total dissolved gas, and temperature in the Snake River; and bacteria, mercury, pesticides, pH, toxics, total dissolved gas, and temperature in the lower Columbia River (for discussions see: WDOE 2013, ODEQ 2013a, IDEQ 2013, and USBR 2004a).

The primary water quality constituent affecting bull trout use of the mainstem Snake and Columbia rivers is temperature. Typically, temperatures exceed PCE targets for bull trout by mid-June. Chandler et al. (2003) suggests bull trout in the mainstem Snake River exhibit "classic fluvial migrations," over-wintering in the mainstem rivers and departing for tributaries in April through June, suggesting migrations are, at least in part, due to water temperature conditions in the mainstem rivers. Previous modeled analyses described in the 2005 opinion indicated that although slight increases in summer water temperatures might occur with the 2005/2007 assessment's proposed actions in place, in most years the resulting temperatures did not exceed 20° C at Lower Granite Reservoir (USNOAA 2005, Tables 6-10 and 6-11). If areas of thermal refugia exist, bull trout have been documented using habitat with temperatures that exceed the PCE target within the migration corridor (Howell et al. 2010, pp. 104-105). Dissolved oxygen levels below the minimum criterion of 6.5 milligrams per liter are most likely a secondary water quality condition attributable to excessive algal production associated with high nutrient levels entering the Hells Canyon Complex reservoirs.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Altered flow and temperature regimes below dams (and associated habitat effects) along with reservoir habitat above dams, have significantly increased the abundance and productivity of nonnative predatory and competing fish species within bull trout critical habitat. Conditions in reservoir reaches typically favor nonnative species and these are prevalent in the mainstem Snake and Columbia rivers. A significant number of bull trout captured in Oxbow and Hells Canyon Reservoirs showed signs of hybridization with brook trout, a result of bull trout and brook trout being present in the tributaries (Chandler et al. 2003). Below the Hells Canyon Complex, bull trout do not show any signs of hybridization with brook trout (Chandler et al. 2003).

2.5 Effects of the Proposed Action

Effects of the action considers the direct and indirect effects of an action on the listed species and/or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. These effects are considered along with the environmental baseline and the predicted cumulative effects to determine the overall effects to the species. Direct effects are defined as those that result from the proposed action and directly or immediately impact the species or its habitat. Indirect effects are those that are caused by, or will result from, the proposed action and are later in time, but still reasonably certain to occur. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation.

2.5.1 Direct and Indirect Effects to Bull Trout

2.5.1.1 Powder River System

From 1968 to present (ODFW 2012, p. 23), fish sampling activities and monitoring of fisheries (gillnet sampling, creel sampling, and boat electroshocking) in Phillips Reservoir has only documented two bull trout (in April 2011); those individuals were likely washed into the reservoir from high flows higher in the basin. Although there is limited information on bull trout use of Phillips Reservoir, the capture of only two bull trout during ODFW's fish sampling and monitoring would reinforce the resident life history form.

If we assume there may be some bull trout with an adfluvial or fluvial life history trait making use of Phillips Reservoir, assumptions on the behavior of these fish could be made using Beulah Reservoir as a comparison. Given that Beulah Reservoir has similar water temperature and water quality metrics as Phillips Reservoir, the behavior of adfluvial bull trout would limit their presence in the reservoir to late fall through early spring. Bull trout use of Phillips Reservoir would likely be limited to overwintering periods. Adfluvial bull trout typically leave lakes or reservoirs in the spring, migrating to spawning locations in headwater tributaries and returning in the fall. This behavior would limit effects of the proposed action to the late fall through early spring season periods when bull trout could be present. However, current operation of Phillips Reservoir also decreases the amount of time the reservoir is actually suitable to bull trout (i.e., if water levels remained higher longer in the spring/summer and filled earlier in the fall, bull trout use of the reservoir, and the benefits, would increase).

The proposed action results in effects to the migration corridor in the spring and fall when reservoir levels are low, leaving areas of the tributary varial zones exposed. The varial zone of the Powder River does not act as a barrier, but Deer Creek has a seasonal barrier (abandoned roadbed) to bull trout that could migrate to and from the reservoir in the spring or fall before pool elevations return to a level that covers the abandoned road beds. This condition occurs annually, during both the fall and spring migration periods. This could lead to stranding by fish that are either "washed" into the reservoir during spring high flow events (as assumed during April 2011) or volitionally enter the reservoir (adfluvial fish) and are not able to return to the headwater streams due to a seasonal barrier caused by low pool elevations and/or increased water temperatures.

Entrainment is not likely to adversely affect bull trout in Phillips Reservoir. While there has been no recent documentation of bull trout in the Powder River below Mason Dam, the extent of entrainment and resulting effects on bull trout is unknown at this time although not anticipated to occur. Entrainment has been identified as occurring in other systems mostly associated with spillway releases during the spring season when bull trout are likely to be in the upper water column feeding. Releases from Mason Dam occur exclusively through the outlet works and not the spillway, thereby eliminating the possibility of entraining bull trout in the spring that are in the upper water column of Phillips Reservoir. Due to the position of the intake at Mason Dam (very low in the pool), water temperatures, dissolved oxygen levels, and flow characteristics at the intake, any bull trout in the reservoir are also not anticipated to be entrained through the intake.

Presently, bull trout in the Powder River subbasin are restricted to headwater areas where adequate in-stream temperatures and habitat remain. Nowak (2004, p. 52) states that the historic distribution of bull trout in the Powder River is unknown. Bull trout were likely seasonally connected to the Snake River until the construction of Thief Valley Dam, which has no upstream fish passage. Construction of Mason Dam in 1968 isolated bull trout in the upper Powder River from bull trout in the North Powder River and other Powder River tributaries. Although there has been no documentation of bull trout in the Powder River downstream of Mason Dam, there is still the possibility that bull trout could enter the Powder River from tributaries such as the North Powder River and Wolf Creek.

2.5.2 Direct and Indirect Effects to Bull Trout Critical Habitat

2.5.2.1 Boise River System

The following is based on the information provided in the Assessment (USBR 2013, pp. 58-72) and Appendix B, the 2005 biological assessment and water quality studies, the 2005 opinion, and other information.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Anderson Ranch Reservoir

The operation of Anderson Ranch Dam will have discountable effects on PCE 1 within Anderson Ranch Reservoir. As noted previously, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in Anderson Ranch Reservoir. Although reservoir operations may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoir as a whole.

South Fork Boise River

The operation of Anderson Ranch Dam will have insignificant effects on PCE 1 in the South Fork Boise River. Generally, reservoir operations (amount and timing of discharge) have the potential to affect hyporheic exchange by changing groundwater residence time (USBR et al. 2011) or by diminishing the function of cold water refugia by releasing warm water. A functioning hyporheic influence persists under baseline conditions (USGS and USBR 2009 unpublished); however, to the extent increased flows may influence the groundwater exchange, reductions in hyporheic exchange are likely masked by the impacts of releasing of cold water from Anderson Ranch Reservoir.

Arrowrock Reservoir

The operation of Arrowrock Dam will have discountable effects on PCE 1 within Arrowrock Reservoir. As noted above, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in Arrowrock Reservoir. Although, reservoir operation may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoir as a whole.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Anderson Ranch Reservoir

Operation of Anderson Ranch Dam may have infrequent adverse effects on PCE 2 during the fall migration period, particularly in low water years when reservoir volumes drop below 62,000 acre-feet (in 2 of 30 years). These adverse effects would be the result of an increased length in the varial zone, increased migration duration, increased risk of predation, and lack of structural diversity within the varial zone. The length of the varial zone during the fall migration ranges from 0.7 to 2.9 miles (1.06 to 4.61 kilometers), but this range may be exceeded when the reservoir volume falls below 62,000 acre-feet in 2 of 30 years (Table 2). Although the migration habitats are degraded during the fall migration which results in a lower degree of functionality of this PCE, the migration corridor remains available.

A couple of factors minimize effects of the low reservoir volume and varial zone influence: 1) Typical migration behavior (timing and rate of migration) and 2) reservoir operations during 28 of 30 years. Typical migration behavior (timing and rate of migration) of bull trout minimizes potential effects of moving through areas with reduced in-stream structure (from small headwater tributaries to over-wintering habitat). Reclamation data show bull trout typically migrate through varial zones at night and generally within a few hours (USBR internal data from Deadwood and Arrowrock Reservoirs). By moving through the varial zone in one evening, the migrating fish minimize risk of predation due to a lack of structural diversity within the varial zone. Reservoir conditions within the range of the operational indicators have been shown to provide habitat conditions suitable for bull trout to migrate through the varial zone in one evening. During 2 of 30 years, when reservoir levels may drop below the 62,000 acre-feet, bull trout may not be able to migrate through the varial zone in one evening because of the increased length of the varial zone or water depth impediments.

Migration corridors in the spring are in good condition. No migration impediments occur during the spring migration period for fish migrating out of the reservoir to spawning habitat because reservoir levels are normally such that a varial zone is minimal or non-existent.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 6) for the remaining term of this action.

South Fork Boise River

Operation of Anderson Ranch Dam will have insignificant effects on PCE 2 in the South Fork Boise River below Anderson Ranch Dam. Generally, operation of Anderson Ranch Dam reduces flow in the winter and increases flow in the summer. Under both winter and summer operation, Reclamation has observed no physical, biological, or water quality impediments to bull trout migration in the South Fork Boise River between Anderson Ranch Dam and Arrowrock Reservoir. While winter warm-water releases have been associated with intermittent ice barriers in other systems, no similar ice dams have been observed in the South Fork Boise River. Climate change forecasts suggest baseline conditions will maintain flows within the range analyzed in the proposed action.

Operation of Arrowrock Dam will have adverse effects to PCE 2 in the South Fork Boise River during fall migration in years when the varial zone into Arrowrock Reservoir is exposed and shallow, resulting in reduced habitat, increased exposure, and potential predation. Adverse effects are expected when the reservoir elevation falls below 3,100 and may also occur as elevation nears that level due to the length and shallowness of the varial zone.

Arrowrock Reservoir

The operation of Arrowrock Dam will have adverse effects on PCE 2 during the fall migration season when the varial zone is exposed and shallow, particularly when Arrowrock Reservoir falls below elevation 3,100 feet in 18 of 30 years, but degradation to the migration corridor is also likely to occur when reservoir elevations are near that elevation. Reservoir drawdowns can expose varial zones with a lack of structural diversity during the fall migration season in most years, resulting in degradation of the migration habitat; however, connectivity is maintained at all times. Habitat surveys performed in the fall of 2011 and 2012 by Reclamation compared habitat between the varial zones and immediately upstream and found no physical barriers to migration; however, in-stream and riparian cover were reduced in the varial zone.

In-stream habitat diversity is seasonally reduced in the varial zone in most reservoir environments; however, varial zone length and functionality as a migration corridor vary depending on the tributary, reservoir, and season. The maximum length of varial zones in Arrowrock Reservoir occurs annually in the fall in association with the end of the irrigation season and a low reservoir storage level which coincides with the fall migration of bull trout returning to Arrowrock Reservoir from spawning tributaries. Varial zone lengths are not expected to exceed 5.6 miles (9.0 kilometers) for the Middle Fork Boise River and 6.8 miles (10.9 kilometers) for the South Fork Boise River. The Middle Fork Boise River varial zone maintains its function as a migration corridor; however, the length combined with a lack of in-stream habitat diversity results in adverse seasonal effects on PCE 2 when the reservoir is low, particularly below elevation 3,100 feet. These effects are primarily due to the increased risk of predation, paucity of cover, and the increased length of time migrations might require over this distance. The South Fork Boise River may also be affected due to the increased length of the varial zone.

As described above, two factors minimize effects of the varial zone: 1) Typical migration behavior (timing and rate of migration) and 2) reservoir operations during 12 of 30 years. Reservoir conditions within the range of the operational indicators have been shown to provide habitat conditions suitable for bull trout to migrate through the varial zone in one evening. During 18 of 30 years fish may not be able to migrate through the varial zone in one evening because of the increased length of the varial zone or water depth impediments restricting the migration corridor.

We anticipate adverse effects to this PCE when reservoir levels are below a water surface elevation of 3,100 feet in 18 of 30 years, because of the length of the varial zone and the lack of structural diversity within the varial zone. The varial zone does not present a physical barrier for bull trout migrating to FMO habitat in Arrowrock Reservoir; nevertheless, the length of the varial zone may diminish the effectiveness of bull trout's ability to migrate through varial zones within a short amount of time.

