



United States Department of the Interior



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01EOFW00-2021-F-0146

Memorandum

To: Larry Salata, Branch Chief for Consultation and Conservation Planning, Ecological Services, Region 9, Portland, Oregon

To: Deputy Area Manager, Columbia-Cascades Area Office
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From: Field Supervisor, Bend Field Office
Bend, Oregon

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Subject: Endangered Species Act Section 7 Biological Opinion regarding the Service's Proposed Issuance of a Section 10(a)(1)(B) Incidental Take Permit (TE89773D-0) for the Deschutes Basin Habitat Conservation Plan and the Bureau of Reclamation's continued Operation and Maintenance of the Deschutes River Basin Project

This memorandum transmits the U. S. Fish and Wildlife Service's (Service) Biological Opinion (attached) on the proposed subject action located in Crook, Deschutes, Jefferson, Klamath, Sherman, and Wasco counties, Oregon, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). This Opinion addresses two actions. The first is the Service's proposed issuance of an ESA section 10(a)(1)(B) incidental take permit (ITP) to the eight irrigation district members of the Deschutes Basin Board of Control and the City of Prineville (collectively referred to as the "prospective DBHCP permittees") for implementation of the Deschutes Basin Habitat Conservation Plan (DBHCP). The eight Deschutes Basin Board of Control irrigation districts are: Arnold Irrigation District, Central Oregon Irrigation District, Lone Pine Irrigation District, North Unit Irrigation District, Ochoco Irrigation District, Swalley Irrigation District, Three Sisters Irrigation District and Tumalo Irrigation District. The second action is the Bureau of Reclamation's (Reclamation) continued operation and maintenance of the Deschutes River Basin Project. Reclamation requested formal consultation on Oregon spotted frog (*Rana pretiosa*; spotted frog), bull trout (*Salvelinus confluentus*), and designated critical habitat for both species. We received Reclamation's request for formal consultation on December 22, 2020.

INTERIOR REGION 9 COLUMBIA-PACIFIC NORTHWEST

IDAHO, MONTANA*, OREGON*, WASHINGTON

*PARTIAL

After reviewing the current status of the species, the environmental baseline, the effects of the proposed action and the cumulative effects, we conclude that the proposed project will not jeopardize the continued existence of the spotted frog or the bull trout. We also conclude that the proposed action will not destroy or adversely modify designated critical habitat for the spotted frog or the bull trout.

The attached Biological Opinion is based on the following information, hereby incorporated by reference:

- The December 2020, Final Deschutes Basin Habitat Conservation Plan (Biota Pacific, 2020), noticed in the Federal Register on November 6, 2020 (85 FR 71086);
- The October 2020, Deschutes Basin Habitat Conservation Plan Final Environmental Impact Statement (DBHCP FEIS) (USFWS 2020a), noticed in the Federal Register on November 6, 2020 (85 FR 71086);
- The December 2020, U.S. Bureau of Reclamation's Final Biological Assessment, December 22, 2020.
- The September 2017 and July 2019, Final Biological Opinions on the Approval of Contract Changes to the 1938 Inter-District Agreement for the Operation of Crane Prairie and Wickiup Dams, and Implementation of Review of Operations and Maintenance and Safe Evaluation of Existing Dams Programs at Crane Prairie and Wickiup Dams, Deschutes Project, Oregon.
- Electronic mail correspondence, telephone conversations, field investigations, meetings between the Service and the prospective DBHCP Permittees between 2008 and 2020;
- References cited in this Opinion; and
- Other information available to the Service.

A complete decision record of this consultation is on file at the Bend Fish and Wildlife Office in Bend, Oregon.

cc: Gregg Garnett, Bend Field Supervisor, Bureau of Reclamation

Endangered Species Act - Section 7 Consultation

Biological Opinion

**The Fish and Wildlife Service Proposed Issuance of an
Endangered Species Act Section 10(a)(1)(B) Incidental Take
Permit for the Deschutes Basin Habitat Conservation Plan**

and

**The Bureau of Reclamation's continued Operation and
Maintenance of the Deschutes River Basin Project**

**U.S. Fish and Wildlife Service Reference:
01EOFW00-2021-F-0146**

Consultation Conducted By:

**U.S. Fish and Wildlife Service
Bend Field Office**

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ACRONYMS AND ABBREVIATIONS

7-DADM	7-day average daily maximum (temperature)
AF	Acre-feet
AID	Arnold Irrigation District
Applicants	collectively, the DBBC districts and Prineville, authors of the DBHCP
Assessment	Biological Assessment
Basin	Deschutes River Basin
BENO	gauge on Deschutes River at Benham Falls
BOR	Bureau of Reclamation
CAPO	gauge on Crooked River at Prineville
CFR	Code of Federal Regulations
cfs	cubic feet per second
Act or ESA	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 <i>et seq.</i>)
CHSU	Critical Habitat Subunit
CHU	Critical Habitat Unit
CLPO	proposed gauge on Crooked River at Lone Pine Bridge
CM	Conservation Measure
Corps	U.S. Army Corps of Engineers
CREO	gauge on Crescent Creek at Crescent Creek Dam
CRPO	gauge at Crane Prairie Dam
CRSO	gauge on Crooked River at Smith Rock State Park
CWA	Clean Water Act
DBBC	Deschutes Basin Board of Control
DPS	Distinct Population Segment
DBHCP	Deschutes Basin Habitat Conservation Plan
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FMO	foraging, migration, and overwintering
FPC	Federal Power Commission
FR	Federal Register
ft ²	square feet
GBD	Gas Bubble Disease
GIS	geographic information system
HCP	habitat conservation plan
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
LPID	Lone Pine Irrigation District
mi	mile(s)
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
NUID	North Unit Irrigation District
OID	Ochoco Irrigation District
Opinion	Biological Opinion
PBF	primary biological feature

PCE	primary constituent element
Project	Deschutes River Basin Project
PRB complex	Pelton Round Butte Hydroelectric Project
Prineville	City of Prineville
PRVO	gauge on Crooked River near Prineville
Reclamation	Bureau of Reclamation
RM	River Mile
RO&M	Reviews of Dam Operations and Maintenance Activities
RPM	Reasonable and Prudent Measures
SEED	Safety Evaluations of Existing Dams
Service	U.S. Fish and Wildlife Service
Services	U.S. Fish and Wildlife Service and National Marine Fisheries Service
SID	Swalley Irrigation District
TDG	total dissolved gas
Tribe	The Confederated Tribes of the Warm Springs Reservation of Oregon
TID	Tumalo Irrigation District
TSID	Three Sisters Irrigation District
WICO	gauge at Wickiup Dam
°C	degree(s) Celsius
°F	degree(s) Fahrenheit

INTRODUCTION

This document represents the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the effects of Federal actions pertaining to irrigation and municipal water management in the Deschutes River Basin (Basin) to Oregon spotted frog (*Rana pretiosa*; spotted frog), bull trout (*Salvelinus confluentus*), and designated critical habitat for both species in Crook, Deschutes, Jefferson, Klamath, Sherman, and Wasco counties, Oregon. This Opinion addresses two Federal actions pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act; ESA). First, this Opinion responds to the U.S. Fish and Wildlife Service's (Service) requirement for intra-Service consultation on the issuance of a section 10(a)(1)(B) permit to the eight irrigation district members of the Deschutes Basin Board of Control and the City of Prineville (collectively, the Applicants) for implementation of the Deschutes Basin Habitat Conservation Plan (DBHCP). The eight Deschutes Basin Board of Control irrigation districts are: Arnold Irrigation District (AID), Central Oregon Irrigation District (COID), Lone Pine Irrigation District (LPID), North Unit Irrigation District (NUID), Ochoco Irrigation District (OID), Swalley Irrigation District (SID), Three Sisters Irrigation District (TSID), and Tumalo Irrigation District (TID). Secondly, this Opinion responds to the Bureau of Reclamations' (Reclamation) December 22, 2020 request for formal consultation with the Service for the continued operation and maintenance of their Deschutes River Basin Project.

1.1 Habitat Conservation Plans and Incidental Take Permits

Section 9 of the ESA prohibits the take of endangered and threatened species without special 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* is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

To obtain an incidental take permit (ITP), an applicant must develop a conservation plan that meets specific requirements identified in section 10(a)(2)(A) of the Act and its implementing regulations at 50 CFR 17.22 (endangered species) and 17.32 (threatened species), and 50 CFR 222.25, 222.27, and 222.31. Among other requirements, the plan must specify the impacts that are likely to result from the taking, the measures the permit applicant will undertake to minimize and mitigate such impacts, and the funding that will be available to implement such measures.

Conservation plans under section 10(a)(1)(B) are known as "habitat conservation plans" or "HCPs" for short. Section 10(a)(2)(B) of the ESA sets forth the statutory criteria that must be satisfied before an ITP can be issued:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
- The applicant will ensure that adequate funding for the plan will be provided;
- The take will not appreciably reduce the likelihood of survival and recovery of the species in the wild; and
- Other measures (if any) that the Secretary of the Interior may require as being necessary or appropriate for the purposes of the plan are implemented.

Because the Act requires the Service to establish that “the taking will not appreciably reduce the likelihood of the survival and recovery the species in the wild” as a pre-condition for issuing an ITP, a permit that satisfies this criterion should also satisfy the first requirement of section 7(a)(2) of the Act: [“... insure that any action authorized, funded, or carried out by (a Federal agency) is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species...”].

1.2 History and Hydrology of the Deschutes Basin

1.2.1 Upper Deschutes River: Headwaters to Bend, OR

The Deschutes River in Central Oregon flows north from its headwaters in the Central Oregon Cascade Mountains to the Columbia River, a total of 252 miles (Figure 1). The Upper Deschutes River is a groundwater and spring-fed system, with highly porous underlying basalt geology. Historically, the Deschutes River had year-round relatively stable flows (Gannett 2001). Since the construction of dams in the Upper Deschutes in the 1930s and 1940s, flows have been managed primarily for irrigation purposes. Consistent with irrigation demand, flows in the winter were highly curtailed to store the maximum amount of water for the upcoming irrigation season; and conversely flows in the summer irrigation season have been extremely high to deliver the maximum volume consistent with State water rights and irrigation demand. Figure 2 depicts the differences between the regulated (with dam) and unregulated (without dam) flows in the Upper Deschutes (USFWS 2017)¹. As described in the *Environmental Baseline* for each species below, these extremely low winter flows and high summer flows have caused physical damage to the river itself and the species that inhabit it. Commitments made in the DBHCP are designed to restore more consistent winter flows, while lowering the summer-scouring flows, thus transitioning back to a more stable hydrologic regime. The spotted frog occupies this reach of the Deschutes River, however none of the covered fish species are present here.

¹ RiverWare modeling has been updated. This is figure 16 from the 2017 Opinion and is included to provide the reader with a broad view of the differences between the regulated and unregulated flows.



3

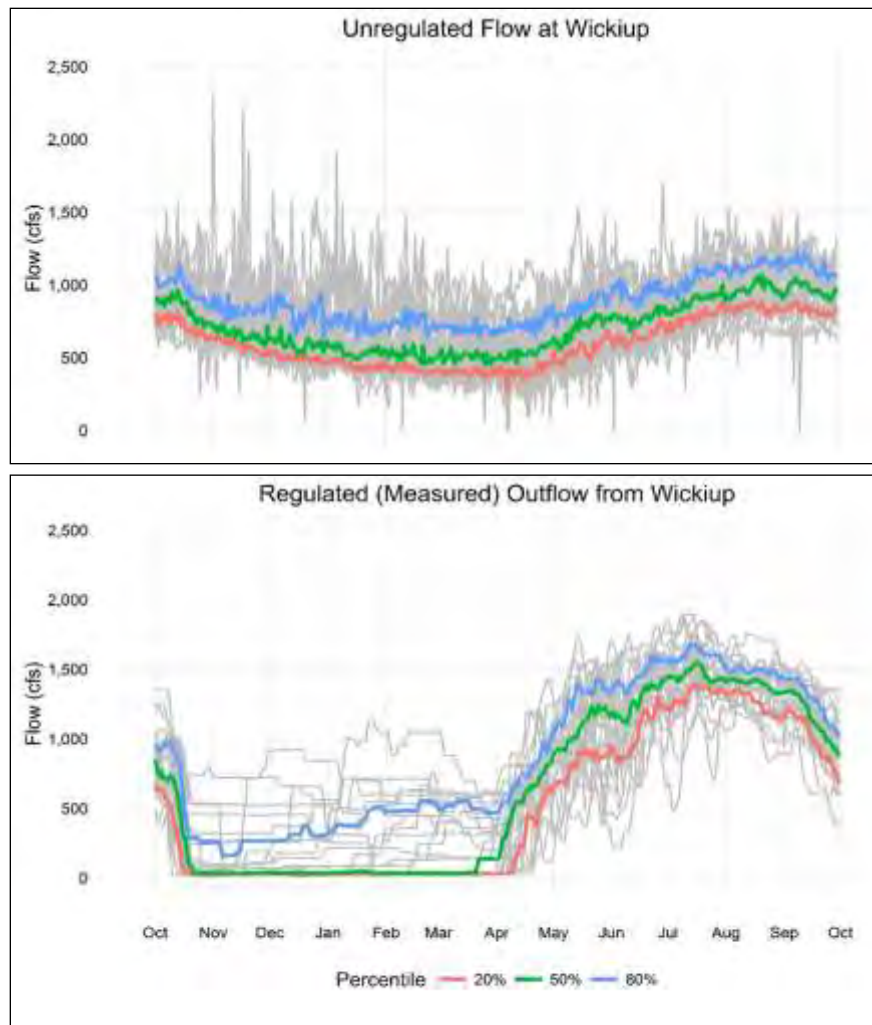


Figure 2. RiverWare-modeled1 unregulated versus regulated (measured) flows out of Wickiup Dam (WICO gauge). Gray lines represent single-year traces for the period spanning 1980 through 2009. Colored lines represent the daily 20th-, 50th, and 80th-percentile exceedance values for the same period.

1.2.2 Middle and Lower Deschutes River: Bend to Lake Billy Chinook to the Columbia River

The Middle Deschutes River is the portion from Bend to and including Lake Billy Chinook. This portion of the Deschutes River consists of large spring inputs and an anadromous blockage at Big Falls, 15 miles above Lake Billy Chinook. Consequently, the DBHCP's covered fish species only occur in a small segment of the Middle Deschutes River. Lake Billy Chinook, formed by the construction of the Pelton Round Butte Hydroelectric Project (PRB complex) in the 1950s and 1960s, is where the Crooked River and Metolius River, tributaries to the Deschutes River, come together. The Lower Deschutes River, below the PRB complex to the Columbia River is a wide, lower gradient reach with habitat for several anadromous fish species and a popular spot for recreational river rafting and fishing. The PRB complex is a 'run-of-river' system, meaning the same volume of flow entering the system leaves the system daily; therefore, flow changes made higher up in the system will continue all the way to the outflow at the Columbia River.

1.2.3 Crooked River

The Crooked River is a tributary to the Deschutes River and similarly had a storage facility (Prineville Reservoir/Bowman Dam) constructed on it in the 1960s. The Crooked River flows for 70.5 miles through canyons and valley reaches, and is a popular fishing location. In November 2019, fish passage was restored at Opal Springs Dam, a small hydro facility at river mile (RM) 0.6 upstream of Lake Billy Chinook that restricted access to fish with its enlargement in 1982. Ochoco Creek is a five mile creek extending from Ochoco Dam, originally constructed in the 1920s but rebuilt in the 1940s, to its confluence with the Crooked River northwest of Prineville, Oregon. McKay Creek flows 37 miles from its headwaters, through irrigated lands, and joins the Crooked River below Ochoco Creek just northwest of Prineville. Chinook salmon and steelhead have been reintroduced into the Crooked River, and bull trout have recently made their way through the Opal Springs Dam fish ladder to once again inhabit the Crooked River subbasin. As explained in more detail the *Environmental Baseline*, the Crooked River subbasin experiences starkly different hydrology than seen in the rest of the Deschutes Basin because of less porous geomorphology and annual precipitation than subbasins with their headwaters in the Cascade Range to the west.

1.2.4 Whychus Creek

Whychus Creek is a 54-mile tributary of the Deschutes River, with headwaters in the Central Oregon Cascade Mountains that flows through Sisters, Oregon and joins the Deschutes River three miles above Lake Billy Chinook. There are no major dam complexes on Whychus Creek. The TSID diversion on Whychus Creek is at RM 24.2 and withdraws a significant portion of instream flows during the irrigation season. One small dam (Plainview Dam, whose 2020 removal has been delayed due to wildfires) and other smaller diversions have also reduced natural flow, impacting habitat for the covered fish species in Whychus Creek.

1.3 DBHCP History of the Deschutes Basin Habitat Conservation Plan

The Service and the National Marine Fisheries Service (NMFS; collectively the Services) have been working with the Applicants on the development of the DBHCP for water management in the Deschutes River Basin for 12 years. The Service has provided the Applicants \$3.3 million in Habitat Conservation Planning grants under section 6 of the Act to develop the DBHCP.

In 2008, a group of seven Central Oregon irrigation districts (AID, COID, NUID, OID, TSID, SID, and TID) formed the Deschutes Basin Board of Control (DBBC) to collectively work towards developing an HCP leading to the issuance of an ITP. Initially the plan was exclusively focused on addressing effects to bull trout and reintroduced steelhead above the PRB complex. Later in 2008, LPID joined the DBBC and the HCP effort. The City of Prineville also joined the planning effort in 2008.

In 2014, the Oregon spotted frog was listed as a threatened species on the Endangered Species List (79 FR 51658). Water management operations were identified as a threat in the listing rule, and the DBHCP effort expanded almost immediately to include the spotted frog.

In 2019, after years of studies, planning, and technical assistance, the DBHCP Applicants submitted a draft DBHCP. The draft DBHCP and a draft environmental impact statement (EIS)

were published in the Federal Register (84 FR 53164) on October 4, 2019, initiating a public comment period. Over 1,600 comments were submitted from Tribal, Federal, State, and local governments; non-governmental organizations; and members of the public. The Applicants refined the DBHCP based on public comment and submitted the Final DBHCP in October 2020. The Final DBHCP and Final EIS were published in the Federal Register on November 6, 2020 (85 FR 71086).

1.4 History of Litigation in the Deschutes Basin Planning Effort

In 2015, the Center for Biological Diversity and Water Watch of Oregon sued Reclamation and five of the DBBC districts (AID, COID, LPID, NUID and TID) for ESA §7 (Reclamation) and §9 (Reclamation/Irrigators) violations related to water management operations and their effects to the spotted frog² (*CBD v. Reclamation*). A motion for preliminary injunction was filed by plaintiffs, but subsequently denied. While not a party to the litigation, the Service provided technical assistance to the Department of Justice regarding the status and habitat needs of the spotted frog in the Upper Deschutes. A Settlement Agreement (*CBD v. Reclamation*, Case 6:15-cv-02358-JR Document 73, Filed 11/09/16) was signed in November 2016, which recognized the need to finish the DBHCP and included interim conservation measures for the spotted frog. The Service consulted with Reclamation under Section 7 on the interim conservation measures, and produced an Opinion in September 2017. Expecting to complete the DBHCP process by 2019, the Opinion included an expiration date of July 2019. While significant progress had been made, the DBHCP was not complete in 2019; therefore, Reclamation reinitiated consultation and the Opinion was extended through December 31, 2020.

1.5 History of the Crooked River Act (2014)

The Crooked River Collaborative Water Security and Jobs Act of 2014 (Crooked River Act; Public Law No: 113-244) was enacted by Congress to amend the 1968 Wild and Scenic Rivers Act to adjust the wild and scenic boundary of the Crooked River, and to allocate the total volume of storage capacity within Prineville Reservoir to contracted irrigation, instream mitigation for the City of Prineville groundwater pumping, and for downstream fish and wildlife purposes. The Crooked River Act therefore allocates the total volume of storage capacity within Prineville Reservoir to satisfy these three purposes. The Act established a “first fill” priority for existing irrigation water contracts and City of Prineville mitigation water. The Act also allocated water stored in Prineville Reservoir to be used to irrigate additional lands in the vicinity of McKay Creek, to reduce irrigation diversions from the creek and improve instream flows. The Act

The Crooked River Act directed Reclamation to develop a Dry Year Management Plan and requires them to consult with the Services to develop an annual release schedule for the ‘uncontracted’ (fish and wildlife) storage water that “maximizes, to the maximum extent practicable, benefits to downstream fish and wildlife.”