Migration corridors in the spring are in good condition with no migration impediments for fish migrating out of the reservoir to spawning habitat due to storage increasing the pool elevation such that varial zones are minimal or non-existent.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 8).

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Anderson Ranch Reservoir

The operation of Anderson Ranch Reservoir has an infrequent adverse effect on PCE 3 when water volume drops below 62,000 acre-feet in 2 out of 30 years and hot calm weather conditions persist for an extended period (USFWS 2005a, p. 242). When those conditions occur (late summer or fall), adverse water quality conditions may cause lethal conditions to kokanee, a principle prey item for bull trout (USFWS 2005a, p. 241).

Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 6).

South Fork Boise River

Operation of Anderson Ranch Reservoir has an infrequent adverse effect on PCE 3 when minimum flow drops below 300 cfs in the winter in about 1 of 30 years (USBR 2004a, p. 202). Very low stream flows may impact prey base by the loss of available over-wintering habitat.

Annual downramping in the fall could also strand prey fishes and invertebrates, but it does not appear that this stranding translates to impacts to prey base. The growth observed in bull trout within this area suggests that prey is not limited. Growth and condition factors of bull trout from 2011-2012 data collection activities indicate bull trout are maintaining an average to above-average condition in the South Fork and sufficient prey exist to support bull trout.

While we anticipate effects similar to those observed under the environmental baseline will continue, climate change forecasts suggest higher reservoir elevations in dry years, indicating a lower probability of flows below 300 cfs (Figure 7).

Arrowrock Reservoir

The operation of Arrowrock Dam has an infrequent adverse effect on PCE 3 when reservoir volume drops below 200,000 acre-feet at the end of June in 3 of 30 years. When those conditions occur, adverse water quality conditions may cause reduced primary productivity (USFWS 2005a, pp. 236-237).

Between August and September of each year, the thermocline erodes, resulting in nutrient ratios associated with algae that are not suitable forage for zooplankton and other aquatic invertebrates (Assessment Appendix B, pp. 15-17). Although water quality conditions may seasonally limit the prey base for bull trout in Arrowrock Reservoir, recent data for water quality and fish sampling (Reclamation internal data) suggests that the prey base for all species of fishes is sufficient to maintain an average or above condition factor for bull trout that use the reservoir for FMO habitat.

In 2011 and 2012, Reclamation sampled the fish community in Arrowrock Reservoir. As part of this work Reclamation also analyzed the stomach contents from 25 bull trout (Reclamation internal data) and found that fish constituted 98 percent of the prey consumed by bull trout during the winter season. The identified prey species targeted by bull trout during this time included yellow perch, bridgelip sucker, and northern pikeminnow. The species richness was similar to sampling performed in 1996 and 1997 by IDFG, although densities of non-game fishes were greater. The large numbers of fishes sampled suggest that primary productivity is sufficient to sustain an adequate prey base for bull trout. Additionally, a fish health analysis (condition factor) described in the baseline condition for PCE 3 demonstrates that sufficient prey is available for all species to maintain average or above average health throughout the winter, the season when bull trout are most likely to be present in the reservoir. These data suggest impacts to primary productivity in Arrowrock Reservoir do not directly correlate to reduced prey base.

While Reclamation anticipates conditions to be similar to those observed in the environmental baseline, some factors suggest reduced impacts to prey base. In the past, the rapid drawdowns during irrigation season passed some portion of nutrients, food organisms, and fish through the dam into Lucky Peak Reservoir (USFWS 2005a, pp. 238-239). Since installation of clamshell gates in 2005, Reclamation now drafts water from lower in the water column, leaving warmer, more productive water in the reservoir and entrains fewer prey species from the reservoir.

Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action with slightly higher elevations in June of dry years (Figure 8). This may suggest a lower severity of adverse effects than those observed under baseline conditions.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

Anderson Ranch Reservoir

The operation of Anderson Ranch Dam has an adverse effect on PCE 4 as water levels within the reservoir are drawn down. We recognize there is a difference in habitat complexity between full pool and lower pool elevations and that the functionality of this PCE varies depending on operations, but is never completely lost. Habitat complexity may be at its best during full pool levels and habitat becomes less complex as water levels drop. The near shore habitat becomes simplified as the interface between the water and riparian vegetation, large wood, and banks, etc., diminishes, as is expected within a reservoir environment based on operations and changes in reservoir elevation.

The quality of habitat depth is also diminished. Although depth may exist within the reservoir and is a component of this PCE, the habitat at depth is not suitable for bull trout during the summer months (mainly late July through September) due to the stratification of the reservoir, warm waters near the surface (Assessment Appendix B, pp. 6-7), and depleted oxygen levels at depth (Assessment Appendix B, pp. 8-9). Habitat complexity within the varial zones associated with tributaries is also simplified and may lack the structural complexity during drawdown.

Most of the year (October through June), affects to PCE 4 are insignificant. Submerged features, bays where tributaries enter the reservoir, and the shallow delta near the mouth of the South Fork Boise River will provide some complexity as the reservoir is lowered. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 7).

South Fork Boise River

The operation of Anderson Ranch Dam has an insignificant effect on PCE 4 in the South Fork Boise River. The South Fork Boise River provides a variety of complex habitat features including an established riparian zone, side channels, and habitat types (i.e., pools, riffles, runs) expected in a river environment. An established riparian zone and interaction with the wetted channel throughout most of the year increases habitat complexity and provides refugia for aquatic biota outside the action area that experience summer base flows. Outside of the irrigation season, the proposed action retains the function of the PCE by maintaining a minimum flow of 300 cfs. Winter flows may limit side channel habitat, but have an insignificant effect because bull trout use main channel habitats in the South Fork Boise River throughout the year and during all flows (Salow 2001, p. 5; USBR telemetry surveys 2012-2014). Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 7).

Arrowrock Reservoir

The operation of Arrowrock Dam has an adverse effect on PCE 4 as water levels within the reservoir are drawn down, particularly when Arrowrock Reservoir falls below elevation 3,100 feet in 18 of 30 years. Habitat complexity within the reservoir and associated varial zones is adversely affected as the habitat is simplified, varial zones are exposed for long distances, and depth refugia becomes unsuitable for bull trout. The varial zones exposed in the fall lack complexity and extend for long distances which make the habitat inhospitable for bull trout.

We recognize there is a difference in habitat complexity between full pool and lower pool elevations and that the functionality of this PCE varies depending on operations, but is never completely lost. Habitat complexity may be at its best during full pool levels and habitat becomes less complex as water levels drop. The near shore habitat becomes simplified as the interface between the water and riparian vegetation, large wood, and banks, etc., diminishes, as is expected within a reservoir environment based on operations and changes in reservoir elevation.

The quality of habitat depth is also diminished. Although depth may exist within the reservoir and is a component of this PCE, thermal and oxygen refugia is not suitable for bull trout during August and September (Assessment Appendix B, p. 17). Depth refugia is degraded, or lost, by warm water temperatures and decreased dissolved oxygen (Assessment Appendix B, pp. 15-17).

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 8).

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Anderson Ranch Reservoir

The operation of Anderson Ranch Reservoir has an infrequent, adverse effect on PCE 5 when water volume falls below 62,000 acre-feet in 2 of 30 years. Reservoir operation influences water temperature and water quality conditions indirectly through a set of complex interactions between incoming water temperature, solar loading, release of cold water from the bottom of the reservoir, and the influence of reservoir elevation on thermal stratification. At volumes below

62,000 acre-feet, elevated water temperatures are possible in much of the reservoir. In the remainder of years, the proposed action provides water temperature refugia during the summer.

Reclamation operates the uppermost reservoir in the Boise River system (Anderson Ranch) to maximize refill capabilities of the system. Managing water in this way generally means Anderson Ranch Reservoir maintains thermal stratification (Assessment Appendix B, p. 6).

South Fork Boise River

The operation of Anderson Ranch Reservoir will have beneficial effects on PCE 5 in the South Fork Boise River due to the cold water releases. Hypolimnetic releases from Anderson Ranch Dam maintain water temperatures between 2° and 15° C throughout most of the year. Similar to other regulated systems, the South Fork Boise River displays colder summer temperatures and warmer winter temperatures than nearby unregulated systems, with reduced diel fluctuations (Lehmkuhl 1974, 216-222; Munn and Brusven 1991, pp. 1-11). During the summer season, water temperatures discharged from Anderson Ranch Reservoir warm daily to approximately 7° C (Assessment Appendix B, p. 22).

Operational indicators for Anderson Ranch Reservoir protect critical habitat by minimizing the frequency of spill to 6 of 30 years (Table 2). These criteria protect water quality (water temperature) by reducing temperature spikes that could occur as a result of discharging surface water from Anderson Ranch Reservoir. Spill from Anderson Ranch could occur in the spring (May or June) and increase water temperature, but not likely outside PCE targets. The frequency of spill is limited to 20 percent of the years under the proposed action (Table 1) and has not occurred since 2006; otherwise, deep water releases from the dam maintain consistent water temperatures throughout most of the year.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will be maintained within the range analyzed in the proposed action (Figure 7).

Arrowrock Reservoir

The operation of Arrowrock Dam has a seasonal adverse effect on PCE 5 when temperatures exceed 15° C from July through September in average years. Arrowrock Dam operation affects water temperature through the release of hypolimnetic water from the lower levels of the reservoir. Subadult bull trout could be present at the time these effects occur, although current data suggests both subadult and adult bull trout migrate from the reservoir before July and return in October. By October, the reservoir pool has begun to refill and water temperatures are below 15° C in most of the reservoir. By November, water temperatures are below 15° C throughout the reservoir.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Anderson Ranch Reservoir, Arrowrock Reservoir, and the South Fork Boise River between the reservoirs have not been designated as spawning and rearing habitat (USFWS 2010a, pp. 629, 641); therefore, the effects to this PCE were not analyzed.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Anderson Ranch and Arrowrock Reservoirs

A natural hydrograph is not present in Anderson Ranch and Arrowrock reservoirs because of the dams. The unnatural hydrograph baseline is not expected to change with the proposed action.

South Fork Boise River

The operation of Anderson Ranch Reservoir adversely affects PCE 7 in the South Fork Boise River throughout the year. The influence of Anderson Ranch and Arrowrock dams operations on the South Fork Boise River is adverse because in general, reservoir operations regulate the hydrograph with flows that are lower in the winter and spring, lower during the spring peak, and higher in the summer which does not follow daily and seasonal fluctuations of nearby unregulated systems. The South Fork Boise River has a ramped increasing hydrograph throughout the spring and then decreases and maintains flows between 600 and 1,800 cfs during the summer. The river has a ramped decreasing hydrograph after irrigation season and then ramps down to winter flows of 300 cfs.

Effects of the proposed action on bull trout migration behavior (habitat use) is being examined by Reclamation as part of the Service's 2005 opinion T&Cs (USFWS 2005, p. 261). Telemetry studies performed over the last 10 years and preliminary results from recent work suggest that bull trout use main channel habitats throughout the year, are not displaced by ramping events, and migrate within the same time frame as fish that over-winter in Arrowrock Reservoir. Thus, the hydrograph does not appear to adversely affect migratory behaviors.

Reclamation is also conducting work in the Boise River system action area to determine effects of ramping on aquatic habitat and stranding of juvenile fishes; work is expected to be completed in FY 2015. Data suggest that stranding may be seasonally limiting the abundance of prey fishes (PCE 3), but not affecting the persistence of prey species.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 7).

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Anderson Ranch Reservoir

PCE 8 is adversely affected by operations when water temperatures are over 15°C in the upper elevation of the reservoir and dissolved oxygen is also decreased. This typically occurs in September and October (Assessment Appendix B, p. 10) when most bull trout will still be in the upstream tributaries. Few bull trout are likely to be present at this time (estimated 4 percent of the population) and they have access through the migration corridor to better habitat upstream of the reservoir. During the rest of the year, water quality conditions are suitable for bull trout and bull trout prey. In addition, the operation of Anderson Ranch Reservoir has an infrequent adverse effect on PCE 8 when the reservoir volume drops below 62,000 acre-feet between July and October in 2 of 30 years. Operational indicators for Anderson Ranch Reservoir limit the frequency of drawdown below 62,000 acre-feet to 2 of 30 years (Table 2). These criteria aim to protect water quality by maintaining thermal stratification during periods of hot and dry weather. Anderson Ranch Reservoir has not been drafted to the 62,000-acre-foot level since the 2005 USFWS opinion.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 6).

South Fork Boise River

The operation of Anderson Ranch Dam has an insignificant effect on PCE 8 in the South Fork Boise River. Water quality and quantity in the South Fork Boise River meet targets for Idaho water quality standards for cold water biota throughout the year. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 7).

Effects of water quality and water quantity conditions on the function of PCE 8 would be reflected in the normal reproduction, growth, and survival of bull trout. Water quality conditions include nutrients, dissolved gas concentrations, and temperature (addressed in PCE 5) and indicate a functional PCE for both bull trout and bull trout prey (see Appendix B of the Assessment). An average to above-average condition factor analysis performed for bull trout in the Arrowrock metapopulation, which includes the South Fork Boise River action area, provides further data to support a functional PCE (Seo 2013 in draft).

Arrowrock Reservoir

The operation of Arrowrock Dam has a seasonal adverse effect on PCE 8 from July through September; however, most bull trout are not likely to be present. Reservoir operation influences water temperature and water quality conditions indirectly through a set of complex interactions with incoming water temperature, solar loading, release of cold water from the bottom of the reservoir, and the influence of reservoir elevation on thermal stratification.

Several factors reduce the impact adverse effects to this PCE have in Arrowrock Reservoir. First, only a small, if any, number of bull trout are likely to be present during the time effects could occur. Recent data suggests all fish may leave the reservoir during those months; conditions in the reservoir, likely exacerbated by operations, renders the habitat unsuitable during this period of time. Second, when bull trout return to the reservoir in November from their spawning migration, water quality and quantity would be adequate: Effects are believed to be seasonal and non-lethal (USFWS 2005a, p. 235). Third, recent sampling indicates large numbers of potential prey fish and average or above average growth for all species during the winter.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 8).

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Anderson Ranch Reservoir, South Fork Boise River, Arrowrock Reservoir

Operations will have an insignificant effect on PCE 9. The proposed action provides an environment that allows the survival of nonnative fishes; however, IDFG exclusively manages the fisheries, including stocking and regulations that favor the presence of individual species that do not appear to be incompatible with bull trout survival and growth. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from operations.

Summary of the Effects of the Proposed Action on Critical Habitat

Under the proposed action, future conditions in Anderson Ranch and Arrowrock reservoirs throughout most of the year will continue to provide conditions important for the survival of bull trout. Seasonally, however, depending on climate patterns and water needs, the availability of bull trout habitat may be limited due to degraded conditions. Although adverse effects to PCEs occurs due to operations and may degrade the functionality of certain PCEs, functionality of PCEs and critical habitat is not lost.

Table 13. Summary of the effects of the proposed action for Anderson Ranch Reservoir, South Fork Boise River (below Anderson Ranch Dam), and Arrowrock Reservoir.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action		
		Anderson Ranch Reservoir	South Fork Boise River	Arrowrock Reservoir
1	Springs, seeps, groundwater sources	Discountable effect	Insignificant effect	Discountable effect
2	Migration habitats with minimal impediments.	Adverse effects in the varial zone during the fall migration when reservoir levels are low.	Insignificant effect	Adverse effects in the varial zones during the fall migration when reservoir levels are low in most years.
3	Abundant food base	Infrequent adverse effects in summer in 2 of 30 years.	Infrequent adverse effects in summer 1 of 30 years.	Infrequent adverse effects in summer in 3 of 30 years.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action		
		Anderson Ranch Reservoir	South Fork Boise River	Arrowrock Reservoir
4	Complex river, stream, lake, and reservoir aquatic environments and process	Seasonal adverse effects when reservoir levels are low.	Insignificant effect	Seasonal adverse effects when reservoir levels are low.
5	Water temps ranging from 2°-15^{o} C with adequate thermal refugia	Infrequent adverse effects in summer when reservoir volume falls below 62,000 acre-feet in 2 of 30 years.	Beneficial effects	Seasonal adverse effects in fall when water temperatures rise above PCE targets.
6	Spawning/rearing substrate.	Not present	Not present	Not present
7	A natural hydrograph, or if flows are controlled, minimal flow departure from a natural hydrograph	The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.	Adverse effects	The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.
8	Sufficient water quality and quantity	Seasonal adverse effects in late summer/early fall.	Insignificant effect	Seasonal adverse effects in late summer/early fall.
9	Sufficiently low levels of nonnative predatory; interbreeding; or competing species	Insignificant effect	Insignificant effect	Insignificant effect

2.5.2.2 Payette River System

The following is based on the information provided in the Assessment (USBR 2013, pp. 101-112) and Appendix, the 2005 biological assessment and water quality studies, the 2005 opinion, and other information.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Deadwood Reservoir

The operation of Deadwood Dam will have discountable effects on PCE 1 within Deadwood Reservoir. As noted previously, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in Deadwood Reservoir. Although reservoir operations may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoir as a whole.

Lower Deadwood River

The operation of Deadwood Dam has an insignificant effect on PCE 1 in the Deadwood River. Effects of discharge from Deadwood Dam on the hyporheic exchange in the river below the dam were modeled in the Deadwood Flexibility Study (USBR in progress). Preliminary results of this work suggest releases from Deadwood Reservoir greater than 400 cfs can lower the hyporheic exchange as a result of increased water pressure that limits where groundwater influence occurs. Flows greater than 400 cfs may occur in the spring under flood control conditions or more often, from mid-June through mid-August when releasing irrigation and salmon flow augmentation flows. At these times, hyporheic flows do not play a significant role in the Deadwood River because cold water released from Deadwood Reservoir provides adequate thermal refuge and because the quantity of subsurface flows is small relative to discharge from Deadwood Dam.

South Fork Payette River

The operation of Deadwood Dam has an insignificant effect on PCE 1 in the South Fork Payette River. In the Payette River, measuring the effects of operations on hyporheic flow has not been performed; however, the effects are thought to be minimal or immeasurable because of the relatively small proportion of flow that the Deadwood River contributes to the Payette River.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Deadwood Reservoir

The operation of Deadwood Dam has infrequent adverse effects on PCE 2 during the fall migration period, particularly in low water years when reservoir volume drops below 50,000 acre-feet (in 2 of 30 years). The operation of Deadwood Dam can extend the length of the varial zone in August and September when reservoir elevations are at their lowest. The varial zone experiences a reduction of structural diversity in the fall, as structural diversity is reduced the risk of predation increases, if predation increases to significant levels, it could pose a biological barrier. Reclamation data show bull trout typically migrate through varial zones at night and generally within a few hours (USBR internal data from Deadwood and Arrowrock Reservoirs). By moving through the varial zone in one evening, the migrating fish minimize (but do not preclude) risk of increased predation due to a lack of structural diversity within the varial zone. Although the migration habitats are degraded during the fall migration which results in a lower degree of functionality of this PCE, the migration corridor remains available.

Migration corridors in the spring are in good condition. No migration impediments occur during the spring migration period for fish migrating out of the reservoir to spawning habitat due to elevated reservoir levels that minimize or make the varial zone non-existent.

Although climate change may increase reservoir elevations under dry conditions, August and September reservoir elevations under median and wet conditions are not expected to change substantially in the future. Accordingly, Reclamation anticipates a similar average varial zone length in the future.

Lower Deadwood River

The operation of Deadwood Dam will have an insignificant effect on PCE 2. The combination of releases from Deadwood Dam and tributary inflow are sufficient to maintain physical, water quality, and biological connectivity between the Deadwood River and its tributaries. The migration corridor has no physical or biological barriers to and from any tributary creek.

South Fork Payette River

The operation of Deadwood Dam will have an insignificant effect on PCE 2 in the South Fork Payette River. While timing of bull trout migration is not well documented in this reach, USFS estimates spawning migrations into tributaries occur in July and those fish return to the South Fork Payette River in September (Green 2008, entire). Reclamation is delivering irrigation and salmon augmentation water at this time. These deliveries increase flows over natural conditions in the river. The deliveries are not likely to have any negative effects on the migration corridors in the river and may have a small beneficial effect by increasing flow conditions during that time period. While the effect of these releases on water temperature is not precisely known (see PCE 5), maximum temperatures released from the dam remain within the range suitable for bull trout migration (as described in Howell et al. 2010).

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Deadwood Reservoir

The operation of Deadwood Reservoir has infrequent adverse effects on PCE 3 when the reservoir volume drops below 50,000 acre-feet in 2 of 30 years. These conditions typically occur in the fall, causing an indirect impact of water quality on primary productivity. Reservoir volumes above 50,000 acre-feet generally support water quality and condition suitable for both phytoplankton and zooplankton production, which in turn support the forage base within the reservoir. Additionally, the higher trophic levels have a diversity of prey species available, including kokanee, long nosed dace, juvenile mountain whitefish, sculpin, and redsided shiners. At reservoir volumes below 50,000 acre-feet, there is an increased risk that high ambient air temperatures could degrade water quality to an extent that would undercut primary productivity and impact the availability of prey fish. Climate change projections suggest low reservoir volumes may occur less frequently, but it is not yet clear how corresponding changes in regional climate may affect productivity. Accordingly, Reclamation anticipates the prey base in Deadwood Reservoir will remain an important contributor to bull trout habitat in most years.

Lower Deadwood River

The operation of Deadwood Dam will have an insignificant effect on of PCE 3 in the Deadwood River. Data collected in the Deadwood Flexibility Study from 2006 through 2012 showed that primary productivity in the river below Deadwood Dam is generally good. The Deadwood River supports densities of macroinvertebrates that are similar to those in reference sites outside the action area in adjacent unregulated watersheds. Under the proposed action, these conditions are expected to continue. The river environment is dominated by periphyton as compared to a phytoplankton-based productivity in the reservoir (PCE 8). Reclamation anticipates PCE 3 will continue to contribute to FMO habitat in the Deadwood River.

South Fork Payette River

The operation of Deadwood Dam will have an insignificant effect on PCE 3 in the South Fork Payette River. The operation of Deadwood Dam can affect flows in the South Fork Payette River; however, these impacts are attenuated by additional inflows from the broader South Fork Payette Basin. While little is data available, sampling performed by IDFG in 2006 showed similar fish assemblages to other areas in the watershed. Reclamation anticipates the conditions observed under the environmental baseline are likely to continue for the duration of the proposed action.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

Deadwood Reservoir

The operation of Deadwood Dam has an adverse effect on PCE 4 as water levels within the reservoir are drawn down, particularly when the reservation falls below 50,000 acre feet. We recognize there is a difference in habitat complexity between full pool and lower pool elevations and that the functionality of this PCE varies depending on operations, but is never completely lost. Habitat complexity may be at its best during full pool levels and habitat becomes less complex as reservoir is lowered. The near shore habitat becomes simplified as the interface between the water and riparian vegetation, large wood, and banks, etc., diminishes, as is expected within a reservoir environment based on operations and changes in reservoir elevation.

Throughout most of the year, Deadwood Reservoir provides a variety of complex habitat features, including bays where tributaries enter the reservoir, a shallow delta area with established vegetation near the mouth of tributaries, islands, and depth refuge within the reservoir. These habitats provide substrate for terrestrial and aquatic macroinvertebrates, as well as cover for juvenile fishes (prey for bull trout). Suitable water quality and depth refugia are available, except when reservoir elevation falls below 50,000 acre feet.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 19).

Lower Deadwood River

The operation of Deadwood Dam has an insignificant effect on PCE 4 in the Deadwood River. The lower Deadwood River provides a variety of complex habitat features including an established riparian zone, side channels, and habitat types (pools, riffles, runs) expected in a river environment. An established riparian zone and interaction with the wetted channel throughout most of the year increases habitat complexity. Outside of the irrigation season, the proposed action retains the function of the PCE by maintaining a minimum flow of 50 cfs.