1.6 History of Consultation

Beginning in 2000, Reclamation and the Services consulted on the ongoing operation and maintenance of Reclamation’s Deschutes River Basin Project (Project). In 2003, Reclamation

² Center for Biological Diversity v. U.S. Bureau of Reclamation, 6:15-cv-02358-JR (D. Oregon).

submitted an Assessment to the Service, analyzing the effects of the Project's operation and maintenance activities to the Columbia River Distinct Population Segment (DPS) of bull trout and bull trout proposed critical habitat (Reclamation 2003a, 2003b). The Service requested additional information and analysis from Reclamation about the potential effects of Project operations on the species. Reclamation submitted an additional analysis of potential Project impacts on March 8, 2004, and determined that the proposed action was not likely to adversely affect the species or proposed critical habitat (Reclamation 2004). The Service issued a letter of concurrence for this determination on May 28, 2004 (USFWS 2004a).

As referenced in the *History of Litigation in the Deschutes Basin Planning Effort* section above, Reclamation initiated formal consultation with the Service by submitting an Assessment in 2016 as a result of the Settlement Agreement in the *CBD v. Reclamation* case. Reclamation analyzed the effects of approval of amendments to the 1938 Inter-District Agreement and its ongoing dam safety, inspection, and maintenance activities to the spotted frog and spotted frog critical habitat (Reclamation 2016). The Service issued a Biological Opinion on September 29, 2017 (USFWS 2017) that expired two years from issuance. The Opinion recognized the upcoming completion of the DBHCP and the Settlement Agreement when establishing an expiration of two years. In 2019, when it was apparent that the DBHCP would not be completed prior to the expiration of the Service's 2017 Opinion, Reclamation requested reinitiation of consultation. The Service issued another Opinion in 2019 on the same activities analyzed in the 2017 Opinion plus additional maintenance activities for the same geography, species, and critical habitat. The Service's 2019 Opinion has an expiration date of December 31, 2020; again recognizing the upcoming (now current) consultation for the Service's DBHCP permit decision and associated Reclamation activities.

Reclamation has determined that baseline conditions, effects to listed species, and/or project actions have sufficiently changed since the initial 2004 Project consultation, requiring reinitiation of consultation with the Services. These conditions include reestablishment of fish passage above the PRB complex in 2012 by PGE and the physical return of adult fish to the upper Deschutes Basin, final designation of critical habitat for bull trout in 2005 and 2010 (70 FR 56211 and 75 FR 63898), listing of Oregon spotted frog as threatened under the Act in 2014 (79 FR 51657 51710), designation of spotted frog critical habitat in 2016 (81 FR 29335 29396), other restoration actions (e.g., establishment of interim trap and haul fish passage at Opal Springs Dam on the Crooked River in 2012, and completion of a permanent fish ladder in late 2019), and finally the completion of the DBHCP, which includes elements requiring Reclamation approval for implementation.

The Service has been engaged with Reclamation in the development of materials and information necessary for reinitiation of formal consultation for over 3 years. Following is a summary of important correspondence and meetings relevant to our consultation with Reclamation and the development of their final Assessment and this Opinion.

1. July 29, 2017 – The Service signed the FWS 2017 Opinion, with an expiration date of July 31, 2019

2. June 1, 2018 – The Service met with Reclamation staff, Carolyn Chad, to discuss which items would be covered by Reclamation’s Assessment and which were covered in the DBHCP
3. September 11, 2018 – The Service met Reclamation staff, Carolyn Chad, to discuss the Deschutes and Crooked River ESA section 7 consultation schedule
4. October 29, 2018 – The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Gregg Garnett, Scott Willey, Scott Hoefer, and Rick Rieber, to kick-off the ESA section 7 consultation process
5. November 16, 2018 – The Service met Reclamation staff, Scott Hoefer, to discuss the Oregon spotted frog analysis
6. December 22, 2018 to January 25, 2019 – Federal government shutdown; the Service staff were precluded from working
7. February 14, 2019 – The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Gregg Garnett, Scott Willey, and Scott Hoefer, to discuss Reclamation’s actions in the Assessment
8. May 2019 to July 2019 – The Service met with Reclamation staff as outlined in the FWS 2019 Opinion on reinitiation of the FWS 2017 Opinion.
9. July 26, 2019 – The Service signed the 2019 Opinion with an expiration date of December 31, 2020
10. January 7, 2020 – The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Gregg Garnett, Scott Willey, and Scott Hoefer, to discuss Reclamation’s implementation of the Crooked River Act for the Assessment
11. January 9, 2020 – The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Gregg Garnett, Scott Willey, Scott Hoefer, and Kavian Koleini, to discuss the Oregon spotted frog analysis for the Assessment
12. August 10, 2020 – The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Candy McKinley, Gregg Garnett, Scott Willey, Scott Hoefer, and Pam Druliner, to discuss technical aspects of the Crooked River Act’s implementation
13. August 20, 2020 to December 18, 2020 - The Service and NMFS staff, Scott Carlon, met with Reclamation staff, Carolyn Chad, Gregg Garnett, and Scott Willey, to discuss details of the Crooked River Act, total dissolved gas effects, and the McKay water switch
14. December 22, 2020 – Reclamation submitted its final Assessment

A complete record of this consultation is on file at the Service’s Bend Field Office.

BIOLOGICAL OPINION

2 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 area³). 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” (50 CFR 402.02). The action area analyzed in this Opinion includes: Crescent Creek from Crescent Lake Dam to the confluence with the Little Deschutes River; and the Little Deschutes River from the confluence of Crescent Creek to the confluence of the Deschutes River; Crane Prairie and Wickiup reservoirs; the Deschutes River between these two reservoirs; the mainstem Deschutes River downstream of Wickiup Dam to the city of Bend, Oregon (including off-channel areas hydrologically connected to the Deschutes River); the Deschutes River from the City of Bend, Oregon to the confluence of the Columbia River; Clear Lake Dam and the White River from Wasco Dam to the confluence of the Deschutes River; Whychus Creek to the confluence of the Deschutes River; Prineville Reservoir and the Crooked River from Bowman Dam to Lake Billy Chinook; Ochoco Dam and Ochoco Creek from Ochoco Dam to the confluence of the Crooked River; and McKay Creek to the confluence of the Crooked River.

During the multi-year development of the DBHCP and this subsequent consultation, the Service worked closely with Reclamation and the Applicants to address the various regulatory requirements for each party under sections 7 and 10 of the Act. Many of these activities would not occur but for implementation of the proposed action (is interrelated and interdependent to the proposed action) to the extent that separating the effects of all specific actions and assigning them exclusively to Reclamation or the Applicants is not practicable or feasible. The Service, in conjunction with the other parties involved, determined that it is more practical and gives a more complete picture of the extent of effects to issue one Opinion that addresses the effects for both the Federal agencies’ (the Service and Reclamation) formal section 7 consultation and the section 10(a)(1)(B) incidental take⁴ permit application by the DBHCP Applicants. NMFS is similarly issuing a single Opinion for effects pertaining to their trust species: Middle Columbia River steelhead trout (*Oncorhynchus mykiss*), which is listed as threatened under the Act, and

³ The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment.

⁴ Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened animal species, respectively. 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 is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

sockeye salmon (*O. nerka*), which is unlisted however included in the DBHCP in the event it does become listed during the life of the DBHCP.

This section of the Opinion contains brief descriptions of the Federal agency actions for which section 7 consultation was requested; the Applicants' actions proposed to receive incidental take coverage including the mitigation, conservation, and other critical sections of the DBHCP; and the amount and types of incidental take resulting from these actions. These brief descriptions are not intended to fully describe or document these actions. This consultation addresses the complete activities as described in full in the DBHCP (Biota Pacific 2020), final Biological Assessment, (Reclamation 2020), and final EIS (USFWS 2020a). The following sections are adapted from the description of the proposed action contained in these final documents, and information contained in them are incorporated into this Opinion by reference, in full.

Notwithstanding the incorporation of the abovementioned documents by reference, the analysis and conclusions reached in this Opinion are exclusively those of the Service and this issuing office.

2.1 Project Overview

The proposed Federal actions –carried out, funded, or authorized– that are addressed in this consultation modify the timing and magnitude of flow in the Deschutes River and a number of its tributaries in Central Oregon through the storage, release, diversion, and return of irrigation water.

The first of the two Federal actions described is the Service's proposed issuance of a permit authorizing incidental take under section 10(a)(1)(B) of the Act for non-Federal actions in implementing the DBHCP by the Applicants. A summary of the non-Federal actions is provided within the *U.S. Fish and Wildlife Service Proposed Action* subsection below (Section 2.1.1.), with a full description in the DBHCP (Biota Pacific 2020).

The second Federal action described is Reclamation's proposed continued operation and maintenance of the Deschutes River Basin Project (Project), which is comprised of the individual Deschutes Project, Crooked River Project, and Wapinitia Project. A summary of these Reclamation projects and actions pertaining to them is provided in the *Bureau of Reclamation Proposed Action* subsection below (Section 2.1.2), with a full description provided in the Assessment (Reclamation 2020).

The action area affected by these two Federal actions consists of the Deschutes River and its tributaries as defined above and in section 2.2 *Action Area*. The activities covered involve a network of water management facilities owned and operated by the Applicants, Reclamation, or a mix thereof. These facilities, and the corresponding activities that pertain to them, occur within six mainstem and tributary reaches of the Basin (Figure 1):

- 1) the Little Deschutes River and Crescent Creek;
- 2) Upper Deschutes River;
- 3) Middle Deschutes River;
- 4) Lower Deschutes River;
- 5) Whychus Creek; and
- 6) Crooked River subbasin (Crooked River and Ochoco, McKay, and Lytle creeks).

Each Federal action includes activities that are associated with identified structures or features, such as dams, reservoirs, diversions (where irrigation water is withdrawn from natural waterbodies), or returns (where irrigation water returns to natural waterbodies). This Opinion covers the operation and maintenance of five major dam-reservoir facilities in the Basin, and the diversions, returns, wells, and various other infrastructure associated with them. These dam-reservoir facilities include Crescent Lake Dam/Reservoir on Crescent Creek, Crane Prairie Dam/Reservoir and Wickiup Dam/Reservoir in the Upper Deschutes River subbasin, and Ochoco Dam/Reservoir and Bowman Dam/Prineville Reservoir within the Crooked River subbasin (Table 1). These facilities and their operation and management are described in more detail in the following subsections.

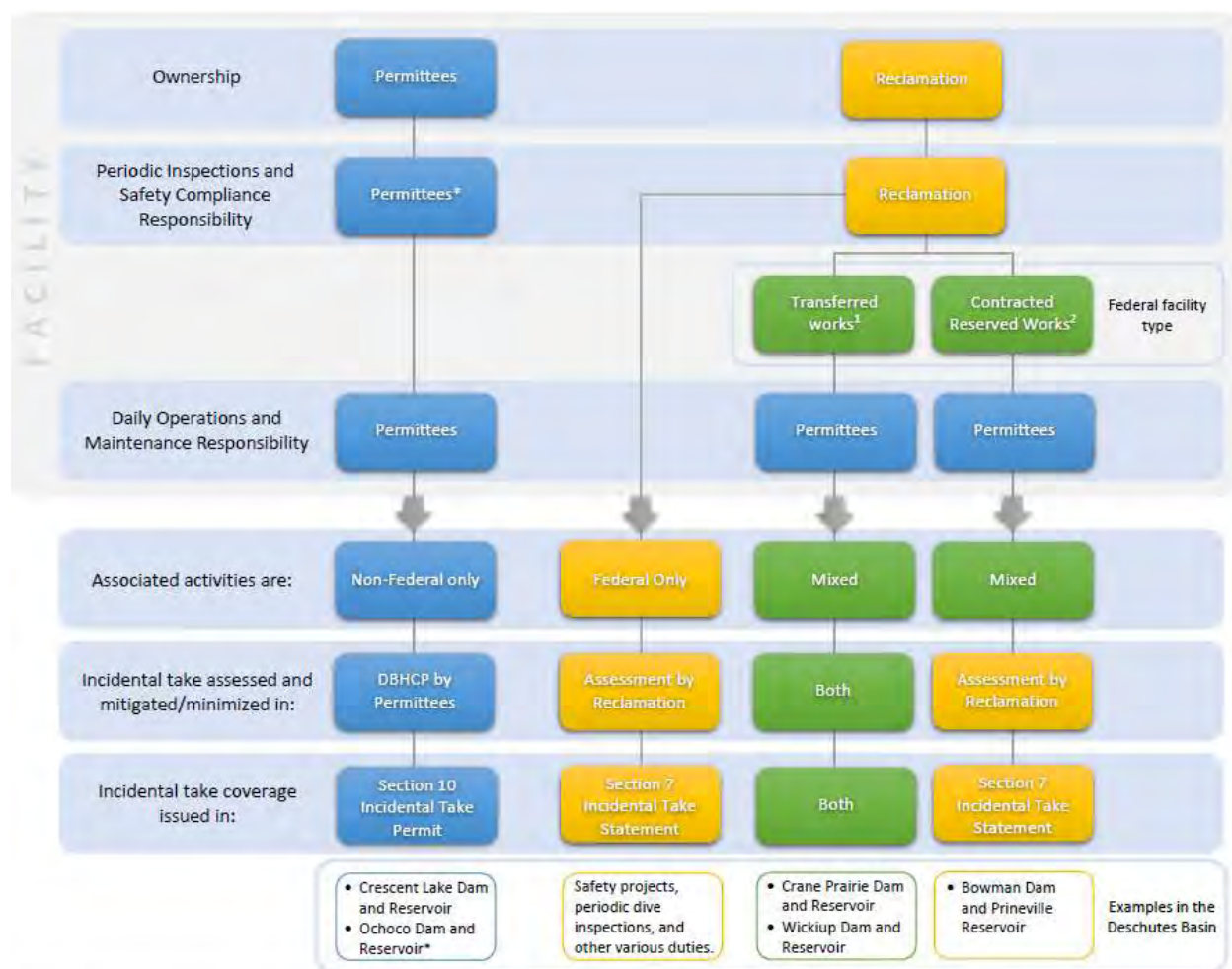
A sixth dam-reservoir facility in the Basin, the Pelton Round Butte Hydroelectric Project (PRB complex), lies within the action area downstream of the irrigation dams covered in the DBHCP but is owned, operated, and maintained by Portland General Electric (PGE) and the Confederated Tribes of the Warm Springs Reservation (Tribe) under license from the Federal Energy Regulatory Commission (FERC) and is not covered in the DBHCP or this Opinion because there are no (known) Oregon spotted frogs (spotted frogs) in that section of the Deschutes River, the PRB complex is operated and maintained by other parties, and the Service consulted on the effects to bull trout from relicensing of the facility in 2004 (USFWS 2004b). The PRB complex spans several miles and consists of a series of three dams: the Round Butte Dam at the upstream end that forms Lake Billy Chinook at RM 117, the Pelton Dam forming Lake Simtustus about 7 miles downstream of Round Butte Dam, and the Reregulating Dam/Reservoir about 2.5 miles

Table 1 Storage Reservoirs and Dams in the Deschutes Basin

Facility	Surface Water	Ownership	Operation/ Maintenance	Description	Effects assessed in
Crescent Lake Dam and Reservoir	Crescent Creek	TID	TID	In-channel facility to store water for TID	DBHCP
Ochoco Dam and Reservoir	Ochoco Creek	OID	OID	In-channel facility to store irrigation water for OID and provide flood control	DBHCP and Assessment
Crane Prairie Dam and Reservoir	Upper Deschutes River	Reclamation	COID (transferred work)	In-channel facility to store water for COID, AID, LPID, and NUID	DBHCP and Assessment
Wickiup Dam, East Dike, South Dike, and Reservoir	Upper Deschutes River	Reclamation	NUID (transferred work)	In-channel facility to store water for NUID	DBHCP and Assessment
Bowman Dam and Prineville Reservoir	Crooked River	Reclamation	OID (reserved work)	In-channel facility to store water for NUID, OID, and City and provide flood control	Assessment
Pelton Round Butte Complex	Lower Deschutes River	PGE and Tribe	PGE and Tribe	Not covered in this Opinion	N/A

below Pelton Dam at RM 100.5. While the PRB complex is not addressed in this consultation, the facility creates a distinct separation point between the upper/middle and lower portions of the Basin, and is thus important to describe for context of the proposed activities and the geographies in which they lie.

Both Federal actions contain multiple components as well as a mix of both Federal and non-Federal activities, which are described briefly in the subsections that follow. A generalized overview of how incidental take for these activities was organized, assessed, and will be subsequently covered pursuant to sections 7 and 10 of the Act are illustrated in Figure 3, based on the various facility ownerships and operational authorities in the Basin. More detailed explanations for how this distribution was determined and organized by DBHCP collaborators is described in the DBHCP Background and Development subsection below. This diagram represents a generalization only and there may be exceptions or components of the actions that do not strictly follow one of these outlined pathways (e.g., Ochoco Dam, as noted in Figure 3).



*Ochoco Dam is owned and operated by OID but Reclamation retains authority for periodic inspection and safety compliance under Section 12 of the Dam Safety Act.

¹ Transferred works are those facilities owned by the U.S., but with contractual responsibility of daily operation and maintenance transferred to local irrigation districts. Transferred works are financed by the irrigation district while Reclamation retains responsibility for periodic inspection and safety compliance.

² Reserved works are those facilities owned by the U.S. and operated and maintained by Reclamation. Bowman Dam and Prineville Reservoir are reserved works whose operations have been contracted to OID, but Reclamation retains administrative and financial responsibility for the facilities.

Figure 3. Overview of proposed Federal take coverage based on facility ownership and operational responsibilities

2.1.1 U.S. Fish and Wildlife Service Proposed Action

2.1.1.1 Issuance of ESA section 10(a)(1)(B) permits

The Service is proposing to issue a 30-year ITP authorizing incidental take under section 10(a)(1)(B) of the Act for non-Federal actions in the implementation of the Deschutes Basin Habitat Conservation Plan by the Applicants, involving a comprehensive suite of water management activities on the Deschutes River and its tributaries in Central Oregon. The nine Applicants include the City of Prineville (Prineville) and the eight irrigation districts in the Basin (Figure 1), which consist of the following:

- Arnold Irrigation District (AID)
- Central Oregon Irrigation District (COID)
- Lone Pine Irrigation District (LPID)
- North Unit Irrigation District (NUID)
- Ochoco Irrigation District (OID)
- Swalley Irrigation District (SID)
- Three Sisters Irrigation District (TSID)
- Tumalo Irrigation District (TID)

The permit application, received by the Service on August 30, 2019, addresses incidental take resulting from non-Federal activities related to the irrigation water management of the Deschutes River Basin. This management includes the storage, release, diversion, and return of water by the irrigation districts, and groundwater withdrawals, effluent discharge, and surface water diversions by Prineville. The Applicants seek incidental take coverage for spotted frog and bull trout, which are both species listed as threatened under the Act with designated critical habitat in the action area. Middle Columbia River steelhead trout and sockeye salmon are also included in the permit application; authorization of incidental take for these two NMFS trust species is subject to a separate ITP assessment by NFMS.

The action by the Service to issue an ITP under section 10(a)(1)(B) of the Act requires the Applicants to list the actions for which coverage under the permit is requested. The amount of incidental take that results from the implementation of these actions is then determined. As part of the analysis in this Opinion, the Service has evaluated the effect of that level of incidental take along with the avoidance, minimization, and mitigation measures contained in the DBHCP to make jeopardy determinations under the Act as required by section 7(a)(2). Additionally, section 10(a)(1)(B) incidental take coverage of non-Federal activities associated with Federal facilities extends only to the Applicants and only to the extent that the Applicants have duties or authorities at the Federal facilities. Federal operation and/or oversight is subject to interagency consultation for exemption of take under section 7 of the Act, and is also addressed in this Opinion. Future implementation of the proposed action may require additional environmental compliance under other statutes (e.g., National Environmental Policy Act, Clean Water Act).