As noted in the baseline discussion of PCE 2, bull trout use of the lower Deadwood River is limited despite the presence of suitable FMO habitat. While reasons for this are not yet known, it may be that naturally occurring baseline factors limit the utility of FMO habitat in this reach.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

South Fork Payette River

The operation of Deadwood Dam has an insignificant effect on PCE 4 in the South Fork Payette River. The South Fork Payette River provides a variety of complex habitat features including an established riparian zone, side channels and habitat types (pools, riffles, runs) expected in a river environment. An established riparian zone and interaction with the wetted channel throughout most of the year increases habitat complexity. During July and August, the South Fork Payette River hydrograph continues to decline, but at a slower pace as a result of water releases from Deadwood Reservoir. The effects of the proposed action are insignificant, as the natural geography of the reach is the primary factor impacting habitat. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Deadwood Reservoir

The operation of Deadwood Dam has an infrequent adverse effect on PCE 5 in Deadwood Reservoir when water volumes fall below 50,000 acre-feet in 2 of 30 years. Generally, water temperature and thermal refugia conditions in reservoir environments are the result of a complex relationship of tributary inflow volume and temperature; reservoir volume and releases; and climatic factors such as solar loading, wind, and air temperature. Operations contribute to this relationship when the cold water stratum is evacuated from the reservoir. These conditions are associated with higher water temperatures and reduced in-reservoir thermal refugia. Climate change forecasts suggest higher reservoir elevations in the future (see section 2.4.2.2.2).

When the reservoir volume exceeds 50,000 acre-feet, the stratified reservoir will continue to provide refugia for bull trout between the warmer epilimnion waters and the minor oxygen depletion in the hypolimnion waters (see Appendix B of the Assessment).

Lower Deadwood River

The operation of Deadwood Dam has both beneficial and infrequent adverse effects on PCE 5 in the lower Deadwood River when summer releases from Deadwood Dam exceed 15° C in 2 of 30 years. Releases from Deadwood Dam affect temperatures downstream differently depending on the time of year and the manner in which water is released from the reservoir. During the winter, water in the reservoir tends to be about 4° C warmer than surrounding tributaries, yet within the suitable range for bull trout. During the spring, releases through the outlet works (about 65 percent of the time) result in temperatures between 5° and 13° C. Release of water from the upper portion of the water column as spill (about 35 percent of the time) is warmer, resulting in temperatures between 10° and 14° C. Summer releases tend to come from the lower, cooler stratum in the reservoir, reducing summer temperatures by up to 4° C from those of the unmanaged tributaries and benefiting PCE 5. In dry years, when the reservoir water volume falls below 50,000 acre-feet, all of the cooler water may be evacuated and releases from the dam may reach 18° C. Generally, the operation of Deadwood Dam results in stream temperatures between 2° and 15° C. In dry years, there may be an adverse effect when temperatures below the dam may rise to 18° C, but cold water refugia and connectivity to cooler tributary habitats likely ameliorates the adverse effect of these high temperatures.

South Fork Payette River

The operation of Deadwood Dam has an insignificant effect on PCE 5 in the South Fork Payette River. Deadwood River flows, of which reservoir releases are one component, are less than 11 percent of the total flow in the Payette River. While the precise influence of Deadwood Dam operation on temperatures in the South Fork Payette River is unknown, it is likely the effects are insignificant and quickly dissipated. There is some indication that the Deadwood River is cooler in summer than the South Fork Payette River, potentially acting as a thermal refuge during July and August when South Fork Payette River temperatures are at their highest. Winter water temperatures recorded near the mouth of the Deadwood River are similar to those in the South Fork Payette River: Cooler than 2° C, but warmer than most tributaries (PCE 5 for Deadwood River).

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Deadwood Reservoir, the Deadwood River, and the S.F. Payette River downstream of the dam have not been designated as spawning and rearing habitat (USFWS 2010a, pages 629, 641); therefore, the effects were not analyzed.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Deadwood Reservoir

A natural hydrograph is not present in Deadwood Reservoir because of the dam. The unnatural hydrograph baseline is not expected to change with the proposed action.

Lower Deadwood River

The operation of Deadwood Dam adversely affects PCE 7 in the lower Deadwood River throughout the year; however, the PCE remains functional and provides beneficial effects to other PCEs as a result of being altered (PCE 4 and 5). Releases from Deadwood Dam will continue to affect the hydrograph in the Deadwood River by shifting peak flows to summer months, maintaining higher flows than unregulated conditions in summer months, reducing flows during from October through March, and diminishing diurnal fluctuations throughout the year. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

The effects of Deadwood Dam operation on the lower Deadwood River are adverse because in general, reservoir operations regulate the hydrograph characterized by flows that are lower in the winter and spring, lower during the spring peak, and higher in the summer with irrigation deliveries. Base flows of 50 cfs from October through March assure adequate migration corridors, but diminish some habitat characteristics (Pruitt and Nadeau 1978). The regulated hydrograph will retain general characteristics of a natural hydrograph, including high spring flows diminishing later in the year. Tributary inflow diminishes these effects as the Deadwood River travels downstream; thus, the greatest effect occurs immediately below Deadwood Dam.

South Fork Payette River

The operation of Deadwood Dam has an insignificant effect on PCE 7 in the lower South Fork Payette River throughout the year. As described in the environmental baseline, the South Fork Payette River retains most characteristics of a natural hydrograph, primarily because the operations of Deadwood Dam are relatively small when compared to tributary inflow between the dam and the South Fork Payette River. A slight effect occurs in July and August (see PCE 7 baseline) when irrigation flows and salmon augmentation releases increase summer base flows in accordance with the 2008 NOAA Fisheries Service opinion (USNOAA 2008). During this period, regulated flows slow the decline of the hydrograph, but do not cause the trajectory to change. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Deadwood Reservoir

The operation of Deadwood Dam has an infrequent adverse effect on PCE 8 when reservoir elevation drops below 50,000 acre-feet in August and September in 2 of 30 years. The operation of Deadwood Reservoir influences water temperatures and water quality conditions indirectly through a set of complex interactions with incoming water temperature, solar loading, release of cold water from the bottom of the reservoir, and the influence of reservoir elevation on thermal stratification. Water quality conditions in the reservoir are typically suitable for bull trout and bull trout prey (PCE 3) at volumes above 50,000 acre-feet (USFWS 2005a, pp. 244-245). Below that volume, an increased probability of degraded conditions for dissolved oxygen exists.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

Operational indicators for Deadwood Reservoir (Table 4) minimize the frequency of drawdown below 50,000 acre-feet to 2 of 30 years. Deadwood Reservoir has not been drafted to the 50,000 acre-foot level since the 2005 USFWS opinion. The Flexibility Study is using newly acquired data to examine the T&C's and operational indicators to determine if there are operations that may minimize effects to bull trout within the reservoir and downstream environment.

Lower Deadwood River

The operation of Deadwood Reservoir has a seasonal adverse effect on PCE 8 in the winter when the combination of no surface ice and air temperatures consistently below freezing cause frazil and anchor ice to form (Tiedemann 2013 cited in USBR 2013, p. 109) in the lower river. Winter conditions allow the formation of subsurface ice because the water temperatures are too warm to promote stable surface ice formation. Surface ice functions to insulate the water beneath it, reducing the potential for the formation of frazil and anchor ice. Frazil ice forms when a "seed crystal" is created and suspended within the water column. Frazil ice recruits additional mass while suspended and tends to cling to unheated subsurface objects such as rock substrate, vegetation, or woody material (Brown et al. 2011, pp. 8-26). Frazil ice that adheres is called anchor ice. An accumulation of anchor ice can reduce flow, resulting in areas of increased velocity and sometimes ice dams. The primary effects of these ice dynamics on bull trout are the potential for increased metabolic expenditure to avoid areas of frazil or anchor ice accumulations and frazil ice to clog a fish's gills.

Operations affect water quality in the spring and summer through biotic processes in Deadwood Reservoir which influences nutrient loads downstream (USBR et al. 2011, page 2). While nutrient loads do not directly impact bull trout, they can influence the productivity of the Deadwood River. However, work performed during the Deadwood Flexibility Study suggests that the water quality is sufficient to provide macroinvertebrate densities similar to unmanaged reference streams within the basin.

Operations also affect the quantity of water in the Deadwood River. Reclamation releases a base flow of 50 cfs from Deadwood Reservoir which maintains a sufficient flow for migration (Pruitt and Nadeau 1978). Furthermore, habitat surveys performed during the Deadwood Flexibility Study suggest that the frequency and depth of pools available for over-wintering maintains the function of PCE 8.

Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

South Fork Payette River

Operation of Deadwood Dam has an insignificant effect on PCE 8 in the South Fork Payette River. Nutrient concentrations will continue to be diluted as they move downstream, presumably reaching levels close to those in the South Fork Payette River (Reclamation et al. 2011). The small amount of influence on the South Fork Payette hydrograph by the Deadwood River would suggest that, although not measured in the South Fork Payette River, nutrient concentrations reach ambient conditions through dilution soon after mixing. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 19).

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Deadwood Reservoir, Lower Deadwood River, South Fork Payette River Basin

The operation of Deadwood Dam has an insignificant effect on PCE 9 for the three areas of critical habitat associated with this system. The proposed action provides an environment that allows the survival of nonnative fishes; however, IDFG exclusively manages the fisheries including stocking and regulations that favor the presence of individual species that are not incompatible with bull trout survival and growth. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from the operation of Deadwood Dam.

Summary of the Effects of the Proposed Action

Under the proposed action, conditions in the Payette Division of the Boise Project in the Deadwood and Payette river drainages would continue to provide conditions throughout most of the year that were identified by the PCEs as important for the survival of bull trout. Depending on climate patterns and water needs, the availability of bull trout habitat may be limited by yearly and seasonal fluctuations in water supply and irrigation demands. Although adverse effects to PCEs occurs due to operations and may degrade the functionality of certain PCEs, functionality of PCEs and critical habitat is not lost.

Table 14. Summary of the effects of the proposed action for Deadwood Reservoir, lower Deadwood River, and South Fork Payette River.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action		
		Deadwood Reservoir	Lower Deadwood River	South Fork Payette River
PCE 1	Springs, seeps, groundwater sources	Discountable	Insignificant effect	Insignificant effect
PCE 2	Migration habitats with minimal impediments.	Adverse effects in the varial zone during the fall migration when reservoir levels are low.	Insignificant effect	Insignificant effect
PCE 3	Abundant food base	Infrequent adverse effects when reservoir volumes drop below 50,000 acre-feet in 2 of 30 years.	Insignificant effect	Insignificant effect
PCE 4	Complex river, stream, lake, and reservoir aquatic environments and process	Seasonal adverse effect when reservoir levels are low.	Insignificant effect	Insignificant effect
PCE 5	Water temps ranging from 2°-15 °C with adequate thermal refugia	Infrequent adverse effects when reservoir volumes drop below 50,000 acre-feet in 2 of 30 years.	Infrequent adverse effect in 2 of 30 years	Insignificant effect
PCE 6	Spawning/rearing substrate.	Not present	Not present	Not present
PCE 7	A natural hydrograph, or if flows are controlled, minimal flow departure from a natural hydrograph	The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.	Adverse effect, but hydrograph remains functional and beneficial to PCEs 4 and 5.	Insignificant effect
PCE 8	Sufficient water quality and quantity	Infrequent adverse effects when reservoir volumes drop below 50,000 acre-feet in 2 of 30 years.	Seasonal adverse effect if frazil ice forms in winter.	Insignificant effect
PCE 9	Sufficiently low levels of nonnative predatory; interbreeding; or competing species	Insignificant effect	Insignificant effect	Insignificant effect

2.5.2.3 Malheur River System

The following is based on the information provided in the Assessment (USBR 2013, pp. 134-140) and Appendix, the 2005 biological assessment and water quality studies, the 2005 opinion, and other information.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The operation of Agency Valley Dam will have discountable effects on PCE 1 within Beulah Reservoir. As noted previously, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in Beulah Reservoir. Although reservoir operations may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoir as a whole.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The operation of Agency Valley Dam will have insignificant effects on PCE 2 in Beulah Reservoir. There are no physical or biological barriers between over-wintering habitat in Beulah Reservoir and spawning and rearing habitat in the North Fork Malheur River and associated tributaries; however, there is a seasonal water quality barrier that occurs in Beulah Reservoir when bull trout are not present. Starting usually in mid-May to late June and lasting through October, water temperatures and low dissolved oxygen levels exceed bull trout tolerances. Bull trout leave the reservoir during this time and remain in the North Fork Malheur River until water temperature and dissolved oxygen return to tolerable levels in the reservoir (PCE 8). This response is typical for migratory bull trout and is not unique to Beulah Reservoir. Reservoir operations do not appear to affect migration timing because upstream water temperatures in the North Fork Malheur River reflect a similar pattern of warming. Prey fishes are unlikely to be adversely affected by this temperature increase, with the exception of stocked rainbow trout. Multiple years of drought can worsen the seasonal temperature effects by significantly reducing the reservoir storage, resulting in greater temperature maximums and lower dissolved oxygen levels.