The DBHCP is a single plan that must be implemented as a whole by all of the Applicants, and the ITP will be issued and remain valid on the basis of the whole DBHCP being implemented. The Service initiated formal consultation on November 6, 2020, addressing the effects of ITP issuance for the DBHCP as it pertains to spotted frog, bull trout, and critical habitat for both species. The DBHCP, ITP, and this consultation will have concurrent terms of 30 years.

2.1.1.2 DBHCP Background and Overview

DBHCP Background and Development

As described above, the nine Applicants who developed the DBHCP consist of the irrigation districts in the Basin and the City of Prineville. All eight irrigation districts are quasi-municipal corporations that were formed and operate under Oregon State law to distribute water to irrigator patrons and have been in existence since the early 20th century. The districts lie along and use the waters of the Deschutes River and its tributary waters. Collectively, the districts serve over 7,500 patrons and provide water to nearly 151,000 irrigated acres. The City of Prineville operates City-owned infrastructure and provides essential services including public safety, municipal water supply, and sewage treatment for about 9,900 residents. The total area within the city limits and urban growth boundary is about 9,500 acres and lies at the confluence of the Crooked River and Ochoco Creek.

Oregon law requires the irrigation districts to provide water to their patrons, consistent with the water rights pursuant to which the districts provide such water, in the amounts and at the times specified in the water rights [ORS 545.025, 545.22]. Similarly, the City of Prineville owns and operates its municipal water system, and, in so doing, is required to comply with the Oregon Drinking Water Quality Act of 1981 to ensure safe, reliable domestic water to its citizens [ORS 225.020, 448.123].

To deliver water to their patrons, the Applicants alter the timing and magnitude of flow in the Deschutes River and a number of its tributaries through surface water and groundwater manipulation and use. These changes in hydrology have altered the natural habitat conditions and pose other measurable adverse effects to spotted frogs and bull trout in the Basin, resulting in incidental take of these species. In the Basin, the historical impacts on the diversity of sites across this broad geography make it challenging, and likely not possible, to design a water management approach that could be implemented to prevent all take of Oregon spotted frog and other covered species. Further, a no-take scenario would likely involve severe restrictions to water supply operations that may preclude the Applicants from effectively delivering irrigation water and would likely conflict with existing State and Federal law, including Basin water rights. Therefore, a no-take scenario was considered to be not realistic, reasonable, or feasible because it would not resolve covered species conflicts with water supply delivery and would require severe restriction or substantial reduction of agricultural water supply in the basin without certainty of preventing take.

To continue their otherwise lawful uses of water and comply with the ESA, the Applicants applied for an ITP that would exempt them from the section 9 prohibitions. As required of their application for an ITP under section 10(a)(2)(A) of the Act, the Applicants developed the DBHCP, which describes the anticipated effects of their activities and how those impacts will be minimized or mitigated to ensure the conservation, and continued path to recovery, of Oregon spotted frog and bull trout (see next section for summary).

To carry out their minimization and mitigation actions such as management of streamflows in much of the Deschutes and Crooked rivers, the Applicants will have to closely coordinate their

activities with Reclamation because the network of facilities, infrastructure, and authorities in the Basin are so highly coordinated and mixed. Many facilities in the Basin are Federally-owned by Reclamation but non-Federally operated and maintained, in whole or in part, by the irrigation districts as transferred works⁵ or contracted reserved works⁶ and are therefore included as covered actions in the DBHCP. (Refer to Section 2.1.1.2 for a description of Reclamation's proposed action.)

The high degree of interconnectedness of the Basin's water management authorities and activities required a decidedly collaborative approach in order to successfully develop a conservation plan that sufficiently minimizes and mitigates impacts to listed species to the standard that supports ITP issuance by the Service. The DBHCP is that comprehensive result after years of close coordination between the Applicants, the Services, Reclamation, and multiple other stakeholders in the region. Government agencies and organized non-governmental groups were invited to collaborate in a DBHCP working group beginning in 2008, with multiple ad hoc technical sub-workgroup meetings as the process evolved (HCP 2.3).

Given the complexity of ownership and operations in the Basin, a major part of these collaborator discussions revolved around how to separate the Applicants' actions that would be assessed in the DBHCP from components attributable to Federal authorities and correspondingly addressed by Reclamation in their Assessment. The Applicants, Reclamation, and the Services reached mutual agreement on an organizational split of activities to be included in each party's respective analyses (i.e., the DBHCP, the Assessment, and the Services' Opinions). For example, non-Federal activities associated with routine operation and maintenance of transferred works would be addressed in the DBHCP, whereas non-Federal activities associated with contracted reserved works would be addressed in Reclamation's Assessment.

The activities addressed by each party are briefly summarized in this Opinion but, again, are not intended to be fully described or documented here. For full descriptions of the complete activities addressed by the Applicants for take coverage under section 10 and by Reclamation for take exemption under section 7, refer to the DBHCP and Assessment, respectively. As previously described, it was agreed that NMFS and the Service would each issue a single Opinion addressing the effects for both sets of actions.

⁵ The term *transferred works* means a Reclamation facility at which operations and maintenance of the facility is carried out by a non-Federal entity under the provisions of a formal operations and maintenance transfer contract or other legal agreement with the Bureau of Reclamation.

⁶ The term *reserved works* means buildings, structures, facilities, or equipment that are owned by the Bureau of Reclamation for which operations and maintenance are performed by employees of the Bureau of Reclamation or through a contract entered into by the Bureau of Reclamation, regardless of the source of funding for the operations and maintenance.

Components of the DBHCP

The activities addressed by the DBHCP include the storage, release, diversion, and return of surface water by the eight irrigation districts and the City of Prineville; the withdrawal of groundwater by Prineville for domestic, commercial, and industrial use; and the discharge of treated wastewater by Prineville. Each activity addressed by the DBHCP is associated with an identified structure or feature, such as a dam, reservoir, diversion, or return.

The Applicants seek coverage for operation and maintenance of dams and reservoirs; operation and maintenance of diversions, pumps, and intakes; diversion of water for irrigation; return of flow to a river or creek; and groundwater withdrawal and effluent discharges. These components are described in more detail in the following subsections. Please refer to Chapter 3 of the DBHCP for a complete description of non-Federal actions within the action area.

The conveyance of water by the irrigation districts beyond the point of diversion, the use of irrigation water by patrons beyond the point of delivery, and the use of water by the City of Prineville and its water customers do not result in incidental take of these listed species because the covered species are not present in areas where these activities occur. These activities are therefore not covered in the DBHCP nor discussed further in this Opinion.

The major components of proposed action including the final DBHCP are summarized below, and in Table 2; a complete description of the DBHCP (Biota Pacific 2020) and associated actions is incorporated by reference.

Table 2 Mechanism for ESA coverage by activity and facility within the Deschutes River Basin

District Maintenance or Related Activities	Effects	Frequency	ESA Coverage				
			Crane Prairie	Wickiup	Crescent	Bowman	Ochoco
Daily dam operations/flow management*	Potential changes to water quantity being released downstream of the dam	Daily	DBHCP	DBHCP	DBHCP	Section 7	DBHCP
Diversions and conveyance of water released from storage at Federal and private points of diversion and through canals	Potential effects from operation of fish screens and reduced flow in areas downstream of diversions.	Irrigation Season	DBHCP	DBHCP	DBHCP	DBHCP Section 7 (Private contract diverters)	DBHCP

District Maintenance or Related Activities	Effects	Frequency	ESA Coverage				
			Crane Prairie	Wickiup	Crescent	Bowman	Ochoco
Complete outstanding and future O&M recommendations	Potentially. Can only analyze existing/ outstanding O&M recommendations	As needed	Section 7	Section 7	Section 7	Section 7	Section 7
Maintenance of diversion dams and canals	None	Non-Irrigation Season	N/A	N/A	N/A	N/A	N/A
Repairs and testing of minor equipment associated with the dam such as pumps, motors, generators, etc. that do not directly affect dam operations/releases	None	As needed	N/A	N/A	N/A	N/A	N/A
Elevator Inspections	None	Yearly	N/A	N/A	N/A	N/A	N/A
Balanced regulating gate testing	Short-term effects to flow	Yearly	DBHCP	DBHCP	DBHCP	Section 7	DBHCP
Unbalanced emergency gate testing	Short-term effects to flow	Every 6 Years	DBHCP	DBHCP	DBHCP	Section 7	DBHCP
Replace/repair minor or major components of the outlet works, such as gates, stilling basin, or inlet structure	Reduced flows, reservoir level restrictions or potential dewatering	Infrequent; as needed	DBHCP (Changed Circumstance)	DBHCP (Changed Circumstance)	DBHCP (Changed Circumstance)	Future Section 7	DBHCP (Changed Circumstance)

District Maintenance or Related Activities	Effects	Frequency	ESA Coverage				
			Crane Prairie	Wickiup	Crescent	Bowman	Ochoco
Extraordinary maintenance of major components of the outlet works, such as gates, stilling basin, or inlet structure as identified during Reclamation CFR & PFR inspections	Reduced flows, reservoir level restrictions or potential dewatering	Infrequent; as needed	Future Section 7	Future Section 7	DBHCP (Changed Circumstance)	Future Section 7	DBHCP Changed Circumstance
Periodic dive inspections	Short-term effects to flow	Every 6 Years	Section 7	Section 7	DBHCP	Section 7	Section 7
Periodic and Comprehensive Facility Reviews	Potential short-term effects to flow	Every 4 Years	Section 7	Section 7	DBHCP	Section 7	Section 7
Safety-of-Dams construction projects	Reduced flows, reservoir-level restrictions or dewatering	Infrequent; as needed	Future Section 7	Future Section 7	DBHCP (Changed Circumstance)	Future Section 7	Future Section 7

*Reclamation's actions at Bowman Dam include: storage and release of uncontracted stored water for fish and wildlife purposes, storage and release of City of Prineville mitigation water, storage and release of contracted water for the McKay Water Switch, storage and release of contacted and live flow irrigation water, and flood control operations.

Operation and Maintenance of Storage Dams and Reservoirs

The Applicants operate and maintain four dams and reservoirs: two owned by the Federal government (Crane Prairie Dam/Reservoir and Wickiup Dam/Reservoir) under the jurisdiction of Reclamation, and two owned by the Applicants (Crescent Lake Dam/Reservoir and Ochoco Dam/Reservoir) (Table 1). These dams and reservoirs are generally operated to store irrigation water during the winter months for agricultural use in the Applicants' service areas during the spring and summer. In some cases, reservoirs are also authorized for flood protection. Figure 1 shows the locations of all of the major dams and reservoirs in the Basin.

The DBHCP addresses all irrigation activities (operation, maintenance and safety-related actions) at the Applicant-owned and operated Crescent Lake Dam, and operation and maintenance activities at Ochoco, Crane Prairie, and Wickiup Dams (Figure 1). While Ochoco Dam is owned and operated by OID, Reclamation retains authority for periodic inspection and safety compliance for the facility as specified in Section 12 of the Reclamation Safety of Dams Act. Crane Prairie and Wickiup Dams are Federal facilities operated by the Applicants as transferred works, which means daily responsibilities for operation and maintenance have been transferred to and are financed by the irrigation district while Reclamation retains ownership and

responsibility for periodic inspection and safety compliance. The DBHCP therefore does not address inspection and safety compliance activities at Ochoco, Crane Prairie, or Wickiup Dams; the effects of these Federal activities have been assessed by Reclamation in their Assessment and are addressed later in this Opinion (refer to section 2.1.2 for description of Reclamation's proposed action).

The other two major dam and reservoir facilities in the Basin are not covered in the DBHCP. Bowman Dam and Prineville Reservoir on the Crooked River are operated by OID under contract with Reclamation, but as reserved Federal works Reclamation retains ultimate operational—as well as administrative and financial—responsibility for these facilities. Bowman Dam and Prineville Reservoir are the only reserved works in the Basin. The effects of the operation and maintenance, and inspection and safety compliance of Bowman Dam/Prineville Reservoir to listed species have been assessed by Reclamation in their Assessment and are addressed later in this Opinion (see section 2.1.2). As described previously, the PRB complex is owned, operated, and maintained by PGE and the Tribe under a FERC license with an existing consultation and take coverage and is therefore not covered in this Opinion.

The covered dams and reservoirs have three main general operating seasons, each of which impacts flows and subsequently downstream spotted frog and bull trout in different ways (see sections 4.4 and 5.4, respectively, for discussion of effects):

- Fall and Winter Operations (October/November to early March). Reservoirs are refilled during the fall and winter. Portions of the natural flow are bypassed at the dams to maintain downstream flows, but there is generally no release of stored water.
- Spring Operations (approximately March to June). Reservoir releases for irrigation can begin as early as March, although natural flow (live flow) is often sufficient to meet irrigation demand until mid-summer. When inflow to the reservoirs exceeds irrigation demand in the spring, the reservoirs generally continue to store the extra water.
- Summer Operations (approximately June to October). Summer operations begin when live flow is insufficient to meet irrigation demand. Storage water, if available, is released from reservoirs as necessary to meet anticipated demands.

Operation and Maintenance of Diversions, Pumps, and Intakes

The Applicants also seek coverage for the presence, operation, and maintenance of the water supply diversion structures, pumps, and intakes used for water diversion by the Applicants and their patrons. All diversions of water by the Applicants occur at instream diversion structures or pumps, with the exception of Ochoco Creek where water is released into the main canal from Ochoco Reservoir at the dam. These diversion structures (primarily small dams) are all operated by the Applicants and direct water to intakes with gates that allow for control of the volume and timing of flow into conveyance systems. Pumps require no separate intake structure. All intake structures that could be encountered by bull trout or other listed species are fitted with appropriate fish screens to prevent fish from being entrained into the conveyance systems.

Diversion of Water

Most of the Applicants divert a combination of live streamflow and in-channel reservoir storage. (TID relies on live streamflow and out-of-channel storage from water storage facilities located outside an existing stream channel, and SID relies entirely on live streamflow.) The amount of water diverted by each of the Applicants is determined by the amount of water available for irrigation, the water rights pursuant to each Applicants' authority, operational constraints of the conveyance system, and local demands.

Water delivery for agricultural irrigation typically starts in April and runs through October. Annual diversion rates are highly variable but peak for summer irrigation diversions is typically between May and September, with minimums in April and October. From November through March, some districts intermittently divert live flows for livestock water; these diversions occur at much lower rates than for irrigation water diversions and are subject to weather conditions and water availability.

Return Flow

Return flow, or water delivered from covered facilities that is allowed to flow back into a river or creek, is a covered activity. Return flow comes in the form of either tailwater or spill return flow. Tailwater is water that has been applied to irrigated lands and subsequently allowed to return to a river or creek through surface or groundwater flow. Tailwater is relatively uncommon in the action area and the Applicants seek coverage only of tailwater returns that occur through drains or canals operated by the eight districts. Spill return flow is diverted irrigation water that is returned to a river or creek without being applied to irrigated lands. Spill return flow is typically used to manage canal flows, during emergencies, or at the end of the irrigation season. The amount of spill return flow varies by irrigation district and delivery facility.

Groundwater Withdrawals and Effluent Discharges

Prineville relies on surface water diversions for irrigation of Prineville lands as well as groundwater withdrawals for municipal use. Prineville's municipal water system currently consists of 12 wells, 10 of which draw water from the alluvial aquifer beneath the Prineville Valley floor and two draw from the deep, confined Deschutes Regional Basalt Aquifer, west of the city. Prineville holds eight water right certificates, three water right permits, and one water right transfer that authorize appropriation of groundwater for municipal purposes.

The Applicants also seek coverage for Prineville's discharge of municipal effluent to the Crooked River. The National Pollutant Discharge Elimination System (NPDES) permit that allows Prineville to discharge treated effluent, defines the activity to four locations: a) directly to the Crooked River at river mile (RM) 46.8, b) as irrigation to Prineville-owned Meadow Links Golf Course, c) as irrigation to Prineville-owned pastureland, and d) into a series of recently-created wetlands adjacent to the Crooked River. Discharge directly to the Crooked River occurs only from November 1 through April 30, only when river flows are greater than 15 cubic feet per second (cfs), and only when the dilution ratio of receiving water volume to discharge volume is

at least 15:1. When effluent cannot be discharged directly to the Crooked River and at all times from May 1 through October 31, treated effluent is discharged only to the other three sites.

Conservation Measures

The Applicants and the Services developed biological goals and objectives for management of lands impacted by the DBHCP to minimize and mitigate the effects of the permitted activities to listed species. Twenty-one conservation measures were developed to achieve these goals and objectives (Table 3). Each of the 21 conservation measures addresses the effects of a specific permitted activity or set of activities, such as operation of storage reservoirs or diversions of water. Most of the measures modify an activity to minimize or eliminate its adverse effects to listed species, while a small number of the measures provide offsetting mitigation for adverse effects that cannot be avoided. For covered activities that are currently providing benefits to listed species, the conservation measures include provisions to continue those benefits.

The goal of most of the conservation measures is to modify the hydrology of the waters in the Basin from historical conditions (i.e., past operation of irrigation reservoirs and diversions) to improve conditions for listed species. Table 3 briefly summarizes these conservation measures and their effects to listed species, organized by Basin reach. A complete description of the conservation measures, including rationale and specific implementation actions and parameters, can be found in Chapter 6 of the DBHCP.

Each of the nine Applicants conducts activities that are distinct from the activities of the other eight; however collectively these activities result in impacts to bull trout and spotted frog in the Deschutes Basin. The conservation requirements of the nine Applicants are combined into the single DBHCP to provide a comprehensive conservation strategy to address the effects of the Applicants' activities, but each Applicant is responsible for independently implementing conservation measures to minimize and mitigate the impacts to listed species. As previously described, the DBHCP is a single plan that must be implemented as a whole by all of the Applicants. As such, an ITP authorizing incidental take is issued by the Service strictly on the basis of the whole DBHCP, and its corresponding conservation measures, being implemented.

Monitoring and Adaptive Management

Three types of monitoring will occur under the DBHCP; compliance, implementation and effectiveness. Compliance monitoring will be conducted by the Applicants to verify the conservation measures and other provisions of the DBHCP are being implemented as required (Table 4). The majority of compliance monitoring will involve the collection of data on stream flows and reservoir volumes. Compliance monitoring will also involve verification that fish screens and other structures covered by the DBHCP are being properly maintained, and that contributions to habitat conservation funds are being made. The results of compliance monitoring will be reported to the Services annually.