Migration corridors in the spring are in good condition. No migration impediments occur during the spring migration period for fish migrating out of Beulah reservoir to spawning habitat. Reservoir drawdowns can expose varial zones during the fall migration season in most years; however, connectivity is maintained at all times. The migration zone experiences a reduction of structural diversity in the fall which causes the risk of predation to increase; however, depth cover is maintained better than in other action areas because of the more incised stream channel and narrow delta entering the reservoir. The presence of a stream channel and established vegetation within the delta (compared to other action areas) maintains more depth and reduces the risk of predation than a channel that spreads out within a wide delta.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

The operation of Beulah Reservoir has an infrequent adverse effect on PCE 3 when water volumes drop below 2,000 acre-feet in 10 of the 30 years (USFWS 2005a, p. 246-247)[10]. At times, these drawdowns can be to run-of-river. When those conditions occur (generally in late summer or fall), adverse water quality conditions may cause lethal conditions for the prey base of bull trout (USFWS 2005a, p. 247). Since 2006, the reservoir volume has fallen below 2,000 acre-feet four times.

Beulah Reservoir is eutrophic and very productive. Reservoir sampling in 2011 resulted in 17,794 total individuals of 11 fish species caught in fyke nets, gill nets, and a weir (Best 2012a, p. 51). Water conditions during 2011 were above average (wet year). Rose and Mesa (2009b, pp. 5-11) reported similar levels of catch during 2006 during a moderate drawdown. However, Rose and Mesa (2009a) reported a significant decline in forage fish following a drawdown to run-of-river. Petersen and Kofoot (2002) indicated that annual recruitment of prey species from the North Fork Malheur River may ameliorate some of the effects of reservoir drawdowns on the bull trout prey base.

Periodic run-of-river drawdowns will continue to occur (see footnote 10). The analysis indicated that in 10 of the 30 years analyzed, reservoir volumes will be below 2,000 acre-feet. Periodic run-of-river drawdowns at Beulah Reservoir temporarily affect prey fish species. Prey fish are able to recolonize from the North Fork Malheur River and Warms Springs Creek; however, there is a decrease in prey available which may adversely impact over-wintering bull trout. Petersen et al. (2003) indicated that historically, gill net catches of various species in Beulah Reservoir following a reservoir drawdown to river level (run-of-river) appear to lag from 1 to 3 years. Rose and Mesa (2009b) also reported significant decrease in prey abundance following a drawdown in 2007 to run-of-river. Prey fish populations recover to previous abundance given sufficient time, indicating that the reservoir is resilient to repeated drawdowns.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions.

[10] A minimum pool of 2000 acre-feet has been put in place through 2015 in order to identify a biologically-based minimum pool recommendation that will reduce the adverse impacts to the prey base in Beulah Reservoir from periodic drawdowns. As stated in the April 23, 2010 letter, should this study fail to identify a minimum pool, the Service recommended defaulting to a minimum conservation pool equal to approximately 18,500 acre feet starting April 30, 2015.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

The operation of Beulah Reservoir has a seasonal adverse effect on PCE 4 as the reservoir is drawn down. We recognize there is a difference in habitat complexity between full pool and lower pool elevations and that the functionality of this PCE varies depending on operations, but is never completely lost. Habitat complexity may be at its best during full pool levels and habitat becomes less complex as water levels drop. The near shore habitat becomes simplified as the interface between the water and riparian vegetation, large wood, and banks, etc., diminishes, as is expected within a reservoir environment based on operations and changes in reservoir elevation.

The quality of habitat depth is also diminished. Although depth may exist within the reservoir and is a component of this PCE, the habitat at depth is not suitable for bull trout during the summer months (mainly late July through September) due to warm waters near the surface (Assessment Appendix B, pp. 47-48), and depleted oxygen levels at depth (Assessment Appendix B, pp. 48-49). In addition, the varial zones associated with tributaries are simplified and may lack the structural complexity during drawdown. Most of the year (October through June), affects to PCE 4 are insignificant.

Climate change forecasts suggest baseline conditions will maintain storage levels within the conditions in the proposed action (Figure 33 in Assessment, pp. 122).

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Operation of Agency Valley Dam may affect PCE 5 during the summer months when temperatures are elevated but this effect is considered insignificant because bull trout do not use the reservoir at these times. Reservoir water temperatures may exceed 15° C from July through September, with little to no thermal refugia at these times. These conditions would occur even without summer drawdowns based on inputs to the reservoir. From November through mid-May, Beulah Reservoir provides adequate water temperatures for bull trout foraging, rearing, and over-wintering.

The adfluvial life history strategy of bull trout allows them to leave inhospitable conditions in shallow lakes or reservoirs, and to return when water temperatures drop in the fall. Furthermore, the 2005 opinion recognizes that bull trout are not present in the reservoir while the seasonal water quality barriers exist and the T&Cs focus on protecting the habitat to maintain the prey base rather than bull trout directly. The seasonal increase in water temperatures above those tolerable to bull trout will continue to occur; however, this temperature increase is unlikely to impair the function of PCE 5 because subadult and adult bull trout migrate out of Beulah Reservoir into the North Fork Malheur River and tributaries to over-summer and to spawn.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Beulah Reservoir has not been designated as spawning and rearing habitat (USFWS 2010a, pages 629, 641); therefore, the effects were not analyzed.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The operation of Agency Valley Dam has an adverse effect during low drawdown. Reservoir operation influences water quality and temperature indirectly through a set of complex interactions with incoming water temperature, solar loading, release of cold water from the bottom of the reservoir, and the influence of reservoir elevation on thermal stratification. At low summer levels there may be an increased probability of degraded dissolved oxygen conditions. These conditions would affect bull trout and primary prey species. Few bull trout are present at this time and they have access through the migration corridor to better habitat.

Operational indicators for Beulah Reservoir have been developed to protect critical habitat by minimizing the frequency of drawdown below 2,000 acre-feet to 10 of 30 years (Table 6, footnote 10). These criteria aim to protect water quality by maintaining thermal stratification during periods of hot and dry weather. Beulah Reservoir has been drafted to the 2,000-acre-foot level four times since the 2005 USFWS opinion.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 33 in Assessment, pp. 122).

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The operation of Beulah Reservoir will have an insignificant effect on PCE 9 in Beulah Reservoir. The proposed action provides an environment that allows the survival of nonnative fishes; however, Oregon Department of Fish and Wildlife (ODFW) exclusively manage the fisheries including stocking and regulations that favor the presence of individual species that are no incompatible with bull trout growth and survival. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from the operation of Agency Valley Dam.

Summary of Effects of the Proposed Action

Under the proposed action conditions in the Vale Project in the Malheur River basin will continue to have an adverse effect on critical habitat. The operations of Beulah Reservoir affect several PCEs (Table 15); in most instances, these effects are insignificant or discountable because the PCEs retained function when bull trout use the reservoir. Although adverse effects to PCEs occurs due to operations and may degrade the functionality of certain PCEs, functionality of PCEs and critical habitat is not lost.

Table 15. Summary of the effects of the proposed action for Beulah Reservoir.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action
		Beulah Reservoir and North Fork Malheur River
1	Springs, seeps, groundwater sources	Discountable effect
2	Migration habitats with minimal impediments.	Insignificant effect
3	Abundant food base	Infrequent adverse effect when reservoir drawdowns drop below 2,000 acre feet expected in 10 of 30 years[11].
4	Complex river, stream, lake, and reservoir aquatic environments and process	Seasonal adverse effects when reservoir levels are low.
5	Water temps ranging from 2°-15 ^{o}C with adequate thermal refugia	Insignificant effect
6	Spawning/rearing substrate.	Not present
7	A natural hydrograph, or if flows are controlled, minimal flow departure from a natural hydrograph	The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.

[11]A minimum pool of 2000 acre-feet has been put in place through 2015 in order to identify a biologically-based minimum pool recommendation that will reduce the adverse impacts to the prey base in Beulah Reservoir from periodic drawdowns. As stated in the April 23, 2010 letter, should this study fail to identify a minimum pool, the Service recommended defaulting to a minimum conservation pool equal to approximately 18,500 acre feet starting April 30, 2015.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action
		Beulah Reservoir and North Fork Malheur River
8	Sufficient water quality and quantity	Seasonal adverse effects during low drawdown.
9	Sufficiently low levels of nonnative predatory; interbreeding; or competing species	Insignificant effect

2.5.2.4 Powder River System

The following is based on the information provided in the Assessment (USBR 2013, pp. 170-181) and Appendix, the 2005 biological assessment and water quality studies, the 2005 opinion, and other information.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Phillips Reservoir

The operation of Mason Dam will have discountable effects on PCE 1 within Phillips Reservoir. As noted previously, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in Phillips Reservoir. Although reservoir operation may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoir as a whole.

North Powder River and Eagle Creek

The operation of Mason Dam will have an insignificant effect on PCE 1 in the Powder River. The presence of PCE 1 in the North Powder and Eagle Creek portions of the Powder River is unknown, although hyporheic influence is thought to persist under baseline conditions. The effects of operations are reduced as the downstream distance increases, with the small effects from the proposed action becoming indistinguishable from the multiple other non-project variables described in baseline section that have a greater effect on this PCE.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Phillips Reservoir

The operation of Mason Dam has a seasonal adverse effect on PCE 2 in Phillips Reservoir. A seasonal physical migration barrier exists in the varial zone of Deer Creek due to the presence of two abandoned roadbeds in close proximity to one another within the full pool margin. Possible biological barriers include water quality and increased risk of predation with the increased length of varial zone. There is a seasonal water quality barrier that occurs in Phillips Reservoir when bull trout are not present in August and September. Water temperatures and dissolved oxygen levels exceed bull trout tolerances. Although we cannot say for certain, we expect that bull trout in Phillips Reservoir would likely behave as they do in Beulah Reservoir when all adult and subadult bull trout leave the reservoir and do not return until temperatures and dissolved oxygen reach tolerable levels in late October (see the Beulah Reservoir discussion).

Habitat surveys performed on the Powder River and Deer Creek in the fall of 2011 and 2012 by Reclamation compared habitat between the varial zone and immediately upstream and found no physical barriers to migration in the Powder River, but did find physical barriers to migration in Deer Creek when pool elevations drop below two abandoned road beds (old highway). The approximate elevation where Deer Creek first intersects each road bed is at 4009 and 3993 feet. Varial zone lengths vary depending on the tributary, the reservoir, and the season. During the study, the varial zone length averaged 1.3 miles (2.1 kilometers) at the Powder River and 0.9 mile (1.4 kilometers) at Deer Creek; however, a split channel at Deer Creek, caused by abandoned road beds, may block the fall return migration until the reservoir levels rise above this location. The proposed action will continue to adversely affect fall migration from lower Deer Creek when the Phillips Reservoir elevation is below the abandoned roadbeds.

North Powder River and Eagle Creek

Operation of Mason Dam and Thief Valley Dam will have insignificant effects on PCE 2 in the Powder River. Generally, operation of Mason Dam reduces flow in the winter and increases flow in the summer. Under both winter and summer operations, Reclamation has observed no physical, biological, or water quality impediments that could affect bull trout migration in the Powder River due to the proposed action. Bull trout are not known to exist below Mason Dam and the effects of the proposed action are reduced as the downstream distance increases from Mason Dam and Thief Valley Dam. Variables independent from the proposed action play a more dominant role in the availability of a migration corridor.

Warm-water winter releases have been associated with intermittent ice barriers in other systems, but no similar ice dams have been observed in the Powder River. Climate change forecasts suggest baseline conditions will maintain flows within the range of conditions analyzed in the proposed action.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Phillips Reservoir

The operation of Mason Dam will have insignificant effects on PCE 3 within Phillips Reservoir. Reservoir operation can influence primary production through the impact of water quality (PCE 8) and in turn, influence the food web including aquatic invertebrates and forage fishes. However, the inactive pool maintains storage that protects the prey base at sufficient levels to maintain prey diversity for migratory bull trout that may use the reservoir to over-winter. Abundant numbers of prey fishes have been sampled annually during ODFW perch removal efforts.

The proposed action includes inactive storage in Phillips Reservoir; the presence of the dead pool contributes to the habitat complexity and water quality and quantity that allow the current abundance of prey fishes that are available to bull trout that could use the reservoir as over-wintering habitat.