Implementation monitoring will be done to support conservation measures that have provisions for real-time adjustment based on weather and site-specific conditions of the covered lands (Table 4). Conservation Measure CC-1 (Table 3) specifies that a portion of Crescent Lake

Table 3 DBHCP conservation measures

Conservation Measure	Activity Affected	Species Affected	Summary	Responsible Applicant(s)
Upper and Middle Deschutes River				
CP-1: Crane Prairie Reservoir Operation	Crane Prairie Reservoir	Oregon spotted frog	Modifies operation of the reservoir to improve habitat for all life stages of spotted frogs found within the reservoir. Improves breeding, summer rearing, and overwintering conditions for frogs within the reservoir by reducing annual fluctuations in water surface elevation through adjustments to the range and timing of reservoir storage and drawdown rate. Establishes year-round minimum and maximum water surface elevations for the reservoir as well as minimum instream flow in the Deschutes River below Crane Prairie Dam. Periodic increases in seasonal reservoir fluctuation may also occur if needed to benefit spotted frogs.	COID
WR-1: Wickiup Reservoir Operation	Wickiup Reservoir	Oregon spotted frog	Modifies operation of the reservoir to improve habitat, year-round, for all life stages of spotted frogs in the Deschutes River from Wickiup to Bend. Adjusts the timing and volume of flow in the Deschutes River to 1) regulate flows below the dam during spring months to support habitat conditions during critical frog breeding periods (e.g., flows increased to 600 cfs by April 1 and maintained within specified limits for the remainder of the month); 2) increase minimum flows during fall and winter months per the incremental schedule below to improve overwintering conditions for frogs, while providing wetland habitats (and frogs) the time necessary to recover from historical, artificially low winter flows; 3) decrease flows during summer months, according to a flow cap starting in year 8 per the incremental schedule below, to minimize habitat scour and degradation, while providing wetland habitats (and frogs) the time necessary to recover from historical, artificially high summer flows; and 4) limit ramp up and down rates during the irrigation season to protect frogs from sudden changes in water depth. Fall and winter (September 16–March 31) minimum flow schedule: • Years 1–7: 100 cfs • Years 8–12 : 300 cfs • Years 13–30: 400–500 cfs (Variable minimum flow between 400 and 500 cfs in years 13–30 determined based on a tool to be developed collaboratively by Service and the Applicants in consultation with OWRD and Reclamation.) Irrigation season flow limits (April 1–September 15): • Years 8–12 : Not more than 1,400 cfs for more than 10 days per year • Years 13–30: Not more than 1,200 cfs for more than 10 days per year Fall and winter minimum flows increase above those listed for years 1–12 in proportion to the amount of live flow made available to NUID during the prior irrigation season as a result of the piping of COID-owned canals after the date of ITP issuance and once approved by OWRD.	NUID

Conservation Measure	Activity Affected	Species Affected	Summary	Responsible Applicant(s)
UD-1 Upper Deschutes River Conservation Fund	Crane Prairie, Wickiup, and Crescent Lake reservoirs	Oregon spotted frog	Provides funds for restoring or enhancing habitat in the Upper Deschutes Basin for spotted frog and other aquatic species, or otherwise addressing conditions in the Upper Deschutes Basin that affect the conservation and recovery of spotted frog in the wild (e.g., expand distribution of existing populations, increase connectivity between populations, increase number of individuals within a population, reduce threats from invasive species, etc.). The responsible Applicants will contribute a total of \$150,000 annually by March 1 for the term of the DBHCP, adjusted annually for inflation.	AID, COID, LPID, NUID, SID, TID
DR-1 Middle Deschutes River Flow Outside of the Irrigation Season	Winter Diversions of Stock Water	Bull trout, steelhead, sockeye salmon	Establishes winter flows (November through March) in the Deschutes River below Bend (from North Canal Dam, RM 165, to Round Butte Reservoir, RM 119.5) be maintained at or above 250 cfs to support salmonid migration habitat and early life stages of other fish. Requires Applicants to coordinate their winter diversions for livestock.	AID, COID, SID
Crescent Creek and Little Deschutes River				
CC-1 Minimum Instream Flow below Crescent Dam	Crescent Lake Reservoir	Oregon spotted frog	Modifies operation of the reservoir to maintain and enhance spotted frog habitat. A portion of the storage capacity (minimum: 5,264 acre feet/year to maximum 12,364 acre feet/year) in the Reservoir will be designated specifically to manage flows in lower Crescent Creek and lower Little Deschutes River, as needed, to improve habitat conditions for spotted frogs. Minimum flow below Crescent Dam from October through June will increase to 10-12 cfs (Years 1-15: 10 cfs; Years 16-20: 11 cfs; Years 21-30: 12 cfs) to enhance overwintering and breeding habitat that would otherwise be insufficient to support spotted frogs. Additional winter flow can be provided, as needed, through adaptive management. Minimum flows of 50 cfs will be maintained from July through September to support summer rearing habitat.	TID
CC-2 Crescent Dam Ramping Rates	Crescent Lake Reservoir	Oregon spotted frog	Modifies operation of the reservoir to maintain and enhance spotted frog habitat downstream of Crescent Lake Dam in Crescent Creek and the Little Deschutes River. Restricts the magnitude of flow increases and decreases (ramping rates) below the dam to more natural fluctuation rates to avoid sudden changes in water levels in downstream wetlands that would be detrimental to all life stages of the spotted frogs occupying them (e.g., frogs left exposed and vulnerable to predation and desiccation, or swept downstream).	TID
CC-3 Crescent Lake Reservoir Irrigation Release Season	Crescent Lake Reservoir	Oregon spotted frog	Modifies operation of the reservoir to benefit spotted frogs downstream of Crescent Lake Dam in Crescent Creek and the Little Deschutes River. Limits the period for ramp down of releases from Crescent Dam to no later than October 31 of each year. This timing constraint is to ensure that flows have fully decreased to their lowest winter flows before frogs have settled into overwintering sites, thereby minimizing the likelihood of, freezing mortalities and disadvantageous relocation movements in winter months.	TID
Whychus Creek				
WC-1 Whychus Creek Instream Flows	Whychus Creek Diversion	Bull trout, steelhead	Modifies operation of the TSID Diversion to improve habitat for listed fish. Increases instream flow in Whychus Creek by establishing a minimum flow (34.18 cfs) past the diversion.	TSID

Conservation Measure	Activity Affected	Species Affected	Summary	Responsible Applicant(s)
WC-2 Whychus Creek Temporary Instream Leasing	Wychus Creek Diversion	Bull trout, steelhead	Improves habitat for listed fish in increases in instream flow by promoting temporary instream transfer of water (leasing). Provides \$6,000 annually, adjusted for inflation, to fund temporary instream flow leasing during drought years (when natural flows may be too low to meet irrigation demands and provide minimum instream flows) and/or habitat restoration work.	TSID
WC-3 Whychus Creek Diversion Fish Screens and Fish Passage	Wychus Creek Diversion	Bull trout, steelhead	Provides for maintenance and operation of fish screens at the TSID Diversion to meet NMFS fish screen criteria, preventing fish entrainment and stranding. Included in the plan are procedures for the annual turn-off of the diversion in November to minimize stranding of fish within the diversion structure.	TSID
WC-4 Piping of Patron Laterals	Wychus Creek Diversion	Bull trout, steelhead	Encourages water conservation and instream transfer of water rights by TSID patrons, thereby improving habitat for listed fish by increasing instream flow. Provides for TSID assistance to its patrons for piping the remaining 5 miles of patron laterals, reducing seepage losses and increasing on-farm efficiency of water use.	TSID
WC-5 Whychus Creek Diversion Ramping Rate	Wychus Creek Diversion	Bull trout, steelhead	Modifies operation of the TSID Diversion to improve habitat conditions for listed fish. Protects listed fish from sudden changes in water depth by establishing maximum diversion increases/decreases (rates of change) during low flows: no more than 5 cfs per hour when flow below the TSID Diversion is 30 cfs or less; no more than 10 cfs per hour when flow is 30-50 cfs.	TSID
WC-6 Whychus Creek Conservation Fund	Wychus Creek Diversion	Bull trout, steelhead	Provides \$10,000 annually, adjusted for inflation, to support restoration and enhancement of aquatic, riparian, and floodplain habitats in Whychus Creek, improving conditions for juvenile salmonid rearing.	TSID
WC-7 Plainview Dam Removal	Wychus Creek Diversion	Bull trout, steelhead	Supports the removal of a small irrigation diversion (Plainview Dam), which is the last remaining man-made impediment blocking fish migration in Whychus Creek, as well as restoration of the associated reach. Also provides for installation of a fish screen at the Runco diversion to prevent entrainment of juvenile salmonids.	TSID
Crooked River, Ochoco Creek, and McKay Creek				
CR-1 Crooked River Flow Downstream of Bowman Dam	Crooked River Diversion	Bull trout, steelhead, sockeye salmon	Protects habitat for listed fish in the lower Crooked River by ensuring winter minimum instream flows of 50 cfs. Requires OID to allow use of its irrigation water (storage release or live flow bypass) to maintain minimum winter flows in years when there is insufficient fish and wildlife water (uncontracted and City mitigation) stored in Prineville Reservoir to meet minimum instream flows.	OID
CR-2 Ochoco Creek Flow	Ochoco Reservoir and Ochoco Creek Diversions	Bull trout, steelhead, sockeye salmon	Protects habitat for listed fish in Ochoco Creek by modifying operation of Ochoco Reservoir and Ochoco Creek diversions to maintain specified minimum flows (from Ochoco Dam to the mouth). Provides for release of additional flow from the Ochoco Main Canal to contribute to flow increases in Ochoco Creek during the irrigation season and non-irrigation season, subject to limitations.	OID
CR-3 McKay Creek Flow	McKay Creek Diversions	Bull trout, steelhead, sockeye salmon	Protects habitat for listed fish in McKay Creek by modifying operation of McKay Creek diversions to maintain specified minimum flows. Provides for release of increased flow into McKay Creek during the active irrigation season. (Outside the active irrigation season, McKay Creek free-flows without diversion.)	OID

Conservation Measure	Activity Affected	Species Affected	Summary	Responsible Applicant(s)
CR-4 Crooked River Conservation Fund	Mitigation for multiple activities	Bull trout, steelhead, sockeye salmon	Provides \$8,000 annually, adjusted for inflation, to support conservation measures and projects that benefit listed species in the Crooked River subbasin.	OID, NUID, City
CR-5 Screening of Diversion Structures	Mitigation for multiple activities	Bull trout, steelhead, sockeye salmon	Provides for maintenance and operation of fish screens on all OID-owned diversions, and funding for screening small patron diversions (pumps) to prevent entrainment of juvenile salmonids.	OID
CR-6 Crooked River Flow Downstream of the Crooked River Pumps	Crooked River Pumps	Bull trout, steelhead, sockeye salmon	Protects habitat for listed fish in the Crooked River by modifying operation of the Crooked River pumps to maintain specified minimum flows. Establishes that water will be diverted at the pumps only when minimum daily flows can be maintained downstream of the pumps. Required minimum flows vary depending on the month and dry versus non-dry years (ranging from 50 to 181 cfs), and are outlined in the DBHCP (Chapter 6, CR-6).	NUID
CR-7 Crooked River Downstream Fish Migration Pulse Flows	OID and NUID Crooked River Diversions	Bull trout, steelhead, sockeye salmon	Protects fish migration pulse flow releases –a quantity of uncontracted Prineville Reservoir storage that is released above and beyond the base release of uncontracted storage for the purpose of facilitating downstream migration of young anadromous salmonids in the Crooked River– from diversion by Applicants.	OID, NUID

Reservoir storage (OSF Storage) will be available each year to increase flows in lower Crescent Creek and lower Little Deschutes River for spotted frogs, but the measure does not specify exactly how and when the water will be used. Rather, the use of the OSF Storage will be determined in coordination with the Service based on the results of annual monitoring of spotted frog breeding and periodic monitoring/assessment of wetland habitat conditions along the affected waters.

Effectiveness monitoring will be conducted to support adaptive management for a subset of the DBHCP conservation measures (Table 5). Adaptive management is included in an HCP when there is uncertainty about the biological effectiveness of a conservation measure. In the case of the DBHCP, adaptive management will be applied to Conservation Measure CP-1 for Crane Prairie Reservoir. Specifically, the effects of the modified reservoir operating regime on wetland vegetation within Crane Prairie Reservoir will be monitored, and the operation will be adjusted within specified limits if the monitoring reveals a reduction in emergent wetland for the spotted frog. The effects of reservoir operation on spotted frog breeding and larval development will also be monitored, and the regime will be altered if monitoring indicates a decline in breeding or impact to developing frogs.

On the Deschutes River, effectiveness monitoring will be conducted to determine whether the specific flow variations can be implemented. Annual spotted frog surveys will inform any potential changes.

Table 4 Summary of DBHCP compliance and implementation monitoring and reporting

Measure	Monitoring Requirement	Reporting Frequency	Annual Report Due Date
CP-1	Daily (midnight) Crane Prairie Reservoir water surface elevation and storage volume	Annual, and as needed when deviations occur	Jan 31
	Daily average flow in Deschutes River below Crane Prairie Dam		
WR-1	Daily (midnight) storage volume in Wickiup Reservoir	Annual, and as needed when deviations occur	Jan 31
	Daily average flow and water depth (stage) in Deschutes River below Wickiup Dam		
	Daily average flow in Deschutes River at Benham Falls	Annual	Jan 31
UD-1	Transfers of live flow from COID to NUID	Annual	Jan 31
	Annual contributions to Upper Deschutes Basin Conservation Fund	Annual	Jan 31
	Dead Slough habitat assessment	Real time (within 24 hours) and annual	Jan 31
	Oregon spotted frog habitat suitability analyses	Real time (within 24 hours) and annual	Jan 31
DR-1	Daily average flow in Deschutes River below Bend from November 1 to March 31	Annual, and as needed when deviations occur	Jan 31
CC-1, CC-2, CC-3	Daily average flow in Crescent Creek below Crescent Dam	Annual, and as needed when deviations occur	Jan 31
	Daily average flow in Crescent Creek below Big Marsh Creek	Annual, and bi-monthly until there is real-time access to gauge readings	Jan 31

Measure	Monitoring Requirement	Reporting Frequency	Annual Report Due Date
	Storage volume in Crescent Lake Reservoir available for OSF management on July 1, and volume released in water year	Annual	Jan 31
	Oregon spotted frog breeding survey results	Real time (within 24 hours) and annual	Jan 31
	Results of monitoring for stranding of Oregon spotted frog tadpoles	Real time (within 24 hours) and annual	Jan 31
	Results of Oregon spotted frog habitat suitability analyses	Annual	Jan 31
WC-1	Permanent instream water right transfers in Whychus Creek	Annual	Jan 31
WC-1, WC-5	Hourly average flow at TSID Diversion and in Whychus Creek when TSID is diverting water	Annual, and as needed when deviations occur	Jan 31
WC-1	Daily average flow and daily maximum water temperature in Whychus Creek at Camp Polk Road	Annual	Jan 31
WC-2	Annual contributions to temporary instream leasing in Whychus Creek	Annual	Jan 31
WC-3	Annual inspection of TSID fish screen and passage	Annual	TBD
	5-year evaluation of TSID fish screen and passage	Every 5 years	Jan 31
WC-4	TSID patron piping (miles piped and water conserved)	Annual	Jan 31
WC-6	Annual in-kind and cash contributions to Whychus Creek Habitat Conservation Fund	Annual	Jan 31
WC-7	Removal of Plainview Dam	Once, after year of completion	Jan 31
CR-1, CR-2, CR-3	Flow at multiple locations and variable intervals (see Table 7-1)	Annual, and as needed when deviations occur	Jan 31
	Temporary instream leasing in Crooked River and Ochoco Creek	Annual	Jan 31
	Status of McKay Creek Water Switch	Annual	Jan 31
CR-4	Annual contributions to Crooked River Conservation Fund	Annual	Jan 31
CR-5	Annual inspection of OID fish screens and fish passage	Annual	TBD
	5-year evaluation of OID fish screens and fish passage	Every 5 years	Jan 31
	Screening of OID patron diversions	Annual in Years 2-6	Jan 31
CR-6, CR-7	Crooked River Pump diversions	Annual, and as needed when deviations occur	Jan 31

Table 5 Summary of DBHCP effectiveness monitoring and reporting

Measure	Monitoring Requirement	Reporting Frequency	Annual Report Due Date
CP-1.1	Monitoring for Oregon spotted frog breeding	Annual	Jun 1 for initial report; Jan 31 for final
CP-1.2	Crane Prairie drawdown monitoring	Real time (within 24 hours) and annual during years of monitoring	Jan 31
CP-1.3	Crane Prairie vegetation monitoring	Annual during years of monitoring	Jan 31
WR-1.1	Monitoring of spring breeding conditions for Oregon spotted frogs	Real time (within 24 hours) and annual	Jan 31
WR-1.2	Monitoring of Oregon spotted frog egg mass survival	Real time (within 24 hours) and annual	Jan 31
WR-1.3	Monitoring of implementation of the variable flow tool for Upper Deschutes River winter minimum flows	To be determined	To be determined

2.1.2 Bureau of Reclamation Proposed Action

2.1.2.1 Deschutes River Basin Project Operation and Maintenance

The Bureau of Reclamation (Reclamation) is proposing to continue operating and maintaining their Deschutes River Basin Project (Project) in Central Oregon, in coordination with their irrigation district partners, the Applicants. Implementation of the Project involves eight components that comprise the proposed Federal action, as identified by Reclamation:

1. Authorizing the Applicants to Operate and Maintain Federally Owned Deschutes Basin Project Facilities and Amending the 1938 Inter-District Agreement to modify the sequence and timing of filling Crane Prairie and Wickiup Reservoir.
2. Operation of Bowman Dam and Implementation of the 2014 Crooked River Act
3. Crooked River Flood Control
4. Gaging Station Installation and Maintenance on the Crooked River
5. Reclamation Monitoring of Crooked and Deschutes River Flows
6. Implementation of Reclamation's Safety of Dam Inspection Program
7. Extraordinary Maintenance at Wickiup, Crane Prairie, Bowman, and Ochoco Dams
8. Operations and Maintenance of the Wapinitia Project

The primary purpose of the operation and maintenance of the Project is to provide irrigation water to water rights holders in the Basin. Secondly, the Project provides flood, fish and wildlife benefits, and minimal recreation opportunities. Reclamation proposes the action according to its authority under various Federal statutes enacted by Congress. Their request for formal consultation, received by the Service on December 22, 2020, addresses the effects of the

Project as it pertains to bull trout, spotted frog, and critical habitat for both species. The DBHCP, ITP, and this consultation will have concurrent terms of 30 years.

2.1.2.2 Deschutes River Basin Project Background and Summary

The Project is comprised of three individual Reclamation projects: the Deschutes Project in the upper Deschutes River Basin, the Crooked River Project in the Crooked River Basin, and the Wapinitia Project in the White River Basin (Figure 4). These projects, and the facilities associated with each of them, are integral components of Applicant operations in the Basin. As such, successful implementation of the DBHCP will require close coordination with Reclamation facilities and activities that are subject to interagency consultation as Reclamation's proposed



Figure 4. Map of the Deschutes River Basin, showing Reclamation's three projects that comprise the Deschutes River Basin Project.

action, as summarized in this section. (Refer to section 2.1.1.1 for a description of Applicant actions covered in the DBHCP.)

Operating strategies for Reclamation projects are based on congressional authorizing legislation for each project. All Reclamation projects in the Basin were authorized for the purpose of irrigation, primarily to develop more reliable water supplies. Some storage facilities are also authorized to be used for flood control, recreation, and/or fish and wildlife purposes. When authorized by Congress, flood control of storage dams is a required, non-discretionary operation; Prineville and Ochoco reservoirs are the only projects in the Basin with formalized authorizations for flood control operations. Lastly, all dams must be operated in a manner that protects them from potential failure. These three purposes –irrigation water supply, flood control, and preservation of the dam– are the most influential factors of reservoir operations in the Basin.

The Deschutes Project was authorized by Congress in 1937 for the purpose of irrigation, and includes a mix of private and Federal transferred works operated by COID and NUID. Reclamation holds legal title to transferred works but responsibility for regular operation and maintenance has been formally transferred to the individual Applicants, and are thus activities analyzed in the DBHCP. While the Applicants are responsible for daily operations and maintenance at transferred works, Reclamation is responsible for required dam safety inspections and implementation of any resultant recommendations for corrective actions at these facilities, which are assessed as part of Reclamation's proposed action. Federal facilities in the Deschutes Project include Wickiup, Crane Prairie, and Haystack dams and reservoirs, and the North Unit Headworks and Main Canal. COID and NUID own both the natural flow and storage water rights for the Deschutes Project.

The Crooked River Project, authorized by Congress in 1964 for irrigation and other beneficial purposes, is similarly a mix of private and Federal facilities operated by OID and NUID. Federal facilities include reserved Bowman Dam and Prineville Reservoir, and a series of transferred diversion dams, canals, and pumping plants. For reserved works, Reclamation retains legal title as well as responsibility for regular operations and maintenance activities. In the case of Bowman Dam, Reclamation has contracted day-to-day maintenance and operation to OID, but ultimate responsibility for all aspects of dam operation and management still rests with Reclamation and are thus part of Reclamation's proposed action. Reclamation holds the storage water right in Prineville Reservoir. The operation and maintenance activities for Bowman Dam were developed to meet the requirements of the original authorizing legislation for the Crooked River Project, encompassing both irrigation and flood control purposes as modified by the Crooked River Collaborative Water Security and Jobs Act of 2014 (Crooked River Act). The Crooked River Act provides first fill water storage rights to OID and NUID and authorizes the use of Prineville Reservoir storage capacity for additional downstream fish and wildlife enhancement, as well as other beneficial purposes.

The Wapinitia Project was authorized by Congress in 1956 for irrigation and consists of one small storage dam, Wasco Dam, and several miles of privately owned irrigation canals that are operated by the Juniper Flat District Improvement Company (JFDIC). All aspects of operations, maintenance, and inspections of the Wapinitia Project are entirely separate and independent from activities covered in the DBHCP, and are addressed solely under Reclamation's proposed action. Federal facilities for the Wapinitia Project consist of Wasco Dam and Clear Lake Reservoir in the subbasin of the upper White River, a tributary to the lower Deschutes River in Wasco County.