North Powder River and Eagle Creek

Operation of Mason Dam and Thief Valley Dam will have insignificant effects on PCE 3 in the Powder River. Reservoir operation can affect prey base through the impact of water quality and primary productivity; however, no bull trout are known to exist in these reaches of the Powder River and effects of the proposed action for bull trout migrating through the action area are insignificant. The Mason Dam is located 57.2 miles upstream from North Powder and 124.0 miles upstream from Eagle Creek; Thief Valley Dam is 47.8 miles upstream from Eagle Creek; therefore, variables independent from the operation of Mason Dam and Thief Valley Dam play a more dominant role in the availability of habitat to support a food base (PCEs 4, 5, 7, and 8) for bull trout that use the action area as a migration corridor.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

Phillips Reservoir

The operation of Phillips Reservoir has an adverse effect on PCE 4 as water levels within the reservoir are drawn down. We recognize there is a difference in habitat complexity between full pool and lower pool elevations and that the functionality of this PCE varies depending on operations, but is never completely lost. Habitat complexity may be at its best during full pool levels and habitat becomes less complex as water levels drop. The near shore habitat becomes simplified as the interface between the water and riparian vegetation, large wood, and banks, etc., diminishes, as is expected within a reservoir environment based on operations and changes in reservoir elevation.

Depth exists within the reservoir (a component of this PCE) and the habitat at depth remains suitable for bull trout until the end of August. This is a result of stratification of the reservoir and warm waters near the surface (Assessment Appendix B, p.55), and depleted oxygen levels at depth (Assessment Appendix B, pp. 58-59). In addition, the varial zones associated with tributaries are simplified and may lack the structural complexity during drawdown. Most of the year (October through June), affects to PCE 4 are insignificant. And although habitat complexity is degraded, it does retain functionality.

Climate change forecasts suggest baseline conditions will maintain storage levels within the conditions in the proposed action (Figure 40 in Assessment, pp. 146).

North Powder River and Eagle Creek

The operation of Mason Dam and Thief Valley Dam will have insignificant effects on PCE 4 in the Powder River below Mason Dam. Discharge from Mason Dam does not affect the habitat complexity within these areas. Although consistent summer flows have allowed a better established riparian zone in the area immediately downstream of Mason Dam, no bull trout are known to exist below either dam and effects of the proposed action for bull trout migrating through the action area are insignificant. Benefits of the proposed action are reduced as the downstream distance increases from Mason Dam. Variables independent from the operation of the two dams (e.g., water withdrawals, land management practices) play a more dominant role in the availability of habitat complexity (PCEs 4, 5, 7, and 8).

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Phillips Reservoir

Operation of Mason Dam has a seasonal adverse effect on PCE 5 from late August through early September. Although the likelihood of bull trout presence is low, their presence cannot be discounted due to recent (2011) capture data of bull trout in Phillips Reservoir. Although we cannot say for certain, we expect that bull trout in Phillips Reservoir would likely behave as they do in Beulah Reservoir when all adult and subadult bull trout leave the reservoir and do not return until temperatures and dissolved oxygen reach tolerable levels in late October (see the Beulah Reservoir discussion). In most years, water temperatures exceed 15° C with little to no thermal refugia in Phillips Reservoir. This is due to summer drawdowns and warm water entering Phillips Reservoir from tributaries. During the remainder of the year, the reservoir provides adequate water temperatures for bull trout that could be present for foraging, rearing, and over-wintering from November through mid-July.

The warm summer water temperatures will not affect prey base because native aquatic biota found within the core area, including many of the prey species, have a tolerance for higher water temperatures and lower dissolved oxygen levels than bull trout. During periods when PCE 5 targets are exceeded for bull trout, conditions would be favorable for prey species, allowing for the presence of an established prey fish population (PCE 3) during seasons when bull trout may be present in the reservoir (November through June).

North Powder River and Eagle Creek

The operation of Mason Dam and Thief Valley Dam have an insignificant effect on PCE 5 in the Powder River below Mason Dam. Hypolimnetic releases from Mason Dam maintain suitable water temperatures throughout most of the year for a limited area directly below the dam. Benefits of the proposed action are quickly reduced as the downstream distance increases from Mason Dam Variables independent from the operation of Mason Dam and Thief Valley Dam (e.g., water withdrawals, land management practices) play a more dominant role in the availability of habitat complexity (PCEs 4, 5, 7, and 8).

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Phillips Reservoir and the Powder River downstream of Mason Dam and Thief Valley Dam have not been designated as spawning and rearing habitat (USFWS 2010a, pp. 629, 641); therefore, the effects were not analyzed.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Phillips Reservoir

A natural hydrograph is not present in Phillips Reservoir because of the dam. The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.

North Powder River and Eagle Creek

The operation of Mason Dam and Thief Valley Dam have seasonal adverse effects on PCE 7 in the lower Powder River; however, the PCE remains functional and provides beneficial effects to other PCEs as a result of being altered (PCE 4 and 5). Typically, spring migration coincides with periods of higher flow when effects of the proposed action would be insignificant. Seasonal adverse effects could occur during the fall when irrigation flows are reduced and discharge is less than unregulated flows. Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions (Figure 40).

The influence of Mason Dam and Thief Valley Dam operations is seasonally adverse because typical fall migration coincides with periods of low flows when reservoir operations regulate the hydrograph characterized by flows that are lower than unregulated hydrograph. In general, reservoir operations regulate the hydrograph characterized by flows that are lower in the winter and spring, lower during the spring peak, and higher in the summer with irrigation deliveries. Due to the regulation of flows out of Phillips and Thief Valley reservoirs, the descending hydrograph does not follow daily and seasonal fluctuations of nearby unregulated systems. Bull trout are not known to exist in these portions of the action area; however, if they were present they would likely only use these areas during migration periods.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Phillips Reservoir

The operation of Mason Dam has an infrequent adverse effect during low drawdown that occurs in late August. Reservoir operation influences water quality and temperature indirectly through a set of complex interactions with incoming water temperature, solar loading, release of cold water from the bottom of the reservoir, and the influence of reservoir elevation on thermal stratification. At low summer levels there may be an increased probability of degraded dissolved oxygen conditions. As noted in the Appendix B, pp. 58-59, oxygen depletion becomes evident in the summer months, likely due to the reservoir becoming strongly stratified and increased bacterial respiration in the hypolimnion removed dissolved oxygen. Oxygen depletion is noted throughout the water column. These conditions would affect bull trout and primary prey species. Few if any bull trout are present at this time and they have access through the migration corridor to better habitat in the Upper Powder River but not to Deer Creek. Although the likelihood of bull trout presence is low, their presence cannot be discounted due to recent (2011) capture data of bull trout in Phillips Reservoir. Although we cannot say for certain, we expect that bull trout in Phillips Reservoir would likely behave as they do in Beulah Reservoir when all adult and subadult bull trout leave the reservoir and do not return until water quality conditions return to suitable.

Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range analyzed in the proposed action (Figure 40 in Assessment, pp. 146).

North Powder River

Operation of Mason Dam will have an insignificant effect on PCE 8 in the North Powder River portion of the Powder River action area. The influence of Mason Dam on PCE 8 is insignificant for two reasons. First, levels of measured constituents in the Powder River immediately below Mason Dam are very low, indicating in most cases, lower loading and less degradation of water quality as compared to nearby rivers. Total dissolved gas concentrations have been monitored in the past and generally dissolved gas concentrations in the Powder River are within ODEQ standards throughout the year (Assessment Appendix B, pp. 59-60). These data for both water quality constituents and dissolved gas concentrations suggests few, if any, direct water quality effects on bull trout. Second, the influence of the proposed action on PCE 8 is attenuated by independent variables as the downstream distance from Mason Dam increases. In this area, these independent variables play a more dominant role in the water quality and quantity. The baseline sections for PCEs 4, 5, 7, and 8 provide more detailed discussion of these independent variables. We anticipate effects similar to those observed under the environmental baseline will continue.

Eagle Creek

Operation of Mason and Thief Valley dams will have an insignificant effect on PCE 8 for this portion of the Powder River. The Eagle Creek critical habitat subunit is 47.8 miles downstream from Thief Valley Dam. As a result, the influence of Thief Valley operations is reduced as independent variables play a more dominant role in the water quality and quantity in this reach. To the extent that Thief Valley influences water quality in non-critical habitat portions of the Powder River, Reclamation advises operations for Thief Valley Dam (operated by the Lower Powder River Irrigation District) to minimize the release of sediment to maintain downstream water quality (USBR 2004b).

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Phillips Reservoir

The operation of Mason Dam will have an insignificant effect on PCE 9 within Phillips Reservoir. The proposed action provides an environment that allows the survival of nonnative fishes; however, ODFW exclusively manages the fisheries including stocking and regulations that favor the presence of individual species whose presence is not incompatible with bull trout growth and survival. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from the operation of Mason Dam.

Powder River - North Powder & Eagle Creek

The operation of Mason Dam will have an insignificant effect on PCE 9 within North Powder River and Eagle Creek. The proposed action provides an environment that allows the survival of nonnative fishes; however, ODFW exclusively manages the fisheries including stocking and regulations that favor the presence of individual species whose presence is not incompatible with bull trout growth and survival. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from the operation of Mason Dam and Thief Valley Dam.

Summary of the Effects of the Proposed Action

Under the proposed action, conditions in the Baker Project in the Powder River Basin will continue to have an adverse effect on critical habitat. The operations of Phillips Reservoir and Mason Dam affect several PCEs (Table 16); in most instances, these effects are insignificant or discountable because the PCEs retained function when bull trout use the reservoir. Although adverse effects to PCEs occurs due to operations and may degrade the functionality of certain PCEs, functionality of PCEs and critical habitat is not lost.

Table 16. Summary of the effects of the proposed action for Phillips Reservoir, North Powder River, and Eagle Creek.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action	
		Phillips Reservoir (Mason Dam)	North Powder and Eagle Creek (Thief Valley Dam)
1	Springs, seeps, groundwater sources	Discountable effect	Insignificant effect
2	Migration habitats with minimal impediments.	Adverse effects in the varial zone during the fall migration when reservoir levels are low.	Insignificant effect
3	Abundant food base	Insignificant effect	Insignificant effect
4	Complex river, stream, lake, and reservoir aquatic environments and process	Seasonal adverse effects when reservoir levels are low.	Insignificant effect
5	Water temps ranging from 2°-15^{o} C with adequate thermal refugia	Seasonal adverse effect	Insignificant effect
6	Spawning/rearing substrate.	Not present	Not present

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action	
		Phillips Reservoir (Mason Dam)	North Powder and Eagle Creek (Thief Valley Dam)
7	A natural hydrograph, or if flows are controlled, minimal flow departure from a natural hydrograph	The unnatural hydrograph baseline is due to the dam and is not expected to change with the proposed action.	Seasonal adverse effect: Low flows after irrigation season.
8	Sufficient water quality and quantity	Seasonal adverse effects in late summer/early fall.	Insignificant effect
9	Sufficiently low levels of nonnative predatory; interbreeding; or competing species	Insignificant effect	Insignificant effect

2.5.2.5 Mainstem Snake River and Columbia River

The following is based on the information provided in the Assessment (USBR 2013, pp. 198-205) and Appendix, the 2005 biological assessment and water quality studies, the 2005 opinion, and other information.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The operation of the dams and reservoirs in the upper Snake River basin will have discountable effects on PCE 1 within mainstem Snake and Columbia rivers. As noted previously, springs, seeps, groundwater sources, and subsurface water connectivity do not play a large role in water quantity or water quality in the reservoirs in the upper Snake River basin. Although, reservoir operations may influence shallow groundwater exchange, the influence of this exchange is not of sufficient scale to influence thermal refugia in the reservoirs as a whole.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The operation of the upper Snake River projects will have an insignificant effect on PCE 2 in the mainstem Snake and Columbia rivers. The small portion of hydrologic effects that could be attributable to the upper Snake River projects would not be measurable in terms of the ability of bull trout to migrate through the mainstem rivers. Under current conditions, water quality is sufficient at times when bull trout would be likely to use the action area for FMO habitat.