Principal Components of the Proposed Action

Reclamation has identified eight activities that comprise the Federal proposed action for this consultation that are the sole responsibility of Reclamation. These eight activities are summarized below; refer to the Assessment (sections 4.1 through 4.8) for a complete description of all components of the proposed Federal action.

An entire listing of Federal and non-Federal facilities in the Basin can be found in Table 2-1 of Reclamation's 2003 Assessment (Reclamation 2003) as incorporated by reference in their 2020 Assessment. All inspections, repairs, and modifications at transferred and reserved works to comply with the Federal Safety of Dams Program and Long-Term Inspection and Maintenance Programs, are overseen by Reclamation and analyzed in their Assessment as part of their proposed action. Activities of this nature that can be predicted with certainty at this time are addressed in this consultation.

Activities such as extraordinary repairs and modifications to Reclamation-owned facilities that may occur in the future will be subject to section 7 consultation at that time and are therefore not analyzed in this Opinion. Examples of future Project activities that would require separate interagency consultation include, but are not limited to, unanticipated Safety of Dam program investigations or repairs, unexpected and required large scale dam infrastructure maintenance actions that are not considered to be routine O&M actions, and future Federally-funded water conservation projects that conserve water and result in improvements to instream flow in both the Deschutes and Crooked River basins. Refer to Table 2 for a breakdown of Project activities that are covered a) by the Applicant's DBHCP, b) by Reclamation's 2020 Assessment as assessed in this Opinion, and c) by separate Reclamation consultations to be conducted in the future.

2.1.2.2.1 Authorizing the Applicants to operate and maintain Federal Basin Project facilities, and amending the 1938 Inter-District Agreement

Reclamation proposes to a) authorize the Applicants to continue operating and maintaining Federal transferred works within the Project on behalf of Reclamation and b) approve operational changes to the 1938 Inter-District Agreement. The 1938 Inter-District Agreement between AID, COID, LPID, and NUID determines seasonal filling and allocation of water in Crane Prairie and Wickiup reservoirs, and operational changes to the agreement are necessary in order to implement the DBHCP.

Transferred works in the Basin are owned by Reclamation but operated and maintained by COID, NUID, and OID on Reclamation's behalf according to the same discretion, authority, and water law limits as Reclamation. In the case of COID and NUID, these districts operate Federally-owned Crane Prairie and Wickiup dams, respectively, and various canals as transferred works. OID similarly operates the OID main diversion canals and pumping plants as transferred facilities. As such, daily operation and maintenance of Federal transferred works that pertain to the Project are covered in the DBHCP in their entirety, the effects of which are analyzed in this Opinion as part of the Service's proposed approval of the DBHCP. OID also operates and maintains Bowman Dam through a contract with Reclamation, but as a reserved work, Reclamation retains legal responsibility. All operation and maintenance of Bowman Dam/Prineville Reservoir is thus a component of Reclamation's proposed action, and is described in following subsections.

The 1938 Inter-District Agreement specifies the process by which Crane Prairie and Wickiup reservoirs be filled during the irrigation storage season and how stored water be allocated among AID, COID, LPID and NUID. The DBHCP modifies operations of these two reservoirs to

improve habitat for spotted frog, requiring the four districts to store and allocate water in a manner that deviates from that specified in the original 1938 Agreement. The districts have thus prepared a newly amended agreement to replace the original, which solidifies the new process and agreement for storage and allocation of stored water (DBHCP, Appendix B).

Because Crane Prairie and Wickiup Dams are Federally-owned works, Reclamation must approve the new Inter-District Agreement on how water will be stored and allocated among these facilities. Thus, approval of the contract changes for the operation of Crane Prairie and Wickiup dams and authorization of the districts to operate them is included as part of Reclamation's proposed action. However, because implementation is actually performed by the irrigation districts, those actions are covered activities in the DBHCP. All effects of implementation (i.e., water storage, delivery, and diversion) to listed species is addressed as part of the Service's proposed authorization of the DBHCP. Incidental take coverage of these DBHCP facilities and activities pursuant to section 10 of the Act by issuance of an ITP obviates the need for separate take coverage to Reclamation for these facilities under section 7 of the Act. As such, Reclamation accepts by reference the description of this action and the analysis of effects that are fully described in the DBHCP and assessed elsewhere in this Opinion as a component of the Service's proposed action.

2.1.2.2.2 Operation of Bowman Dam and implementation of the 2014 Crooked River Act

Summary of Prineville Reservoir Water Storage and Use Accounts

As described previously, operation and maintenance activities for Bowman Dam were developed to meet the requirements of the original authorizing legislation for the Crooked River Project, encompassing irrigation, flood control, dam preservation, and other beneficial purposes as modified by the Crooked River Act. Irrigation operations and flood control management are considered primary operations and represent a priority in terms of how Reclamation operates the dam and reservoir. In addition to all aspects of flood control (described in the next section, *Crooked River Flood Control*), Reclamation's proposed action addresses:

- A. the storage and release of 68,273 AF contracted water and live flow for irrigation purposes to OID and private irrigation diversion districts for legal water right holders in the Crooked River subbasin,
- B. the storage and release of up to 5,100 AF contracted water to mitigate groundwater pumping impacts as a result of Prineville groundwater well pumping,
- C. The storage and release of up to 10,000 AF contracted water available first to NUID and subsequently to other irrigation storage contract holders,
- D. the storage and release of up to 2,740 AF contracted water to comply with requirements of the McKay Water Switch, and
- E. the storage and release of 62,527 AF uncontracted water for fish and wildlife enhancement.

It should be noted that once flows are released from Prineville Reservoir, they become live flow in the Crooked River and are subject to use by downstream users with legal water right

certificates for live flow diversion unless otherwise protected by Oregon State law or instream secondary water rights.

The allocation of contracted (volumes of water under contract with Reclamation) and uncontracted (volumes without contract with Reclamation but now allocated to fish and wildlife per the Crooked River Act of 2014) storage water rights in Prineville Reservoir is defined by the 1964 Crooked River Project authorizing legislation and the 2014 Crooked River Act. Prineville Reservoir has 21 contracted storage accounts with a combined storage right of 86,113 AF. The remaining 62,520 AF of uncontracted storage space is authorized for use to the benefit of fish and wildlife as described in the Crooked River Act. The total authorized volume of storage capacity within Prineville Reservoir is 148,633 AF. Table 6 summarizes the water right contract holders that are served from contracted and uncontracted water stored in Prineville Reservoir.

Table 6 Allocated contracted storage water rights in Prineville Reservoir at full storage pool (148,633 AF). (Assessment, Table 3).

Water Allocation	Amount (AF)	Season of Use	Authorization
Ochoco Irrigation District	58,273	Irrigation Season	Crooked River Project Authorization
Peoples Ditch Diversion	10,000 (Managed by OID)	Irrigation Season	Crooked River Project Authorization
Lowline Ditch Diversion			
Other small Contracted Diverters			
City of Prineville	5,100	Irrigation and Non-Irrigation Season	Crooked River Act
McKay Water Switch	2,740	Irrigation Season	Crooked River Act
NUID Supplemental Water	10,000	Irrigation Season	Crooked River Act
Uncontracted Fish and Wildlife Water	62,527	Irrigation and Non-Irrigation Season	Crooked River Act

With its passage in 2014, the Crooked River Act modified the use of water storage rights in Prineville Reservoir including defining the method by which reservoir storage accounts would be filled and how unused water would be carried over from one water year to the next. The bill establishes “first fill” water storage rights for Prineville and for existing water contracts. In below average water years when Prineville Reservoir does not reach full fill of 148,633 AF, this prioritized fill accounting results in less uncontracted storage water remaining to provide for fish and wildlife purposes. In order to find ways in which more water could potentially be made available for fish and wildlife purposes in dry years, the Crooked River Act has a provision that required Reclamation to develop a voluntary Dry Year Management Plan (Reclamation 2018). Any stored water not called for and released by the end of the irrigation season is carried over and accounted for as part of the ‘first fill’ storage quantities of the subsequent water year.

Procedures for irrigation water delivery and flood control require continuous water management adjustments and include many system operating considerations. Reclamation must consider several complicated factors when making decisions about water management in the Crooked River subbasin during the irrigation and non-irrigation seasons each year because of the reservoir’s operating strategies, authorizations, and predominant water runoff and precipitation

patterns (as described in the *Environmental Baseline*). These factors include the overall availability of water supply in any given year, availability and allocation of contracted water supplies to stored water contract holders, flood control, fish and wildlife protection, and availability of uncontracted water supplies for fish and wildlife enhancement purposes as directed by the Crooked River Act.

Project operations are tailored to accommodate annual variations in water supply and demands while ensuring that flood prevention requirements are satisfied and that stored water delivery obligations are met. The processes Reclamation uses to determine water availability, factors they must consider in Crooked River flow management each year, and how they partition available flow among the various water users with contracted and uncontracted storage accounts are described in section 4.2.2 of the Assessment (Crooked River Operating Strategies).

A. Storage and Use of 68,273 AF of Contracted Water Delivery for Irrigation

Reclamation will release up to 68,273 AF of stored water contracted during the irrigation season from April 1 to October 15, at the quantities requested by OID and individual contract holders with legal water right certificates. As illustrated in Table 6, this water consists of 58,273 AF for OID and 10,000 AF for delivery to private irrigation districts downstream of Bowman Dam. Reclamation has contracted with OID to make the required releases from Prineville Reservoir for contracted water deliveries. In most years, Reclamation assumes that the entirety of the 68,273 AF will be called for and used. In addition to stored water releases, if there are live flow inflows into the reservoir, Reclamation will pass-through live flow up to the amount of downstream live flow water rights.

B. Storage and Use of 5,100 AF of Contracted Water for Prineville Groundwater Mitigation

Reclamation will release 5,100 AF of stored contracted water to be used to enhance streamflows below the City of Prineville as mitigation for water pumped from groundwater wells for municipal purposes, as directed by the Crooked River Act. Reclamation will release water from the Prineville mitigation account according to a schedule developed annually in coordination with the Services. In drafting our annual flow recommendations to Reclamation, the Services consider how this contracted groundwater mitigation water can be used in combination with uncontracted storage supplies to maximize the benefits to downstream fish and wildlife year-round. The Services' have prioritized including the 5,100 AF of groundwater mitigation water with the uncontracted storage releases in winter months (December and January) to maintain beneficial instream flows when the irrigation season ends and all other contracted releases cease.

Currently, water from this contracted account has been recommended by the Services' annual flow proposals to be released during the winter months of December and January. As a result, Reclamation has been implementing these water release recommendations and is releasing this water during the winter storage season within these two months at a constant rate of 41 cfs (i.e. $41 \text{ cfs} \times 1.98 \text{ AF/cfs} \times 62 \text{ days} = 5,100 \text{ AF}$). Reclamation will release the 5,100 AF of Prineville's mitigation water according to a schedule developed annually in coordination with the Services.

City of Prineville groundwater mitigation water releases during the storage season will contribute to the maintenance of winter flows in the lower Crooked River to benefit fish and wildlife as described in the DBHCP. It is anticipated that these releases will occur as described above in the future, unless OWRD determines this water must be released concurrent with groundwater pumping by the City of Prineville. However, since the 5,100 AF groundwater mitigation water has a secondary in-stream water right, if it is released during the irrigation season it is not considered live flow and therefore not available for diversion. If that determination is made, Reclamation will work with the Services to develop an alternative release schedule for this 5,100 AF that provides alternate benefits to fish and wildlife species in the Crooked River. Release of the 5,100 AF during the irrigation season would likely replace uncontracted releases during that same period, thus saving the same total volume of uncontracted water for release during the winter.

C. Storage and Use of 10,000 AF of NUID Supplemental Contracted Water Delivery

Although the NUID contracted water is described as supplemental water to be used only when needed, Reclamation assumes that this water will be used each year by NUID to supplement its water diversion losses from the Deschutes River as a result of water use agreements specified in the 2020 DBHCP (Biota Pacific 2020). The Crooked River Act directs Reclamation to provide 10,000 AF of Prineville storage, when available and if needed, for NUID and the other Prineville storage contract holders for irrigation. NUID has first option on the water, and any of the other contract holders can call for whatever NUID does not request. If NUID or other contract holder calls for any of the 10,000 AF in any given year, Reclamation will issue a 1-year temporary water service contract for release of the water. Reclamation will release the water from Prineville Reservoir in accordance with the temporary water service contract. This block of water must be called upon by NUID by June 1st, otherwise it becomes available to other Reclamation contract holders. If NUID and other contract holders elect not to initiate a contract for the 10,000 AF of supplemental Prineville Reservoir storage by June 1st in any year the water may be made available and released to benefit downstream fish and wildlife. The 10,000 AF volume of water has never been made available to downstream fish and wildlife uses, and the Service does not anticipate that it will.

Reclamation will release the 10,000 AF from Prineville Reservoir according to a rate and schedule developed by NUID each spring and summer that the water is called for by NUID based on prevailing basin water conditions. Contracted water released for NUID diversion at the NUID Pumping Plant will also be used to provide ancillary irrigation and instream flow benefits in the Crooked River from Bowman Dam but only to the NUID Pumping Plant. These benefits consist of additional carry water at the OI diversion dam during times when the OI is diverting water at the Main Feed Canal diversion as well as instream flow quantities to help meet flow targets as established by Reclamation each year and measured at the CAPO gauge near the City of Prineville. These contracted NUID supplemental water releases from Prineville Reservoir will be added to any uncontracted water releases during the irrigation season (April to mid-October) to cumulatively meet Reclamation's proposed target flows at CAPO for those months. See Section 4.2.6 and Tables 8 through 10 for a description of Reclamation's Crooked River

flow proposals and how any NUID supplemental flow releases will be used in combination with uncontracted fish and wildlife water to make up the total irrigation season flow targets.

Per agreement with NUID and as included in the DBHCP, NUID will allow 50 cfs or the DRC agreement flows (whichever is greater) to pass by NUID's pumps during irrigation season, if sufficient live or protected flows are present (Attachment D). This excludes flows released from Prineville Reservoir to satisfy NUID's 10,000 AF supplemental water contract that was authorized by the 2014 Crooked River Act. Beyond NUID's pumps, there are few additional diversions that could pick up the uncontracted storage releases as live flow.

D. Storage and Use of 2,740 AF of Contracted Water Delivery for McKay Water Switch

The 2014 Crooked River Act authorized the storage and release of up to 2,740 AF of water from Prineville Reservoir for delivery to McKay Creek water users to replace surface water diversion currently withdrawn as live flow from McKay Creek. Prineville Reservoir stored water will be provided to McKay Creek water users through increased OID Main Feed Canal diversions and subsequent delivery to newly installed McKay Creek pressurized pipes and turnouts. This storage and release of 2,740 AF of Prineville Reservoir water is an important component of the McKay Water Exchange Project (McKay Water Switch) and makes this project feasible. The intent of implementing the McKay Water Switch project is to improve canal and point of delivery infrastructure to McKay Creek water users, efficiently deliver stored water in exchange for leaving naturally occurring live flows in important reaches of McKay Creek and the Crooked River, and improving habitat for listed species in the Crooked River basin. This action will increase instream flows in the Crooked River mainstem and in McKay Creek downstream of current points of live flow diversion. The cumulative action of completing all components of the McKay Water Switch will result in a net benefit of instream flow and habitat improvement for listed species in the Crooked River as well as in McKay Creek.

The 2014 Crooked River Act modified OID's contract with Reclamation for Prineville Reservoir water to include 2,740 AF of water annually to serve up to 685 acres on McKay Creek. OID will supply this stored water to McKay Creek water users on an acre-per-acre basis following the transfer of existing McKay Creek live flow water rights to instream use. Water supplied would be sourced from Prineville Reservoir through improved infrastructure and pressurized piping, providing irrigators along McKay Creek with more water security throughout the irrigation season and the ability to cease withdrawals of live flow water from inefficient diversions from McKay Creek.

E. Storage and Use of 62,257 AF of Uncontracted Storage for Fish and Wildlife Enhancement

The Crooked River Act requires the Secretary to store and release the previously unallocated 62,527 AF of Prineville Reservoir storage capacity to an uncontracted water account to provide instream flows in the Crooked River between Bowman Dam and Lake Billy Chinook. To help meet this requirement, the Crooked River Act specifies that instream flows for fish and wildlife released from available uncontracted storage space are to be released at a rate recommended

through consultation with the USFWS and NMFS. The stated purpose of these uncontracted water releases from storage are for maximizing, to the maximum amount practicable, benefits to fish and wildlife resources in the Crooked River basin (Crooked River Act 2014). This new allocation of water to “other purposes” is also designed to be consistent with in-channel strategies described in the Deschutes Subbasin Plan (NPCC 2005).

Reclamation’s past strategy for the release of uncontracted water during the irrigation and non-irrigation season depended on how much water is stored in any given year. Reclamation determines the annual amount of water available for the uncontracted storage account by subtracting the amount of contracted storage (86,113 AF as described above) from the total amount of water storage in Prineville Reservoir at the day of allocation (DOA) which usually occurs in the spring during April or May. As a result, the amount of uncontracted storage available for use for the upcoming water year is determined at or near the beginning of the irrigation season. The DOA is determined when the following four parameters are satisfied (Reclamation 2015a):

- Surcharge on the spillway ceases following the peak runoff;
- Maximum Prineville Reservoir contents has occurred;
- All accounts have stopped filling following peak runoff; and,
- Reservoir contents begin to deplete

After the four parameters identified above are met, the DOA has occurred and all contracted space and uncontracted space holders will be notified of the total amount of stored water available for the water-year.

In years when Prineville Reservoir does not completely fill, to fulfill all the contracted allocations described in the Crooked River Act, “first fill” gives priority to water storage for the City of Prineville and for existing irrigation contracts. The result is that there may be less uncontracted storage quantities remaining to provide for fish and wildlife purposes.

Reclamation has determined that it is able to release uncontracted water that has benefit for irrigation purposes even if it is not intended to be diverted for irrigation. One example is “carry water” which is the instream flow released in addition to water intended for irrigation, and which in effect carries irrigation releases to their point of diversion. However, such carry-water releases may also provide limited benefits for portions of the Crooked River for fish and wildlife purposes. Also, based on Reclamation’s interpretation of the intent of the Act as a whole, the annual schedule of fish and wildlife releases cannot restrict other users from access to their water. Hence, Reclamation’s releases of uncontracted storage during the irrigation season have deviated from the Services proposed schedule based on the need for carry-water in the system to support irrigation operations, though Reclamation believes these carry-water flows still provide benefits to fish and wildlife. Similarly, during some years Reclamation has reduced storage season flows below the Services’ recommended levels in order to provide additional storage to contracted storage accounts.

The Services provide their annual flow recommendation to Reclamation on or about the annual DOA. This meets the USFWS and NMFS requirement in the Crooked River Act legislation and

allows the Services to provide input on prioritizing how available uncontracted water can be best used for fish and wildlife enhancement each year. The Service's flow recommendations have to encompass the entire water-year from one DOA to the next DOA, including both the irrigation and non-irrigation seasons. The Services' recommendations for irrigation season releases, therefore, can only be made after they consider the needs for the non-irrigation season, and for uncontracted storage carry-over. The Services' annual flow recommendations contain several components that Reclamation must consider in establishing their flow release schedule. These can include the quantity of water requested for release during both the irrigation and the non-irrigation season, any proposed pulse-flows for fish benefits, how much uncontracted water is requested to be carried over for the following storage season and based on anticipated irrigation use of contracted water, how the current year's proposed flow schedule may affect overall water availability in the following year.

Finally, at the request of the Services, Reclamation will consider using available uncontracted water during the spring period to provide pulse flows for fish migration. The frequency and timing of these spring pulse flows will be variable in the future and will be dependent each year based on prevailing storage in Prineville Reservoir and on the recommendation from the Services as to whether or not there is available water to make a pulse flow. Consistent with the DBHCP, Reclamation will follow the guidance provided by the Services pulse flow recommendations and implement any request for pulse flows that do not interfere with the ability of Reclamation to provide contracted water to downstream users, reduce water storage for winter flows to less than 13,000 AF, and do not overly impact carryover storage in Prineville Reservoir for the following year.

Reclamation has made such pulse flows in the past (including in May of 2020). Reclamation will work with the DBBC Irrigation Districts whenever proposing to make a pulse flow release from uncontracted water accounts to ensure that this water is not diverted as live flow by either OID or NUID. The DBBC Irrigation Districts have agreed in past years to allow any uncontracted water pulse flows to pass their respective diversions and to remain instream for fish benefits. The DBHCP (Biota Pacific 2020) has included language in its conservation measures to ensure that this water is allowed to pass OID and NUID points of diversion.

Live Flow Releases

There are currently numerous natural flow rights on the Crooked River below Bowman Dam. The total combined natural flow right below Prineville Reservoir and above the Highway 126 Bridge is approximately 226 cfs. For accounting purposes, all natural flow rights are considered to be satisfied when the inflow into Prineville Reservoir, as determined by the CRPO gauge, is greater than 226 cfs but decreases as natural inflow decreases. Once natural inflow is less than the total natural flow right, withdrawals from contracted storage accounts begin to be used and are computed for allocation accounts (Reclamation 2015a).

Reclamation recognizes the fact that once water is released from storage from Prineville Reservoir that it becomes "live flow" according to Oregon State law and is subject to subsequent withdrawal by downstream users with legal live flow water rights. Reclamation also recognizes

that any live flow releases (specifically the uncontracted releases) made during the irrigation season may not stay instream to satisfy the intended goal of meeting instream flow targets as measured at the CAPO gauge or below the NUID Pumping Plant as measured at the Crooked River at Smith Rocks State Park gauge near Terrebonne, OR (CRSO gauge).

During the non-irrigation season, up to a maximum of 10 cfs of live flow shall be bypassed (meaning not stored in the reservoir) as Prineville Reservoir releases during those months when there are no other discharges occurring for other purposes. This is water withdrawn from the uncontracted storage account. During the irrigation season, all live (natural) flow available up to the current natural flow water right demand is bypassed to meet that day's natural flow demand. After the day of allocation, all live flow is bypassed since by definition, the day of allocation is set when there is no longer enough natural flow to fulfill demands and have left-over water to store.

2.1.2.2.3 Crooked River Flood Control

Regulations for flood control at Prineville and Ochoco reservoirs were set forth in 33 CFR 208.95 in December 1944, which identify Reclamation as responsible for the operation of Bowman and Ochoco Dams for flood control. Reclamation retains ownership of Bowman Dam while Ochoco Dam is owned and operated by OID. As stated previously, Prineville and Ochoco reservoirs are the only projects in the Basin with formalized authorizations for flood control operations. Both reservoirs are operated such that releases conform to Corps guidance and prescribed flood control rule curves. The approved flood control storage reservation diagrams for Bowman Dam/Prineville Reservoir and Ochoco Dam/Reservoir are illustrated and described fully in the Assessment, Figures 9 and 8, respectively.

Successful flood control depends on accurate runoff volume forecasts based on expected precipitation and the water content of the subbasin snowpack periodically measured during the winter and spring. Forecasts are made with an equation that uses antecedent runoff, a snow water index, precipitation index, and an index of future meteorological conditions subsequent to the date of the forecast. The volume forecast is then referred to the respective storage reservation diagram to determine needed storage space for flood control. Between November 15 and February 15, 60,000 AF of space is reserved to store floodwaters in Prineville Reservoir, and 16,500 AF in Ochoco Reservoir. Between February 15 and April 30, the amount of reserved space necessary is determined by projecting the runoff volume through August 31 on a particular date and plotting it on the respective flood control storage reservation diagram. During the irrigation season, releases for irrigation preclude the need to release water for flood control, except in rare events that cause unusually high inflows that exceed reservoir capacity.

Flood control in the subbasin requires close coordination between Reclamation, the Corps, and OID. When reservoir inflows indicate that flood control releases may be imminent, Reclamation will, to the extent practicable while complying with the Corps flood control rule curve, coordinate with the Services to shape flood control releases to minimize impacts or increase benefits to listed fish species. Reclamation has evaluated how climate change could influence flood control activities in the Crooked River (Runyan 2018) and concluded that the existing rule curves may need to be modified in extraordinarily wet and dry years (Reclamation 2020). Flood

control regulations are subject to temporary modification by the Corps, if necessary, in time of emergency.

2.1.2.2.4 Gaging station installation and maintenance on the Crooked River

Reclamation proposes to install one new instream flow monitoring station on the Crooked River mainstem and three gauging stations on private irrigation canal diversions within important streamflow and canal diversion monitoring reaches in the subbasin. These new streamflow and canal diversion monitoring stations will enhance the ability of Reclamation, OWRD, and OID to accurately perform water accounting and management in near real-time.

The new proposed streamflow gauge will be located on the Crooked River at Lone Pine Bridge (RM 24.6). This gauging station will be used to monitor streamflows in the mainstem Crooked River immediately upstream of the NUID Pumping Plant to assess the quantity of uncontracted fish and wildlife flow and the amount of live flow or contracted storage water (if any) that is available for NUID to divert at its pumps. The three proposed canal diversion monitoring stations include Peoples Ditch Diversion Canal (RM 49.4), Rice-Baldwin Irrigation Ditch Diversion Canal (RM 56.8), and Crooked River Central Diversion Canal (RM 41.5). These three private irrigation canals divert live flow and contracted storage water from Prineville Reservoir stored water releases. Canal diversion data collected at these locations will be used by OWRD, Reclamation, and the three diversion owners to improve water management activities, including reducing flow fluctuations that result from failure to coordinate water diversions with releases from Prineville Reservoir. This coordination will ensure more stable instream flows, enhancing habitat quality for downstream fish species during the irrigation season.

Installation and data collection from these four important flow monitoring locations will not only be used for determining the amount of water available for withdrawal at NUID and private irrigation diversion canals, but will also be important for documenting and recording the streamflow or canal diversion withdrawal quantities that occur each irrigation season at these locations. Reclamation will use data collected at these locations to document that certified water rights are being adhered to at those private irrigation canal diversion sites with limited water diversion rights each year. The new gauges will also help with compliance monitoring of instream flow quantities of uncontracted water released for fish and wildlife enhancement purposes, better enabling Reclamation to meet targeted flows at the CAPO gauge and in general improving their ability to manage the uncontracted storage account for beneficial fish and wildlife releases.

Reclamation has secured funding to install the Lone Pine Bridge and People's Ditch Diversion gauging stations in Fiscal Year 2021, with the remaining Rice-Baldwin Ditch Diversion and Crooked River Central Canal gaging stations to be installed in FY 2022. The Lone Pine Bridge Gauging Station will include real-time uploading of 15-minute and calculated daily average flow summary statistics to Reclamation's Hydromet streamflow management database system.

2.1.2.2.5 Reclamation monitoring of Crooked and Deschutes river flows

High variability in flows occurs downstream of Bowman Dam during the irrigation season when several irrigation districts and canals are taking live flow and stored contracted water supplies for

authorized irrigation purposes at both Federal and non-Federal facilities. The extent of the daily variation at any flow monitoring location increases in direct relation to the distance downstream of the reservoir, and as the number of irrigation diversion points and water inputs increase below the dam. Reclamation must account for this high degree of observed variation when setting flow targets and when monitoring flow at storage dams in both the Deschutes and Crooked River subbasins. Accounting for high levels of streamflow variation is particularly important when monitoring flows at instream flow target locations downstream of Reclamation storage dams where multiple diversions, return flow points, and tributaries are present.

To account for observed flow fluctuations and variability that occur at instream flow monitoring gauges below storage dam discharge points versus areas downstream of these water release locations, Reclamation will be using different levels of resolution or criteria when measuring flow at identified Deschutes and Crooked River stream flow monitoring gauges. Reclamation proposes to meet instantaneous flow targets, measured in cfs, at monitoring gauges that are located at or immediately downstream of Reclamation storage dams. This would be the case at

Table 7 Summary information about Reclamation Hydromet stations within the Deschutes and Crooked River basins used to monitor Deschutes Basin Project flows.

Flow Monitoring Location	Gauge Designation	Dam Release or Instream Flow Location	Flow Monitoring Resolution (Instantaneous or Daily Average)	Who Monitors and Reports
Deschutes River Basin				
Crane Prairie Dam	CRPO	Dam	Instantaneous	DBHCP ²
Wickiup Dam	WICO	Dam	Instantaneous	DBHCP
Deschutes River at Benham Falls	BENO	Instream Flow	One-Day Average	DBHCP
Crooked River Basin				
Crooked River near Prineville	PRVO	Dam	Instantaneous	Reclamation
Crooked River at Prineville	CAPO	Instream Flow	One-Day Average	Reclamation
Crooked River at Lone Pine Bridge	CLPO ¹	Instream Flow	One-Day Average	Reclamation
Crooked River at Smith Rocks State Park	CRSO	Instream Flow	One-Day Average	DBHCP and Reclamation ³

Notes:

- 1 – This instream flow gauge has not yet been installed or given an official gauge designation. Reclamation assumes that this gauge will be installed in 2021 and will be designated as station (CLPO).
- 2 - The DBHCP will monitor flows at several flow monitoring locations in both the Deschutes and Crooked River basins as part of the DBHCP (Biota Pacific 2020). Reclamation will accept by reference the DBHCP flow monitoring analyses at these locations that involve Reclamation facilities and flow releases.
- 3 – The DBHCP will monitor flows at the CSRO gauge during the April-October irrigation period due to the DBHCP requirement for NUID to meet minimum instream flows downstream of the NUID pumping plant whenever pumping occurs. Reclamation will monitor and report flows during the storage season when the NUID/DRC Minimum Flow Agreement is not in effect.

Crane Prairie Dam (CRPO gauge), Wickiup Dam (WICO gauge), and at Bowman Dam (PRVO gauge). For these gaging stations, Reclamation will monitor any established flow targets using an instantaneous measurement of flow based on the 15-minute data timestep. Because Reclamation cannot fully eliminate highly variable hourly and daily flow fluctuations at minimum target flow monitoring locations downstream of Reclamation storage dams, Reclamation proposes to measure flows using a 1-day moving average of instantaneous flows as a means of determining that established target flows are being met. Table 7 provides a list of the major flow monitoring gauges in the Deschutes and Crooked River basins used for water management by Reclamation and the proposed level of monitoring resolution used for measuring flow at each location. For those streamflow monitoring locations with established minimum flow targets (e.g. CAPO gauge on the Crooked River), Reclamation will monitor and record flows as calculated 1-day averages of 15-minute data and will ensure that the observed level of flow variation is limited to +/- 20% of the minimum target flow to limit the overall level of flow fluctuation at that instream flow monitoring gauge. This +/- 20% variation around the 1-day average flow is the acceptable level of variation that Reclamation can realistically meet given the high range of variation in the Deschutes and Crooked River systems. Reclamation and OID have been using this level of variation and 1-day averaging level of variation at the CAPO gauge when providing uncontracted flows to meet established targets that have been recommended by the Services. This +/- 20% level of resolution is also the standard that is also being applied to the DBBC Irrigation Districts at stream gauges that are being monitored for streamflow compliance in the DBHCP (Biota Pacific 2020).

If 1-day average flow monitoring of a minimum target flow indicates that flows are not sufficient to meet the minimum target flow established for that location, a flow exceeded violation will be identified. If such a flow exceedance violation occurs, then Reclamation will work with OID to release more contracted water from Bowman Dam until such releases result in the 1-day average flow increasing or surpassing the minimum target flow. This procedure will ensure that only contracted flows are used to increase Crooked River flows to meet project minimum target flows.

Reclamation believes that the amount of hourly and daily variability anticipated in the Crooked River system will decrease at the CAPO monitoring location (and ultimately at other instream flow monitoring locations such as the new Lone Pine Bridge Gauge) as Reclamation and OID improve measurement of private canal diversions, implement improved procedures for irrigation district calls for water diversion and delivery of contracted water, and as the water accounting and delivery methods are incorporated in the future. Reduction of hourly and daily flow variation will not result in overall elimination of hourly and daily flow variations at any Crooked River flow monitoring location, but will help ensure that variation is kept to within an acceptable limit as part of the proposed action.

2.1.2.2.6 Implementation of Reclamation's Safety of Dam Inspection Program

Reclamation's Dam Safety Program consists of required Reviews of Dam Operations and Maintenance Activities (RO&M) and Safety Evaluations of Existing Dams (SEED).

Reclamation's RO&M and SEED programs require scheduled examinations of Federally owned

dams with special requirements on high-hazard dams where failure or mis-operation could cause a loss of human life. These examinations include physical inspections and tests that require short-term changes in facility operation. The program may recommend or require the Districts to complete specific maintenance activities that also require short-term changes in operations. To reduce potential adverse effects that these changes in operations may have on listed species, Reclamation proposes to coordinate inspection scheduling and discretionary maintenance activities with OID, COID, NUID, and the Services.

The RO&M and SEED programs require three types of combined facility examinations to ensure that dams do not present an unacceptable risk to public safety and continue to operate effectively: 1) annual site inspection, 2) periodic facility review (PFRs), and 3) comprehensive facility review (CFRs). Annual site inspections consist of a general assessment on the condition of pertinent dam features. Periodic facility reviews involve more in-depth review of the structural integrity and performance of the dam and the efficacy of management processes and procedures. Comprehensive facility reviews are the most in-depth of the three reviews, requiring thorough examination of normally inaccessible features. Periodic and comprehensive facility reviews occur every six to eight years on a staggered schedule, such that one or the other occur every three or four years at each facility. The specific activities of each examination depend largely on the needs associated with each dam. While examination activities must occur within the year they are scheduled, Reclamation retains discretion in identifying the exact timing of these inspection activities within potential windows of opportunity.

Facility examination and maintenance activities may require short-term changes in operations that could shut down flows from the dam's outlet works and stilling basins or reduce reservoir elevations below the specified minimum pool. For example, dive inspections of outlet or intake gates require flows to be shut down completely for very short amounts of time to allow divers safe access to the component of the dam to be inspected; gate valve tests require valves to be fully closed or opened to exercise the valves or to test for operational capability. Similarly, maintenance activities may require operational changes that could require reductions in pool elevations or minimum flows, ranging from a few minutes to three days, and may require flows to be completely shut down during the entire examination or inspection activity.

Historically, Reclamation has coordinated requests for operational changes with OID, COID, NUID, and OWRD to limit disruptions in normal operations. Reclamation proposes to add the Services to the scheduling-required examination and maintenance activities prior to the year in which they are required to occur. When possible, Reclamation will attempt to combine some of these inspections, tests, and maintenance items so as to do them all at the same time to limit interruptions in downstream flow or minimum pool elevations.

Details for inspection and operational testing activities planned all storage facilities that Reclamation owns or has maintenance responsibilities for are outlined in Tables 17-20 in their Assessment. Activities scheduled at Wickiup Dam require flows to be reduced to as low as 10 cfs for up to 3 days in October or November on 8-year intervals (Assessment, Table 17). Activities required at Crane Prairie Dam require flows to be reduced to as low as 0 cfs for up to 4 hours and 25 cfs for up to 6 hours in October on 8-year intervals (Assessment, Table 18). The

Gate Full-Open/ Full-Close Test requires flows at 500 cfs for up to 5 minutes in early-August. At Bowman Dam, the dive inspection of the outlet requires flows to be reduced to 25 cfs for 4 hours in October or November on an 8-year interval (Assessment, Table 19). Activities required at Ochoco Dam require flows to be reduced to as low as 0 cfs for up to four hours and 25 cfs for up to four hours sometime between August and October on 8-year intervals (Assessment, Table 20). The Emergency (guard) Gate unbalanced testing requires gates to be opened up to 15% during the irrigation season.

2.1.2.2.7 Extraordinary maintenance at Wickiup, Crane Prairie, Bowman, and Ochoco Dams

After the RO&M and SEEM program examinations are completed, Reclamation dam maintenance and safety of dam engineering staff may make recommendations for follow up repair and maintenance actions to bring Reclamation-owned dams into compliance with established maintenance and safety protocols. These recommendations are formally described and documented and are issued to dam operations programs for scheduled completion. Reclamation works with all dam operations staff, regardless of whether the dam is a reserved or transferred works, to ensure that all recommendations are completed within an acceptable timeframe.

Extraordinary maintenance actions typically require greater amounts of effort and more severe flow reductions to complete than the RO&M or SEED activities described in the preceding section. Most activities require outlet work flow reductions from 0 to 45 cfs for the activities to occur safely, and require flows to be reduced for longer periods of time (3 to 6 days) than needed for RO&M and SEED examinations (less than 1-day).

Details for anticipated extraordinary maintenance activities identified at all storage facilities in the Basin that Reclamation owns are outlined in Tables 21-23 of the Assessment. Similar to the inspection and operational testing activities described in the previous section, these activities are provided as specific changes to operations necessary to ensure the ongoing safe operation of the dams.

Extraordinary maintenance activities scheduled at Wickiup Dam require flows to be reduced to as low as 10 to 45 cfs for up to 6 days in October or November on a one-time basis (Assessment, Table 21). There are other maintenance and repair recommendations required at Wickiup Dam that are not included in this consultation. These official maintenance recommendations will require long-term flow reductions lasting up to 3 weeks. Due to the length of time required to complete these activities and because the exact methods of dewatering and repair are not fully known at this time, Reclamation will consult with the Service separately on these activities prior to their implementation. This will be done to ensure that all impacts to spotted frogs and their habitat will be considered prior to implementing any long-term flow reductions downstream of Wickiup Dam. These long-duration repair activities are anticipated to be scheduled during the first 7 years of DBHCP implementation in order to complete them before minimum winter flows increase starting in year 8, minimizing the impacts of required maintenance work to frogs and frog habitat downstream of Wickiup Dam.

Extraordinary maintenance activities required at Crane Prairie Dam require flows to be reduced to zero cfs for up to 6 days in October 8- to 10-year intervals (Assessment, Table 22). At Ochoco Dam, the chute/outlet works extraordinary maintenance requires flows to be reduced to 0 cfs for up to 6 days in October at 8-year intervals (Assessment, Table 23). There are no current or active dam maintenance or safety of dams maintenance or repair recommendations issued for Bowman Dam at this time.

2.1.2.2.8 Operations and maintenance of the Wapinitia Project

Reclamation proposes to continue operating and maintaining their Wapinitia Project, which consists of one small, Federally-owned storage dam and several miles of privately owned irrigation canals that are entirely separate and independent from activities covered in the DBHCP. There have been no operational changes or maintenance issues deviating from those previously described for the Wapinitia Project since Reclamation consulted with the Services on the project in 2003-2005 (USFWS 2004a). Reclamation's 2020 Assessment references their 2003 Assessment (Reclamation 2003a) and the *Operations Description of the Deschutes River Basin Projects* report (Reclamation 2003b, pp. 91-94) for a full description of Wapinitia Project facilities and operations.

The Wapinitia Project is located near the confluence of the White and Deschutes Rivers and is near Maupin in north Central Oregon. Congress authorized the Wapinitia Project, Juniper Division, in Public Law 84-559 dated June 4, 1956 for the irrigation of about 2,100 acres of irrigated lands on Juniper Flat, a plateau 3 to 6 miles wide and approximately 17 miles long. Construction of minimum basic recreation facilities to allow public access and maintain health and safety were also authorized. Federally owned project features of the Wapinitia Project included in the proposed action are Wasco Dam and its reservoir, Clear Lake. Wasco Dam is the only storage facility in the Wapinitia Project, with a total active capacity of 11,900 AF.

The proposed action includes the storage behind and release of water from Wasco Dam for diversion at the Clear Creek Diversion. Clear Creek Diversion is privately owned and operated by the Juniper Flat District Improvement Company (JFDIC). The JFDIC holds all storage and natural flow water rights for the Wapinitia Project, and uses storage in Clear Lake to supplement other privately developed water supplies. Diversion of this storage water would not occur but for implementation of the proposed action (is interrelated and interdependent to the proposed action) and is, therefore, considered an effect of this action.

The drainage area of Clear Lake comprises over 8 square miles and is fed from seasonal precipitation, principally in the form of winter snowfall. Wasco Dam storage is used to supplement the irrigation flows on the project when the natural flows begin to decrease in July during wet years and as early as April in dry years. The total amount of water diverted from natural streamflow and storage for the Wapinitia Project is about 5,000 AF annually.