Accordingly, the operation of the upper Snake River projects does not appear to have a significant effect on migration between tributary and mainstem habitats. The continued augmentation of flows for salmon under the proposed action would continue to provide slight benefits to bull trout by improving water temperatures, dissolved oxygen levels, and potential physical impediments at the mouths of tributaries during the summer months when those parameters could fall below target values. Migration habitats would remain fragmented or impounded by dams as described in environmental baseline.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

The operation of the Upper Snake projects will have insignificant effects on PCE 3 in the mainstem Snake and Columbia rivers. Upper Snake project operational changes are not likely to have any measurable effect on bull trout prey base in the Hells Canyon Complex and downstream areas (USFWS 2005a, p. 247). Operation of the upper Snake River projects may increase inflows to Brownlee Reservoir as much as 1,100 cfs in July (at the 90 percent exceedance level) with salmon flow augmentation. The changes in Brownlee Reservoir inflows, as a result of the upper Snake River projects, are relatively minor compared to existing inflows and Brownlee Reservoir elevations (as well as Oxbow and Hells Canyon) are not likely to be affected at all since salmon flow augmentation is passed through the three reservoirs. Changes in flows below Hells Canyon Dam would also be unlikely to have a measurable effect on bull trout prey base. Conditions favoring nonnative species would continue to provide a prey base. Brownlee Reservoir inflows are decreased in winter and increased in spring and summer.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

Operation of the upper Snake River projects will have an insignificant effect on PCE 4. Generally, PCE 4 is not present in Snake and Columbia river reservoirs (75 FR 63898, p.63934). While some portions of the mainstem Snake and Columbia rivers may exhibit complex processes, it is unlikely these processes provide a significant contribution to bull trout use of these habitats. Throughout most of the year, the variability associated with upper Snake project operations is subsumed by the operation of mainstem dams, making the influence of upper Snake River projects on river elevation nearly immeasurable in much of the Snake and Columbia rivers. In August and September, salmon flow augmentation releases may temporarily ameliorate low summer flow conditions although the scope of these benefits to habitat complexity is unknown.

PCE 5: Water temperatures ranging from 2° to 15° C (36° to 59° F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

PCE 5 is not present in the mainstem Columbia or Snake River CHUs (75 FR 63898, p. 63934); therefore, the effects were not analyzed.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

PCE 6 is not present in the mainstem Snake and Columbia rivers. The lakes, reservoirs, mainstem Snake River, and mainstem Columbia River have not been designated as spawning and rearing habitat (USFWS 2010a, pp. 629, 641); therefore, the effects were not analyzed.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The operation of the upper Snake River projects will have an insignificant effect on the function of PCE 7 on the mainstem Snake and Columbia rivers. Generally, the operation of the upper Snake River projects reduces inflow to Brownlee Reservoir from October through June, with the most substantial influence in May and June. Reclamation anticipates hydrologic conditions similar to those observed under the environmental baseline will continue. Salmon flow augmentation releases from the upper Snake River projects increase flows in August and September. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions.

This influence is insignificant for two reasons. First, the intermediating influence operation of downstream dams, particularly those of the Hells Canyon Complex, overwhelm the influence of the Upper Snake River projects at time scales necessary to control the magnitude, duration or stability of the peak, high, low and base flows that make up a natural hydrograph. In other words, while the operations of the Upper Snake River projects influence the context in which downstream management actions occur, this influence is not sufficient to overcome the impacts of baseline regulation downstream and restore characteristics of a natural hydrograph.

Second, what influence the Upper Snake River projects may have on mainstem hydrology, this influence has insignificant effects on the function of this habitat for FMO use. Generally, the primary benefit of a natural hydrograph for FMO habitat is in providing stable flows to avoid impacting foraging and over-wintering behaviors (75 FR 63898, p. 63931). Under baseline conditions, base flows remain sufficiently stable to support bull trout feeding, migration, and over-wintering. Chandler et al. (2003) found that bull trout use the Oxbow Bypass reach and Hells Canyon Reservoir primarily during late fall and winter. While peak spring flows have been reduced from a natural hydrograph, it is unclear whether this has any effect on bull trout migration from the mainstem rivers to tributary habitats. Typically, water temperature and tributary hydrology are the primary triggers for migratory behavior.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The operation of the upper Snake River projects will have an insignificant effect on PCE 8 in the mainstem Snake and Columbia rivers. Generally, adequate water quantity exists within the mainstem rivers to support migration habitats (PCE 2) and bull trout prey base (PCE 3). A slight beneficial effect to summer water quantity may occur as a result of salmon flow augmentation, although these benefits diminish below Lower Granite Dam. The operation of the upper Snake River projects influences water quality in the mainstem Snake River by temperature regimes, suspended sediment, and nutrient transport dynamics (USBR 2007); however, these effects are insignificant and do not affect the function of the PCE. Incoming water temperatures to Brownlee Reservoir are primarily a function of baseline meteorologic functions rather than upper Snake operations. The volume of water could influence temperature gradients within the reservoirs and the temperature of water released downstream, but the degree of this influence is largely determined by the operations of the Hells Canyon Complex facilities. From November through mid-June, water temperatures are suitable for bull trout through much of the Snake River below Brownlee Reservoir. This suggests that flow reductions attributable to upper Snake River project operations do not have a significant influence on water temperature. In the summer, the influence of salmon flow augmentation releases depends on the operation of Snake River facilities. When passed over the top of dams, salmon flow augmentation releases may increase water temperatures, although salmon flow augmentation is generally associated with a slight reduction in temperatures below Lower Granite Dam (USCOE 2013). Reclamation anticipates effects similar to those observed under the environmental baseline will continue. Climate change forecasts suggest baseline conditions will maintain storage levels within the range of observed conditions.

The delivery of water for agricultural use can also influence sediment transport regimes. Project reservoirs trap sediment loads from upstream tributaries, while water deliveries can indirectly increase loads due to agricultural practices. Reclamation anticipates that continued implementation of sediment TMDLs will reduce sediment loads from those observed under the environmental baseline. To the extent that operations may increase sediment transport in the upper Snake River, these effects are not anticipated to have a significant effect on PCE 8 below Brownlee Reservoir because the reservoir traps much of the incoming sediment.

Similarly, water deliveries can influence nutrient loads within the upper Snake River. Generally, nutrients are deposited within Brownlee Reservoir where they affect nutrient dynamics within the reservoir. As summer water temperatures rise, this may increase nutrient consumption within the reservoir and cause dissolved oxygen levels both within the reservoir and downstream to decrease. Once dissolved oxygen is depleted, the reservoir becomes anoxic and a portion of incoming nutrient loads are bypassed downstream. Generally, these effects diminish with each reservoir downstream. Reclamation does not anticipate this influence to have a significant effect on the function of PCE 8 because bull trout are not present at times when water temperature causes downstream dissolved oxygen and nutrient loading issues.

Below Lower Granite Dam, the influence of upper Snake operations on water quality and quantity becomes immeasurable; therefore, no significant effects are anticipated for the lower Snake River below Lower Granite Dam and the mainstem Columbia River.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The operation of upper Snake River projects will have an insignificant effect on PCE 9 within mainstem Snake and Columbia rivers. The proposed action provides an environment that allows the survival of nonnative fishes; however, state fish and game departments exclusively manage the fisheries including stocking and regulations that favor the presence of individual species. The proposed action plays an insignificant role in the occurrence of nonnative fishes compared to variables (fish management and interbreeding) independent from the operation of the upper Snake River projects.

Summary of the Effects of the Proposed Action

Hydrologic effects to PCEs in the mainstem Snake and Columbia River CHUs are summarized in and detailed in the following paragraphs. PCEs 5 and 6 are excluded from analysis because they are not present in these CHUs (75 FR 63898, p. 63934).

Table 17. Summary of the effects of the proposed action for the mainstem Snake/Columbia River system.

PCE	PCE Description (Abbreviated)	Effects of the Proposed Action
1	Springs, seeps, groundwater sources	Discountable effect
2	Migration habitats with minimal impediments.	Insignificant effect
3	Abundant food base	Insignificant effect
4	Complex river, stream, lake, and reservoir aquatic environments and process	Insignificant effect
5	Water temps ranging from 2°-15 ^{o}C with adequate thermal refugia	Not present
6	Spawning/rearing substrate.	Not present
7	A natural hydrograph, or if flows are controlled, minimal flow departure from a natural hydrograph	Insignificant effect
8	Sufficient water quality and quantity	Insignificant effect
9	Sufficiently low levels of nonnative predatory; interbreeding; or competing species	Insignificant effect

2.5.3 Interrelated and Interdependent Effects to Bull Trout and Bull Trout Critical Habitat

Effects of the action under consultation, in this case Reclamation's O&M of the upper Snake River projects, are analyzed together with the effects of other activities that are interrelated to or interdependent with, that action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interdependent activities include diversion of storage water through privately owned facilities.

We recognize that return flows to the Snake and Columbia basins (including the rivers discussed in this consultation – the Boise, Payette, Malheur, and Powder rivers) that carry project water, also carry effluents, sediments, and other pollutants from overland flow, irrigation returns, municipalities, industry, and other sources unrelated to the proposed action back to the rivers and these flows may have effects on critical habitat. However, we cannot separate the effects associated with the proposed action and other activities or sources of pollutants to accurately describe the potential effects. We acknowledge that they occur and may have effects on bull trout critical habitat. We did not identify any interrelated activity that is part of the proposed action.

2.5.4 Cumulative Effects

The implementing regulations for section 7 define cumulative effects to include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

2.5.4.1 Cumulative Effects – Bull Trout

In the Powder River, private and state activities and management programs may affect bull trout through the continuation of effects associated with ongoing activities that include timber harvest, agriculture, mining, road construction and maintenance, recreation, water diversions, and residential development. It is likely that future non-federal actions will continue over the life of this consultation at similar intensities as in recent years and these actions will cumulatively affect bull trout. The Service anticipates that majority of cumulative effects related to State and private activities will occur within bull trout forage, migratory, and overwintering habitats where the greatest concentration of non-federal lands occur.

2.5.4.1.1 State Actions

Most future actions by the state of Oregon are described in the *Oregon Plan for Salmon and Watershed* measures, which include the following programs designed to benefit salmon and watershed health:

- Oregon Department of Agriculture water quality management plans;
- Oregon Department of Environmental Quality development of total maximum daily loads (TMDLs) in targeted basins and implementation of water quality standards;
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions;
- ODFW and OWRD programs to enhance flow restoration;
- OWRD programs to reduce over-appropriation of water sources;
- ODFW and Oregon Department of Transportation programs to improve fish passage and culvert improvements/replacements;

- Oregon Department of Forestry state forest habitat improvement policies and the Board of Forestry pending rules addressing forestry effects on water quality and riparian areas;
- Oregon Division of State Lands and Oregon State Parks Department programs to improve habitat health on state-owned lands;
- Department of Geology and Mineral Industries program to reduce sediment run-off from mines.

If these programs are implemented, they may improve habitat features considered important for bull trout in the Powder River Basin. The Oregon Plan also identifies private and public cooperative programs for improving the environment for listed aquatic species. The success and effects of such programs will depend on the continued interest and cooperation of the parties.

In the past, Oregon's economy has depended on natural resources, resulting in intense resource extraction. Changes in the State's economy have occurred in the last decade and these are likely to continue, with less large-scale resource extraction, more targeted extraction, and significant growth in other economic sectors. Growth in new businesses, primarily in the technology sector, is creating urbanization pressures and increased demands for buildable land, electricity, water supplies, waste-disposal sites, and other infrastructure.

Some of the state programs described above are designed to address these impacts. Oregon also has a statewide, land-use-planning program that sets goals for growth management and natural resource protection. These programs may help lessen the potential for the adverse effects discussed above.

2.5.4.1.2 Local Actions

Local governments in Oregon are considering ordinances to address effects on aquatic and fish habitat from different land uses. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore, the effect of such actions on listed aquatic species. Overall, unless beneficial programs are comprehensive, cohesive, and sustained in their application, it is not likely that local actions will have measurable positive effects on listed aquatic species and their habitat and may even contribute to further degradation.

2.5.4.1.3 Private Actions

The effects of private actions on bull trout are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses, provided their actions do not result in "take". Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

Illegal and inadvertent harvest of bull trout is considered a cumulative effect. Harvest can occur through both misidentification and deliberate catch. Schmetterling and Long (1999, p. 1) found that only 44 percent of the anglers they interviewed in Montana could successfully identify bull trout. Being aggressive piscivores, bull trout readily take lures or bait (Ratliff and Howell 1992, pp. 15-16). Spawning bull trout are particularly vulnerable to harvest because the fish are easily observed during autumn low flow conditions. Hooking mortality rates range from 4 percent for non-anadromous salmonids with the use of artificial lures and flies (Schill and Scarpella 1997, p. 1) to a 60 percent worst-case scenario for bull trout taken with bait (Cochnauer et. al. 2001, p. 21). Thus, even in cases where bull trout are released after being caught, some mortality can be expected.

2.5.4.1.4 Summary of Cumulative Effects to Bull Trout

Non-Federal actions are likely to continue affecting bull trout in the Powder River Basin. The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape covered by this consultation, the geographic and political variation in the action area, the uncertainties associated with government and private actions, and ongoing changes to the region's economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the population and growth trends identified in this section, adverse cumulative effects are likely to increase. Although state, Tribal, and local governments have developed plans and initiatives to benefit listed aquatic species within the action area, they have yet to be implemented or have not been implemented to the point where it has measurably benefited the status of bull trout.

An additional cumulative effect to bull trout in the Powder River is global climate change. Warming of the global climate seems quite certain. Changes have already been observed in many species' ranges consistent with changes in climate (Independent Scientific Advisory Board 2007, p. iii; Hansen et al. 2001, p. 767). Changes in hydrology and temperature caused by changing climate have the potential to negatively impact aquatic ecosystems in Idaho and Oregon, with salmonid fishes being especially sensitive. Average annual temperature increases due to increased carbon dioxide are affecting snowpack, peak runoff, and base flows of streams and rivers (Mote et al. 2003, p. 45). Downscaled regional climate models for the Columbia River basin predict a general air temperature warming of 1.0 to 2.5 °C (1.8 to 4.5 °F) or more by 2050 (Rieman et al. 2007, p. 1552). This predicted temperature trend may have important effects on the regional distribution and local extent of habitats available to salmonids (Rieman et al. 2007, p. 1552), although the relationship between changes in air temperature and water temperature are not well understood.

Climate change will likely interact with other stressors, such as habitat loss and fragmentation (Rieman et al. 2007, pp. 1558–1560; Porter and Nelitz 2009, p. 3); invasions of nonnative fish (Rahel et al. 2008, pp. 552–553); diseases and parasites (McCullough et al. 2009, p. 104); predators and competitors (McMahon et al. 2007, pp. 1313–1323; Rahel et al. 2008, pp. 552–553); and flow alteration (McCullough et al. 2009, pp. 106–108), rendering some current spawning, rearing, and migratory habitats marginal or wholly unsuitable. Increased frequency and severity of flood flows during winter can adversely affect incubating eggs and alevins in the streambed and over-wintering juvenile fish. Eggs of fall spawning fish, such as bull trout, may suffer high levels of mortality when exposed to increased flood flows (Independent Scientific Advisory Board 2007, p. iv).

The Powder River below Mason Dam is currently not cold enough for bull trout spawning, incubation, and juvenile rearing. In areas such as the Powder River basin that already have degraded water temperatures and are at the southern edge of the bull trout's range, bull trout may already be at risk of impacts from current as well as future climate changes.

2.5.4.2 Cumulative Effects – Bull Trout Critical Habitat

Cumulative effects from a variety of activities are likely to continue to effect critical habitat throughout the action area. Activities include, but are not limited to, industrial and residential development, road construction and maintenance, mining, fish management activities, recreation, agriculture and grazing, and fire management. Continued operation and maintenance of non-Federal Idaho Power dams in the Hells Canyon complex would continue to contribute to degradation of critical habitat elements as described in environmental baseline. The state fish and wildlife agencies exclusively manage the fisheries within the action area including the stocking and regulations that favor the presence of individual species. Effects from stocking of nonnative species throughout the mainstem rivers and from angling activities would continue to affect bull trout and their critical habitat through direct competition, hybridization, and predation.

Watershed assessments and other education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

Water discharge and temperatures are impacted by changes and variability in regional climate across the Columbia River basin. Seasonal variation in the Columbia River discharge is impacted by winter precipitation amounts and snowpack depths in higher elevation areas throughout the basin. Possible future climate warming across the basin has anticipated impacts on snowpack and runoff patterns.

Climate change has the potential to profoundly alter the aquatic habitat through both direct and indirect effects. Effects would be evident in alterations of water yield, peak flows, and stream temperature. Future projections suggest that the Pacific Northwest may gradually become wetter than historical conditions. This is significantly different from projections in the southern United States. Warming trends may lead to a shift in cool season precipitation, resulting in more rain and less snow which would cause increased rainfall-runoff volume during the cool season accompanied by less snowpack accumulation. Future climate projections based on hydrologic analyses suggest that warming and associated loss of snowpack will persist over much of the western United States, affecting the availability and timing of snowmelt. Decreased snowpack volume also could result in decreased groundwater infiltration, runoff, and ultimately decreased contribution to summer base flow in rivers.

With a warming climate, thermally suitable bull trout spawning and rearing areas are predicted to shrink during warm seasons, in some cases very dramatically, becoming even more isolated from one another under moderate climate change scenarios (Rieman et al. 2007, pp. 1558–1562; Porter and Nelitz 2009, pp. 5–7). Bull trout spawning and early rearing areas are currently largely constrained by low fall and winter water temperatures that define the spatial structuring of local populations or habitat patches across larger river basins (Rieman et al. 2007, p. 1553). Increases in water temperature may cause a shift in the thermal suitability of aquatic habitats (Poff et al. 2002, p. iii). Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features as described in the PCEs.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to ensure the persistence of bull trout and other species dependent on cold water. Thermal refugia are important for providing bull trout with patches of suitable habitat while allowing them to migrate through or to make foraging forays into, areas with above optimal temperatures. Populations that are currently connected may become thermally isolated, which could accelerate the rate of local extinction. Current studies demonstrate the ability of bull trout to temporarily tolerate conditions outside their previously defined ranges. The life history of adfluvial bull trout may adapt to more fluvial habitats, using reservoir environments seasonally as is currently observed in some reservoirs, as long as migration corridors are open.

2.6 Conclusion

2.6.1 Bull Trout

The Service has reviewed the current status of the bull trout, the environmental baseline in the action area, effects of the proposed action, and cumulative effects, and it is our conclusion that the proposed action (operations and maintenance associated with Reclamation facilities in the Powder River system) is not likely to jeopardize the species continued existence for the following reasons.

- The bull trout populations in the Powder River system are assumed to be resident; however a migratory component may still exist. Occasional “flushing” of bull trout into Phillips Reservoir does occur so operations may still have adverse effects, and although they are likely to be minimal, they are not discountable.
- Reservoir operations will seasonally decrease availability of habitat in the reservoir but the inactive pool maintains storage that protects the prey base at sufficient levels to maintain prey diversity for migratory bull trout that may over-winter.
- No bull trout are anticipated to be entrained through the intake at Mason Dam due to the position of the intake (low in the pool), water temperatures, dissolved oxygen levels, and flow at the mouth of the intake.

Therefore, the project is not expected to appreciably reduce either the survival or recovery of bull trout. The amount of incidental take predicted to result from the proposed action is small and the spatial scope (limited) of that incidental take means the incidental take will not have a meaningful impact on reproduction, numbers, or distribution of bull trout.

2.6.2 Bull Trout Critical Habitat

The Service has reviewed the current status of bull trout critical habitat, the environmental baseline in the action area, effects of the proposed action, and cumulative effects, and it is our conclusion that the Reclamation’s O&M of the upper Snake River projects is not likely to destroy or adversely modify designated critical habitat for bull trout. Although the PCEs of bull trout critical habitat may be adversely affected in some portions of the action area, we expect operational indicators to minimize the frequency and duration of effects. Most adverse effects will occur when reservoir volumes (conservation pools) are low, causing a loss of cover and habitat and reduction in water quality, and when winter flows are low.

While adverse effects will occur within the action area as described in this Opinion, given the amount of habitat in the area, combined with the habitat in the Snake and Columbia rivers systems, and the significance and extent of effects, impacts to critical habitat will not affect the functioning or conservation value of the Boise River, Payette River, Malheur River, or Powder River. Likewise, impacts to critical habitat will not reduce the functionality of the Southwest Idaho River Basin, Malheur River Basin, Powder River Basin CHUs, or by extension, critical habitat rangewide in providing for the conservation of the bull trout. Critical habitat rangewide will remain functional to serve its intended recovery role for the bull trout. Therefore, we conclude that the project will not destroy or adversely modify designated critical habitat.

2.7 Incidental Take Statement

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species, respectively, without specific exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm in the definition of take in the Act means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The Bureau of Reclamation has a continuing duty to regulate the activity covered by this incidental take statement. If the Bureau of Reclamation fails to assume and implement the terms and conditions the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Bureau of Reclamation must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

The incidental take statement and associated terms and conditions from the 2005 opinion remain valid. Although Reclamation has conducted numerous studies in compliance with the T&Cs, the new information does not indicate an effect of a different degree or nature than was previously considered by the Service in the 2005 opinion. The incidental take statement herein is limited to bull trout within the Powder River as described below.

2.7.1 Form and Amount or Extent of Take Anticipated

The Service anticipates that the proposed action may result in incidental take of bull trout in the forms of harm or harassment, including impairing essential behavioral patterns such as breeding, feeding, or sheltering. The expected incidental take will result from the Project’s adverse influence when fish passage to the Upper Powder River and other tributaries (Deer Creek/Lake

Creek) is blocked during annual low reservoir levels or through decreases in the amount of time the reservoir is actually suitable for bull trout due to drawdown/fill times.

Due to the perceived and unconfirmed low overall abundance of bull trout within the Powder River Basin (USFWS 2002b), the likelihood of project activities causing detectable harm and harassment that would be attributable to the Project's activities is low, but not discountable.

Based upon a recent documented encounter with bull trout in Phillips Reservoir, an estimate of bull trout incidental take has been calculated. The estimate provided should be considered a worst-case scenario. As noted in this Opinion, two bull trout were sampled during yellow perch removal operations in the spring of 2011, a high flow year (USBR 2014). No other bull trout have ever been encountered in Phillips Reservoir although gillnet sampling, creel sampling, and boat electrofishing have all been conducted since 1968 during multiple years. Flows reached the 2011 peak level six times between 1991 and 2013 (BOR 2014), or 27 percent of the time. By applying this percentage to the remaining 21 years left in the proposed action, it is expected that an additional 6 (5.7 rounded to 6) high flow events will likely occur. Therefore, it is anticipated that a maximum of 12 bull trout (two bull trout per incident) may be harmed or harassed through activities undertaken as part of the proposed action. The Terms and Conditions for implementing the Reasonable and Prudent Measures contained in this Opinion are anticipated to minimize this level of incidental take.

2.7.2 Effect of the Take

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the bull trout across its range.

2.7.3 Reasonable and Prudent Measures

The Service concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the take of bull trout caused by the proposed action.

- Minimize incidental take of bull trout resulting from operations of Phillips Reservoir (decreased water levels and increased temperatures) and from impaired fish migration above Phillips Reservoir.

2.7.4 Terms and Conditions

- Enhance knowledge of project impacts to bull trout and refine the amount of take anticipated by collaborating with the Service and Oregon Department of Fish and Wildlife to develop and implement a 5-year sampling plan to better determine bull trout use of Phillips Reservoir. The bull trout sampling plan must be completed by March 1, 2015, and must be implemented as soon as funding can be programmed and budgeted.

2.7.5 Reporting and Monitoring Requirement

In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [(50 CFR 402.14 (i)(3)]. Monitoring requirements from the 2005 opinion are still valid.

2.8 Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery programs, or to develop new information on listed species.

- Agency Valley Dam/Beulah Reservoir – Preparation of a reinitiation strategy to address water discharged over the spillway since this has now occurred twice since 2006 and there is only one additional spillway discharge anticipated for the remainder of the life of the Opinion.
- Powder River Basin – Restore bull trout foraging, overwintering, and migratory habitat in mouth of Deer Creek by implementing restoration actions that include the removal of two abandoned road beds that currently act as seasonal fish passage barriers.
- In the Boise River and Payette River Basins – Evaluate how reservoir elevations influence the varial zones of the tributaries, particularly during the fall migration period. If possible, adjust operations to improve depth and structure within the varial zones where needed and to minimize length of the varial zone.

2.9 Reinitiation Notice

This concludes formal consultation on the Bureau of Reclamation's Operations and Maintenance in the Upper Snake River Basin Above Brownlee Reservoir. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if:

1. The amount or extent of incidental take is exceeded.
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion.
3. The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion.
4. A new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

3. LITERATURE CITED

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