Summer inflows are received from many springs in the immediate reservoir area. In order to refill the reservoir for the irrigation season, the emergency gate is closed every year from October through April, with the regulating gate remaining open to bypass possible flood flows. If

the elevation of the lake were to reach 3511 feet during the closure period, flood flows would discharge via the overflow weirs and through Wasco Dam's open regulating gate.

JFDIC diverts water from Clear Creek about 3 miles downstream of Wasco Dam into the JFDIC Ditch which is privately owned by the JFDIC. Natural flows of Frog Creek are also diverted over to Clear Creek for diversion to the Main Ditch. Diverted water is conveyed from the Clear Creek diversion works through the JFDIC Main Ditch to McCubbin's Gulch, a natural watercourse. Water is then carried down McCubbin's Gulch to the extreme western edge of the district where it becomes part of the JFDIC's delivery system at Pine Grove. Flows at Pine Grove typically need to be 20 to 25 cfs to meet irrigation demand, with 30 cfs being the maximum capacity. Total annual diversions to the JFDIC are estimated to be 5,400 AF per year. Diversion of natural flow from Clear, Frog, Rock and Pine Hollow Creeks by the JFDIC is through private facilities and is therefore not considered to be part of the proposed or interrelated and interdependent actions for this consultation.

JFDIC holds all permits and certificates for storage water in Clear Lake and for diversions from Clear Creek and tributary streams. JFDIC has a water right to divert a maximum of 52.9 cfs at the Clear Creek Diversion. In normal years, natural flows from Clear Creek and Frog Creek will typically meet irrigation demands until sometime in May or June before releases are needed from Wasco Dam. In wet years, reservoir releases may not be needed until late June or early July; in very dry years, releases may be needed in April. Clear Creek is essentially dewatered at the Clear Creek Diversion works during the irrigation season (except for early season water in excess of irrigation demand), but some leakage occurs, and springs begin to replenish the live flow within about a mile downstream (Reclamation 2003b).

2.2 Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. The action area for this proposed Federal action is based on the geographic extent of augmented hydrology as depicted in Figure 1. We consider the action area to be the seasonally or permanently wetted area extending from all reservoirs listed in this Opinion to the mouth of the Deschutes River where it meets the Columbia River.

The action area analyzed in this Opinion includes: Crescent Creek from Crescent Lake Dam to the confluence with the Little Deschutes River; the Little Deschutes River from the confluence of Crescent Creek to the confluence of the Deschutes River; Crane Prairie and Wickiup reservoirs; the Deschutes River between these two reservoirs; the mainstem Deschutes River downstream of Wickiup Dam to the city of Bend, Oregon (including off-channel areas hydrologically connected to the Deschutes River); the Deschutes River from the City of Bend, Oregon to the confluence of the Columbia River; Clear Lake Dam and the White River from Wasco Dam to the confluence of the Deschutes River; Whychus Creek to the confluence of the Deschutes River; Prineville Reservoir and the Crooked River from Bowman Dam to Lake Billy Chinook; Ochoco Dam and Ochoco Creek from Ochoco Dam to the confluence of the Crooked River; and McKay Creek to the confluence of the Crooked River.

3 ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND DESTRUCTION OR ADVERSE MODIFICATION DETERMINATIONS

3.1 Jeopardy Determination

Section 7(a)(2) of the Act requires that Federal agencies insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed endangered or threatened species. The analysis in this Biological Opinion relies on the following four components: (1) the Status of the Species, which evaluates the range-wide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the consequences of the proposed Federal action; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species.

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 species' 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 listed species in the wild.

The jeopardy analysis in this Biological Opinion emphasizes the range-wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

3.2 Destruction or Adverse Modification Determination

Section 7(a)(2) of the Act requires that Federal agencies insure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification of critical habitat" was published on August 27, 2019 (84 FR 44976); the final rule became effective on October 28, 2019 (84 FR 50333). The revised definition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical or biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations discontinue use of the terms "PCEs" or "essential features," and rely exclusively on use of the term "PBFs" for that purpose because that term is contained in the statute. However, the shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features. For those reasons, in this Biological Opinion, references to PCEs or essential features should be viewed as synonymous

with PBFs. All of these terms characterize the key components of critical habitat that provide for the conservation of the listed species.

Our analysis for destruction or adverse modification of critical habitat relies on the following four components: (1) the Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat for the listed species in terms of essential features, PCEs, or PBFs, depending on which of these terms was relied upon in the designation, 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 all consequences to critical habitat that are caused by the proposed action on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units.

For purposes of making the destruction or adverse modification finding, the effects of the proposed Federal action, together with any cumulative effects, are evaluated to determine if the proposed action will appreciably diminish the value of critical habitat as a whole for the conservation of the species.

4 OREGON SPOTTED FROG

4.1 STATUS OF THE SPECIES

For a detailed account of the status of the Oregon spotted frog, refer to Appendix A: Oregon Spotted Frog Status of the Species.

4.2 STATUS OF CRITICAL HABITAT

For a detailed account of the status of critical habitat for the Oregon spotted frog, refer to Appendix B: Oregon Spotted Frog Status of Critical Habitat.

4.3 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

The action area includes the Upper Deschutes River basin. The broader basin includes the Upper and Little Deschutes River subbasins, both of which are occupied by Oregon spotted frogs. All

areas occupied by spotted frogs are within designated critical habitat. Figure 5 depicts the geographic extent of the area occupied by spotted frogs that is affected by the ongoing water management influenced by Reclamation's Deschutes Project and implemented by the irrigation districts. Nearly all of the area affected by the proposed action is within designated critical habitat. These Upper and Little Deschutes river subbasins are hydrologically connected and the ongoing storage and release of water for irrigation in one subbasin often influences water management in the other. Natural hydrological events in the Little Deschutes River influence spotted frog habitat in the Upper Deschutes River, specifically those located downstream of its confluence with the Deschutes River near Sunriver, Oregon.

We describe the environmental baseline condition for spotted frogs in the Upper and Little Deschutes River subbasins. This delineation by subbasin reflects the grouping of spotted frog sites or populations in the final listing rule and the units in the final critical habitat rule. Therefore, the habitat conditions described in the environmental baseline also illustrate the functioning condition of critical habitat. Figures 6 and 7 represent spotted frog sites or breeding locations/populations within the two subbasins that are both within the action area and outside of the area affected by the Deschutes Project.

For the purposes of this Opinion, we refer to some sites as populations. Sites may be referred to as populations where breeding sites are grouped within a waterbody such as Crane Prairie Reservoir. Sites may also be referred to as a population where they are separated by large distances such as the breeding areas located along the Deschutes River downstream of Wickiup Dam. Within the Little Deschutes River subbasin, areas that occur along the river systems such as Crescent Creek or the Little Deschutes River are referred to as breeding locations or sites. Due to large areas of private, unsurveyed lands that contain wetlands that are suitable habitat for spotted frogs, we assume that there are other areas outside of those where breeding counts have occurred that also are inhabited by spotted frogs. We assume that there is connectivity between these breeding locations along these river corridors. Therefore, without genetic work to elucidate population groups, we refer to these spotted frogs by breeding location within the river system where they occur. Big Marsh, represents a large, wetland complex inhabited by spotted frogs within the Little Deschutes River subbasin and we refer to this site as a population. The current distribution and abundance of spotted frogs and hydrological condition of spotted frog habitat is described by subbasin and site below.

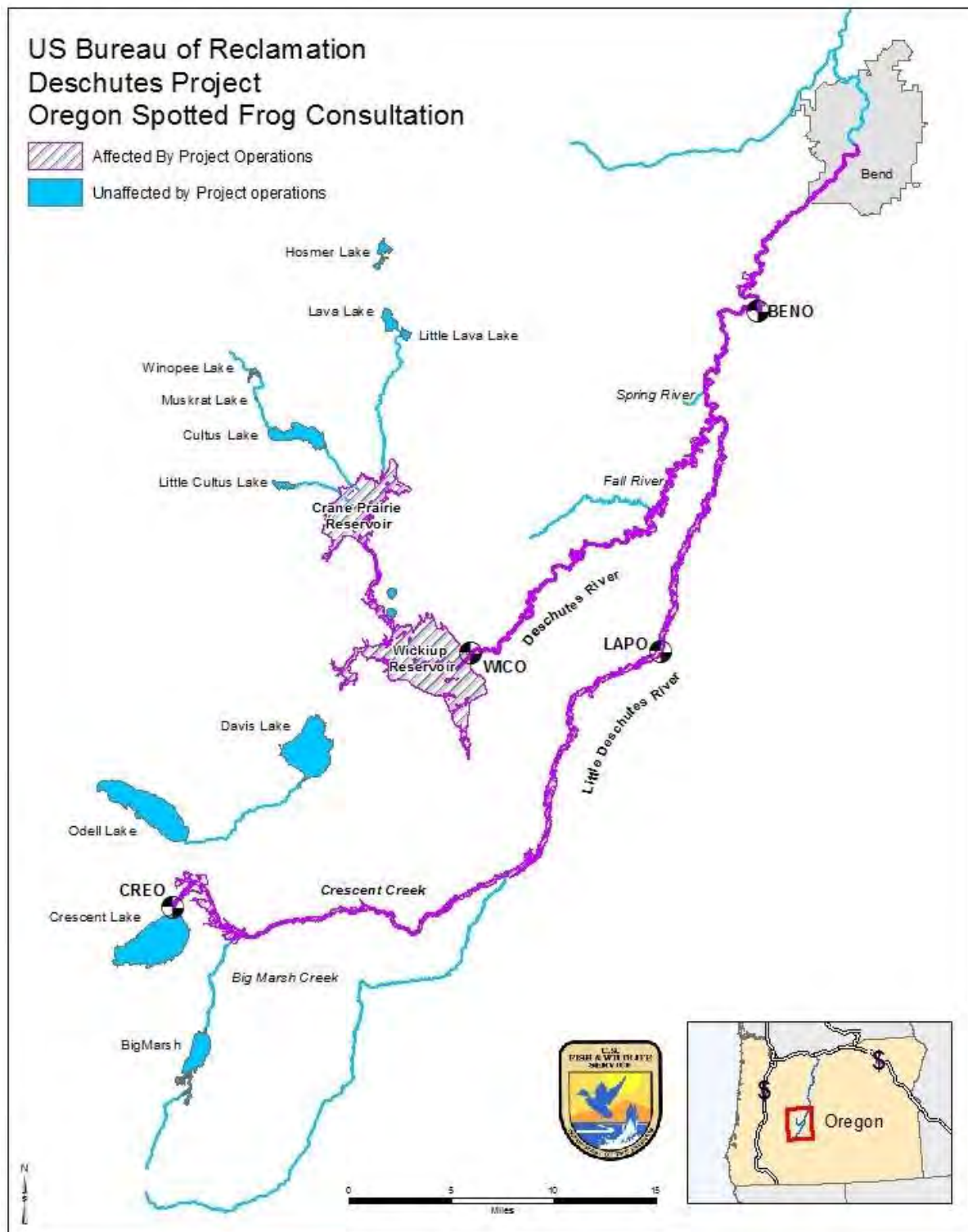
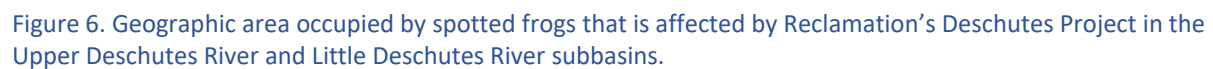


Figure 5. Geographic area occupied by spotted frogs that is affected by Reclamation's Deschutes Project in the Upper Deschutes River and Little Deschutes River subbasins.



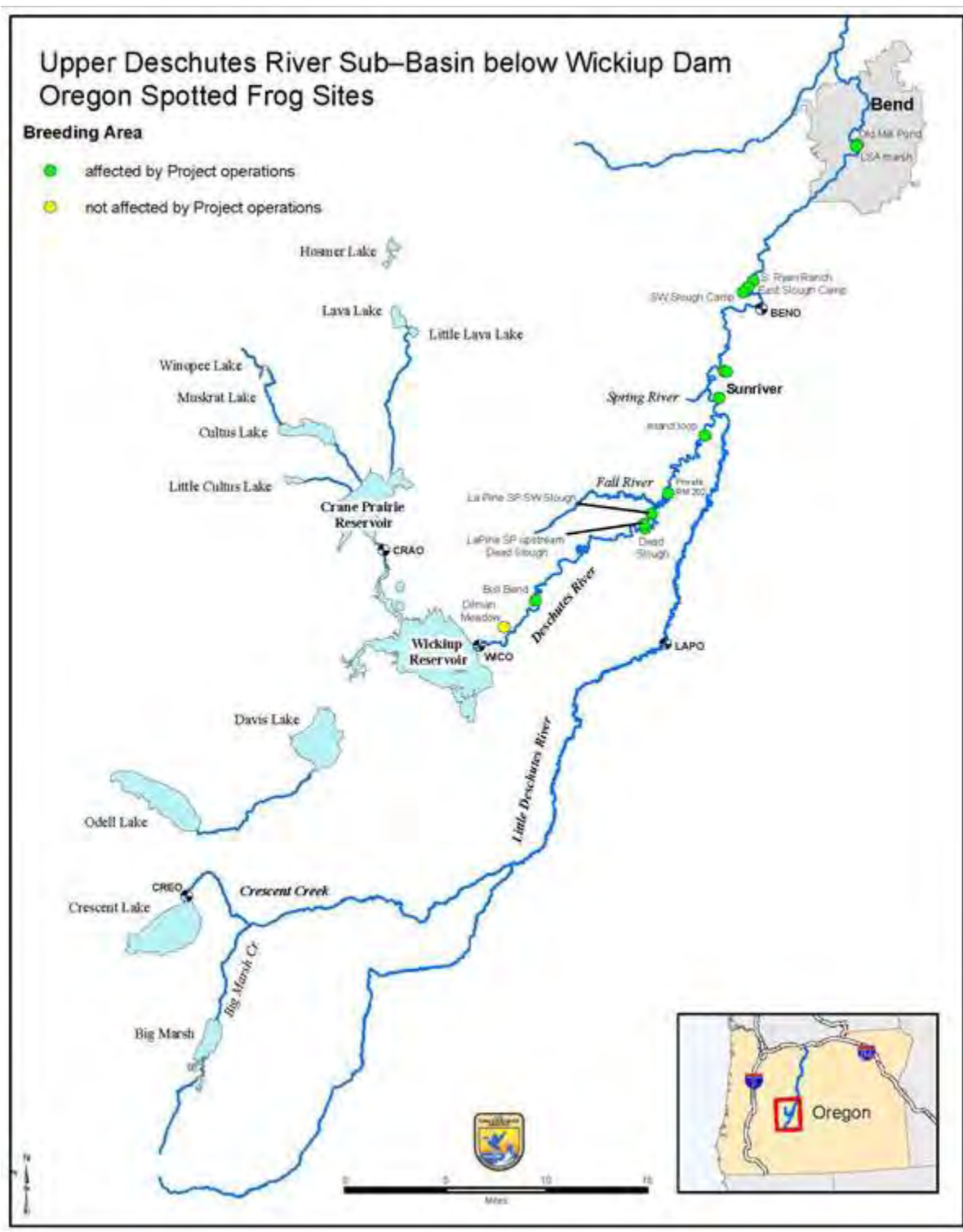


Figure 7. Oregon spotted frog breeding sites within the Upper Deschutes River subbasin below Wickiup Dam. Sites identified with green circles are those that are affected by ongoing irrigation storage and release operations. Sites identified with yellow circles are sites that are outside of the influence of storage and release operations.

4.3.1 Status of the Spotted Frog in the Upper Deschutes River Subbasin

Spotted frogs in the Upper Deschutes River subbasin occur in high-elevation lakes up to 5,000 ft (1,524 m), wetland ponds, and riverine wetlands and oxbows along the Deschutes River. At the time of listing in 2014, there were less than 20 known breeding locations (i.e., sites) within four watersheds (HUC 10) in the subbasin: (1) Charleton Creek; (2) Browns Creek; (3) Fall River; and (4) the North Unit Diversion Dam watershed. Most of these known sites are located on the Deschutes National Forest. The distribution of Oregon spotted frog sites remains essentially the same as it was at the time of listing in 2014.

4.3.1.1 Spotted Frog Sites/Populations in Areas Unaffected by the Proposed Action

Nearly half of the known breeding site/population locations in the Upper Deschutes River subbasin are in lakes, ponds and riverine wetlands that are not affected by the storage and release of water from Crane Prairie and Wickiup Reservoirs under the proposed action (Figure 6). Table 8 lists the spotted frog sites in this subbasin that are outside of the area affected by the Deschutes Project by waterbody or drainage.

Table 8 Spotted frog-occupied sites or populations within the Upper Deschutes River subbasin that are not affected by the Deschutes Project.

Watershed (HUC 10)	Waterbody or Drainage	Site Name/Population
Deschutes River- Charleton Creek	Isolated	Hosmer Lake
	Isolated	Lava Lake
	Deschutes River	Little Lava Lake
		Upper and Lower Blue Pools
		Oxbow N of FS RD 40
		Cow Meadow Camp oxbows
	Cultus Creek	Winopee Lake
		Muskrat Lake
	Deer Creek	Little Cultus Lake
Browns Creek - Deschutes River	Unnamed tributary to Odell Creek/Davis Lake	Odell Creek fen - Scotty Big Boy
Fall River - Deschutes River	Deschutes River	Dilman Meadow

Threats to spotted frog sites above and outside of the influence of the reservoir system primarily include lodgepole pine encroachment and non-native predatory fish introductions. Bull frogs are not currently present at these sites and reed canarygrass abundance, if present, is relatively low.

This consultation will focus primarily on the effects of the proposed action on spotted frog-occupied sites that are likely to be affected by water management operations (Figures 6 and 7). Therefore, there will be no further discussion of the above-mentioned spotted frog sites unless these areas provide demographic support to populations within the action area.

4.3.1.2 Spotted Frog Sites/Populations in Areas Affected by the Proposed Action

The extent of the action area within the Upper Deschutes River subbasin includes Crane Prairie and Wickiup Reservoirs, and the Deschutes River between the reservoirs and downstream of Wickiup Dam to the city of Bend, Oregon. Within this geographic area, there are approximately 17 known spotted frog-occupied sites or populations that will be described below in the context of ongoing water management operations (Table 9). For the purposes of this opinion, we refer to some sites as populations. For example, there are several breeding sites in and around Crane Prairie Reservoir. Therefore, we may refer to the Crane Prairie population of spotted frogs. In the geography downstream of Wickiup Dam, spotted frog sites are separated by large distances and we suspect that there is limited genetic exchange. Therefore some of these sites may be referred to as a population. For example, the Old Mill area represents the most downstream extent of the spotted frog's current distribution; this area is located 12 miles downstream of the Slough Camp spotted frog site. Given the large distance between the locations of frogs and other factors described below, we describe these areas as populations. Genetic work is needed to properly assess population groupings.

Table 9 Spotted frog populations or sites within the Upper Deschutes River subbasin that are affected by ongoing water management activities.

Upper Deschutes River Subbasin	Watershed -10 th Field Hydrological Unit Code	Waterbody or River	Population/Sub-population/site Name
Above Wickiup Dam	Deschutes River- Charleton Creek	Crane Prairie Reservoir	Crane Prairie Reservoir NE bay
			Crane Prairie Reservoir NW Bay
			Crane Prairie Reservoir SE shore
			Osprey Point
			Crane Prairie Reservoir ODFW Gold fish pond
	Browns Creek – Deschutes River	Deschutes River	Deschutes River Arm of Wickiup
Below Wickiup Dam	Fall River – Deschutes River	Wickiup Reservoir	Wickiup SE Bay
			Bull Bend*
			Dead Slough
			Benchleg Pond
			La Pine SP SW Slough
			Private land*
	North Unit Diversion Dam- Deschutes River	Deschutes River	Island Loop (private)
			Sunriver
			SW Slough Camp
			East Slough Camp
			S. Ryan Ranch*
			Private Preserve **
			Old Mill - LSA Marsh

* Occasional breeding detected.

** New site; only juveniles detected.

The geographic areas where spotted frogs occur are delineated in this section as above and below Wickiup Dam. This delineation corresponds to the critical habitat designation of sub-units 8A and 8B. The sites or populations are then described in terms of demographics using egg mass counts and other population level monitoring where it exists. A description of spotted frog

habitat is then discussed in the context of ongoing water management operations. Subtle nuances to hydrological function at specific sites are then described where it is appropriate or necessary to elucidate how spotted frogs are being affected by changing water conditions.

Over the entire action area within the Upper Deschutes River subbasin, spotted frog habitat has been significantly altered and continues to be influenced by the operation of Crane Prairie and Wickiup reservoirs. Current water management operations influence spotted frogs and their habitat differently upstream and downstream of Wickiup Dam. Generally, reservoir operations store water during the winter months (October to April) and release stored water during the spring and summer (April to October). Therefore, reservoirs may be very full during winter while habitats downstream of the dam are lacking water. The reverse scenario occurs at the onset of irrigation season in April when reservoirs are drawn down and flows return to the Deschutes River and adjacent wetland habitats. Clearly, the timing, duration and spatial extent of inundation vary across the entire geography where spotted frogs occur. Moreover, the temporal and spatial variation in inundation of habitats can vary between years in response to variations in weather relative to rain and snowfall.

The regulated hydrology of the reservoirs and Deschutes River, and the hydrological influence on spotted frogs and spotted frog habitat, are described below.

4.3.1.2.1 Monitoring Spotted Frog Habitat within the Context of Water Management

The following sections describe how we have and continue to assess hydrological conditions at various spatial scales (i.e., site versus landscape). We also describe ongoing biological surveys for spotted frogs. These monitoring efforts are ongoing and provide important data to inform water management operations.

Photo Monitoring to Assess Hydrological Conditions

Much of the existing information on the effects of the water management on spotted frogs has been collected via ground observation and photos. Photos taken at the site-scale facilitate our understanding of the timing and duration of inundation in wetlands. Establishing a photo series over several years at particular sites facilitates our understanding of the variability in the hydrological system in response to managed storage and release of water as well as from the natural variation in rainfall and snow. Hydrological conditions may vary between years (e.g., wet years versus dry years) and irrigation management changes made in response to environmental conditions. For purposes of this analysis, we have used photos to describe the range of hydrological conditions within wetland habitats inhabited by spotted frogs in the action area.

In addition to site-scale photos, aerial flights have been conducted by the Service periodically prior to and during irrigation ramp up and ramp down along the Deschutes River and around the reservoirs to observe and photograph hydrological conditions at a larger spatial scale. These photos highlight habitat areas that may retain water through the winter and help to inform where to conduct breeding surveys in the spring. The photos elucidate when particular flows may inundate or dewater wetlands, and facilitate an assessment of hydrological connectivity at a landscape scale. Table 10 lists the flights that have been conducted by the Service to date with

corresponding flows measured at the WICO, BENO (Station ID: 14064500) and LAPO gauges and storage volumes at Wickiup and Crane Prairie Reservoirs.

Site-scale and aerial photos will be referred to within this document to describe hydrological conditions that affect the function of wetlands inhabited by spotted frogs and the life cycle of the spotted frog. Appendix C contains reference images to facilitate the explanation of site conditions within the text below.

Table 10 Aerial flights to conduct photo monitoring of the action area between 2015 and 2019 and OWRD near real-time hydrographics data.

Aerial flight dates	WICO gauge (cfs)	BENO gauge (cfs)	LAPO Gauge (cfs)	Wickiup Storage (acre feet)	Crane Prairie Storage (acre feet)
9 30 2015	983	1430	68	17,410	26,510
10 5 2015	542	1160	51	16,970	26,670
3 18 2016	28	743	345	169,500	41,140
4 7 2016	609	1220	313	173,300	41,540
3 17 2017	99	847	411	166,300	43,770
4 21 2017	626	1490	469	171,700	46,610
10 11 2018	340	880	59	2,830	35,350
4 12 2019	399	1120	535	138,700	45,410
10 2 2019	488	983	114	19,810	35,260

NOTE: WICO flow data are provisional for 2018 and 2019. BENO and LAPO flow data are provisional for 2017 through 2019.

Assessing the Hydrological Function of the Deschutes River and Adjacent Wetlands

Wickiup Ramp Down Study

Sequential photo series have been used to monitor the Deschutes River and adjacent wetland habitats. In the fall of 2014, photo monitoring was conducted for a two-week period along approximately 53 miles of the Deschutes River between Wickiup Dam and Lava Island Falls during a staged ramp down of irrigation water between flows of approximately 700 and 47 cfs out of Wickiup Dam. The study, described in more detail below, included known spotted frog breeding habitat and numerous locations along the river that are within designated critical habitat for the spotted frog. Surface water elevational data were collected in addition to photos over the course of this monitoring effort. See photos in Appendix C that depict the current condition of spotted frog habitat photographed during the experimental ramp down in 2014.

Hydrological Monitoring - Quantitative

In cooperation with irrigation districts during development of the Deschutes River Basin HCP, hydrological monitoring was conducted at two locations along the Deschutes River (Bull Bend and Slough Camp). The purpose of the monitoring was to gain a better understanding of the relationships between reservoir operations and water surface elevations (water depths) in wetlands occupied by spotted frogs.

Through use of pressure transducers, surface water elevational changes in wetlands were correlated to changes in flow in the river. Stage data for the river was compared to stage data for the associated wetlands to determine the temporal relationships between changes in river flow and changes in wetland water depth.

The hydrological connections between the river and the associated wetlands are variable over the 61 river miles from Wickiup Dam to Bend. Wetlands with direct surface connections to the river fluctuate in direct and immediate responses to changes in river stage. Other wetlands with subsurface (groundwater) connections to the river may show lags of several days before water tables respond to changes in river flow. The data collected at transducer sites on the Deschutes River provide us with important information on the timing of changes in water levels within wetlands and quantify lag effects to changes in flow within the river due to irrigation storage and release operations. A preliminary report from Biota Pacific describes the network of transducers and the hydrological monitoring results from September 2015 through October 2016 in the Slough Camp wetlands (Vaughn 2017a), which are discussed in detail below.

Hydrological Modeling of Deschutes River Flows to Assess Floodplain Inundation

Floodplain inundation modeling techniques that utilize LiDAR (Light Detection and Ranging) are often used to assess the extent of spatial inundation, and hydrological experts have suggested that these techniques be developed for the Deschutes River Basin. However, existing LiDAR data in the Basin have been collected during the summer when the flows in the Deschutes River are high and wetlands are inundated with water. LiDAR does not penetrate the surface of the water. Therefore, the elevational data for the river and floodplains that would be necessary to conduct hydraulic modeling are not available at this time.

The Service has been working with partners to develop hydrological modeling to further inform our understanding of how water management influences wetlands along the Deschutes River. To date, hydrological modeling of Deschutes River flows and inundation of floodplain wetlands has been small-scale, primarily due to a lack of data, described above, and funding.

The Basin Study Work Group (BSWG), a large collaborative group focused on developing water solutions in the Deschutes Basin, funded an instream flow study that was completed by River Design Group (RDG) (RDG 2017). The BSWG directive for the instream flow study was to complete an analysis that evaluates the relationships between instream flow and adjacent wetland habitats. The study focused on two areas along the Deschutes River reach between Wickiup Dam and the Fall River where spotted frogs occur: Bull Bend and Dead Slough.

Although this modeling effort only covers two spotted frog locations, it provides some useful information about the reach of the Deschutes River immediately downstream of Wickiup Dam that is primarily influenced by flows measured at the WICO gauge. The RDG modeling effort is discussed below that describes spotted frog habitat between Wickiup Dam and the Fall River.

Further downstream, another effort to model inundation of floodplain wetlands was attempted by the USGS Oregon Water Science Center in collaboration with the Service but this effort is currently unfunded. The USGS water group conducted a data collection effort in 2016 within the

reach of the Deschutes River between Benham Falls to Dillon Falls for use in floodplain inundation modeling efforts. The final data include water surface elevations from 15 water level loggers in the main channel between Benham and Dillon falls and two loggers placed in two of the off-channel ponds in that reach. The temporal scope of the final data ranges from March 26 to October 9, 2016. The data are published at <https://doi.org/10.5066/F7DR2SP5>. Due to a lack of funding, the USGS has not initiated hydraulic modeling studies in this reach of the river at this time.

Spotted Frog Population Monitoring

In addition to hydrological monitoring, breeding counts are conducted in early spring through a large, interagency collaborative effort. Egg masses are easy to detect relative to other life stages of the spotted frog (tadpole, juvenile, adult). As explained below, we use egg mass counts to gain a general idea of how many breeding adult frogs may be present within wetlands where they are known to occur. It should be noted that these surveys cannot be relied upon to determine trends in populations. However, in areas where breeding counts have been conducted over long periods of time (e.g., Sunriver) we can assess how management may be affecting the adults within the population. More intensive monitoring is needed to understand the population demographics of the spotted frog.

Breeding counts typically commence in mid-March and continue into early May, though the bulk of time is spent during the first few weeks in April when breeding occurs at many of the sites. Spotted frog breeding has been described as “explosive” whereby it occurs all at once (Pearl et al. 2010, p. 4). This rush of breeding can be completed within a couple of weeks. This rapid rate of breeding can hinder our ability to gather counts at all of the known sites across the entire landscape.

Breeding surveys are currently conducted via a multi-agency collaborative effort that includes a private researcher (i.e., J. Bowerman) and consultants (Biota Pacific, Campbell and Associates). Currently, Reclamation is partnering in this effort through funding to the USGS. The Service coordinates with the U.S. Forest Service, USGS, Oregon Department of Fish and Wildlife and private individuals prior to each breeding season to ensure that many of the key spotted frog sites are being surveyed and that there is no duplication of effort as a protection measure for spotted frogs. ESA section 10 permits have been issued to individuals conducting the survey work.

Despite the large coordinated effort to conduct breeding counts, it is nearly impossible to reach every site in a single year due to insufficient personnel, the large geographic area to be surveyed, and the abundance of snow that hinders accessibility of sites during the breeding season (e.g., Wickiup and Crane Prairie Reservoirs and high elevation sites).

Ongoing Studies

Information on many aspects of population biology, habitat use, and connectivity for spotted frogs in the Deschutes River Basin is being gained through partnership with the USGS. The Service and USGS received funding under a Scientific Support Partnership (SSP) in 2017 to conduct a study that assessed the status and biology of spotted frog populations along the Deschutes River that are affected by the storage and release of water from Wickiup Dam. These studies have and continue to focus on three sites through USGS and partner funding: (1) East Slough Camp; (2) SW Slough Camp; and (3) Dead Slough (Pearl et. al. 2018; Duarte et. al. 2020; and Rowe et. al 2020 In Review).

The SSP study (2017) addressed specific questions related to spotted frog population dynamics (size, growth, survival, etc.) and distribution within the managed water regime. The study built upon ongoing survey and monitoring efforts by utilizing mark-recapture and telemetry techniques. The work characterized the redistribution of frogs as flows and water levels are reduced in late summer, as well as assessed inter-site and cross-river movements that have implications for population connectivity and colonization of restoration sites. The sampling efforts conducted to date will facilitate future landscape genetic analysis. Data collection began in the summer of 2016 prior to the receipt of funding for the project; that funding was confirmed in June of 2017. The Service continues to provide funding to USGS for this work through Recovery Funds.

The USGS published a manuscript paper on the late-seasonal movement and habitat use of spotted frogs in 2018 that included the three Deschutes River sites, described above (Pearl et al. 2018). Spotted frogs were tracked at these sites from September through December. This temporal window allowed USGS to document distance and rate of movements of frogs to their wintering areas within the lifespan of the telemetry batteries. Data were gathered from 23 frogs with transmitters at the three sites. Movement periods for the Deschutes River frogs coincide with the irrigation storage season and the timing of long distance movements at Dead Slough and East Slough Camp are likely influenced by the dropping water levels in the wetlands.

During the tracking period frogs relocated from primarily aquatic lentic habitats to a range of habitats for wintering. Oregon spotted frogs used primarily aquatic habitats during the early weeks of tracking (mid- to late-September) and moved to winter sites that included semi-terrestrial retreats at the two Slough Camp sites and a mainly aquatic wintering site at Dead Slough. The farthest any of the Deschutes frogs traveled from their point of release over the period they were monitored was just over 200 m (Figure 2 in Pearl et al 2018).

Telemetry work was conducted by USGS at Crane Prairie Reservoir in 2018 to gain a better understanding of how spotted frogs may utilize the reservoir during winter. The telemetry study of spotted frogs at Crane Prairie Reservoir was funded by Reclamation, as per Term and Condition 9 in the Incidental Take Statement accompanying the 2017 Opinion (pp. 213-214). The purpose of the study was to determine fall movement and habitat utilization prior to overwintering. The telemetry work was conducted from September to December 2018, and approximately 32 spotted frogs were tracked over this time period. Preliminary data show that

spotted frogs do not move far from the regularly used spring oviposition sites and that they are using both the reservoir and tributaries to the reservoir for overwintering. A manuscript for the telemetry study at Crane Prairie Reservoir is in review (Pearl et. al. In Review 2020).

4.3.1.2.2 Oregon Spotted Frog Sites above Wickiup Dam

Both Crane Prairie and Wickiup reservoirs and the Deschutes River in between the reservoirs are occupied by Oregon spotted frogs. Of the approximately 15,365 acres encompassing this area, approximately 15,213 acres are contained within the two reservoirs. Although the reservoirs represent a large portion of this geography, the habitat areas where spotted frogs have been detected represent much smaller acreages than the entirety of the reservoirs (Figure 8).



Figure 8. Oregon spotted frog breeding sites within Crane Prairie and Wickiup Reservoirs.

The reservoirs provide breeding, rearing and overwintering habitat for the OSF and facilitate an aquatic connection between populations. However, the quality of OSF habitat is influenced by current water management operations, water storage volumes and surface water elevations within the reservoirs. Our understanding of where spotted frogs overwinter and how spotted frogs move between overwintering and breeding sites along the reservoir margins is limited within the vast area of the reservoirs. Current reservoir operations, particularly in Wickiup Reservoir, result in significant fluctuations in water levels that limit the availability of habitat. A recent study at Crane Prairie reservoir indicates that most spotted frogs are moving into the reservoir in the fall to overwinter (Pearl et al. in review 2020). The increasing water depth from November through March when water is being stored in the reservoirs provides OSF overwintering habitat.

Breeding survey efforts have been limited within the entire geography depicted in Figure 8, mostly due to the expansive area to be covered and difficulty in accessing these sites when roads are snowed in during the late spring. Our current understanding of the distribution and abundance of Oregon spotted frogs within this geographic area is based on existing breeding surveys and summer observations, described below.

Crane Prairie Reservoir

OSF Distribution and Abundance

Crane Prairie reservoir supports one of the larger populations of the OSF in the Deschutes River subbasin as indicated by the results of breeding surveys in 2013, 2015, 2017, 2018 and 2019 (Table 11). Monitoring of the Crane Prairie OSF population has been consistent since 2013. Breeding counts indicate that water management of the reservoir has had a major influence on OSF productivity and survival, as discussed below.

Within the reservoir, there are four main areas where breeding has been detected. Other wetlands and ponds draining or adjacent to the reservoir also serve as breeding sites for OSF. However, these habitats are less influenced by reservoir water management. The majority of spotted frog breeding occurs in wetlands along the north shore of Crane Prairie between the Cultus River and east of the confluence with the Deschutes River and the reservoir (i.e., Crane Prairie NW bay and Crane Prairie NE bay) (Figure 9). In 2018, a large breeding area was detected as Osprey Point on the west shore of the reservoir. A small number of egg masses have recurrently been located along the south shore of the reservoir (Crane Prairie SE; Table 11). A pond adjacent to the reservoir (i.e., ODFW Goldfish Pond) also consistently serves as a breeding site for spotted frogs. Wetland oxbows adjacent to the Deschutes River (i.e., Cow Meadow Wetland and Oxbow N. FS 40 RD) also serve as consistent breeding sites for OSF. The approximate 8.5 mile stretch of the Deschutes River upstream of Crane Prairie provides connectivity for spotted frogs to move into Crane Prairie from other populations (Blue Pool, Little Lava Lake) located upstream of the reservoir. It is also possible that Deer Creek which hosts spotted frog populations of OSF upstream of Crane Prairie reservoir allows for spotted frog immigration into the reservoir along the northwestern shore.



Figure 9. Oregon spotted frog breeding sites at Crane Prairie Reservoir from 2013 to 2017.

Table 11 Egg mass counts at breeding locations at Crane Prairie Reservoir

Breeding site	2012	2013	2014	2015	2016	2017	2018	2019
Crane Prairie Reservoir NE bay	-	100	-	168	18	82	178	336
Crane Prairie Reservoir NW Bay	-	95	-	118	10	292	495	387
Crane Prairie Reservoir SE shore	2	-	-	5	6	0	13	2
Osprey Point	-	-	-	-	-	-	84	190
Total Reservoir Egg Mass Count		195		291	34	374	770	915
Crane Prairie Reservoir ODFW Gold fish pond	40	-	-	10	25	13	23	49
Deschutes River - Cow Meadow wetland	-	21	-	-	-	4	10	0
Deschutes River – Oxbow N. FS 40 RD	7	2	-	9	5	-	16	1

In 2016, a summer survey of spotted frogs detected predominately juvenile spotted frogs at various locations around the reservoir outside of known breeding locations (Biota Pacific 2016) (Figure 10). Summer observations indicate that the distribution of spotted frogs is throughout the entirety of the reservoir. In 2018, USGS captured spotted frogs in late summer along the entire north shore of Crane Prairie, indicating that breeding efforts west of the Cultus River on the north shore have not been accounted for in past surveys.



Figure 10. Summer observations of Oregon spotted frogs at Crane Prairie in 2016.

In the fall and early winter of 2018, the USGS tracked 32 OSF at Crane Prairie Reservoir to identify potential overwintering locations. Movement patterns of individually tagged spotted frogs showed that frogs did not move far from where they were belted. Those captured within the wetlands along the reservoir moved into the reservoir to winter (Pearl et. al In Review 2020). Figure 11 depicts fall and winter locations of OSF in 2018 during the USGS study.

Influence of Hydrology on Spotted Frogs and Critical Habitat

Crane Prairie Reservoir is relatively shallow with a maximum physical capacity of 55,300 acre feet and storage water rights of 50,000 acre-feet. Crane Prairie Reservoir sits on permeable basalt which results in a large amount of seepage. Crane Prairie Reservoir storage and water elevations and exceedance values (80, 50 and 20 percent) from 1983 to 2009, depicted in Figure 12 below, show the seasonal volumes of water at Crane Prairie Reservoir based on historical use and the



Figure 11. Wintering locations of Oregon spotted frogs at Crane Prairie Reservoir in 2018.

predicted use that was modeled for the 2017 Opinion operations (OSF Proposal). In general, Crane Prairie Reservoir begins to fill in October and reaches maximum storage during the spotted frog's breeding and rearing period in April or May. Historically, the reservoir drawdown typically occurred in mid-April and continued to October when the reservoir reached its lowest storage volume between 18,270 and 33,940 acre feet (20- and 80 percent exceedance storage values). The historical drawdown resulted in an average difference between the annual maximum and minimum pool elevation for Crane Prairie Reservoir of 5.4 feet.

Under historical operations, the Crane Prairie Reservoir pool would often fall outside suitable Oregon spotted frog habitats within the emergent wetland vegetation along the shoreline which is predominately inundated when reservoir volumes are above 40,000 acre feet. Figure 13 depicts the water line of the reservoir at the end of irrigation season (September 30, 2015) at 26,500 acre feet of storage. During the fall season, frogs move to overwintering habitats and wetted emergent vegetation allows frogs to move easily under cover from predators. Ideally, frogs choose locations to winter within the water that are not accessible by predatory fish.

Historically, when reservoir volumes exceeded 50,000 acre feet, the water intersected more terrestrial vegetation that was less suitable habitat for Oregon spotted frog. As illustrated in Figure 12, from 1983 to 2009, peak storage in reservoir exceeded 50,000 acre-feet in half of the years. Crane Prairie Reservoir stayed above 35,000 acre feet in only two of those years;

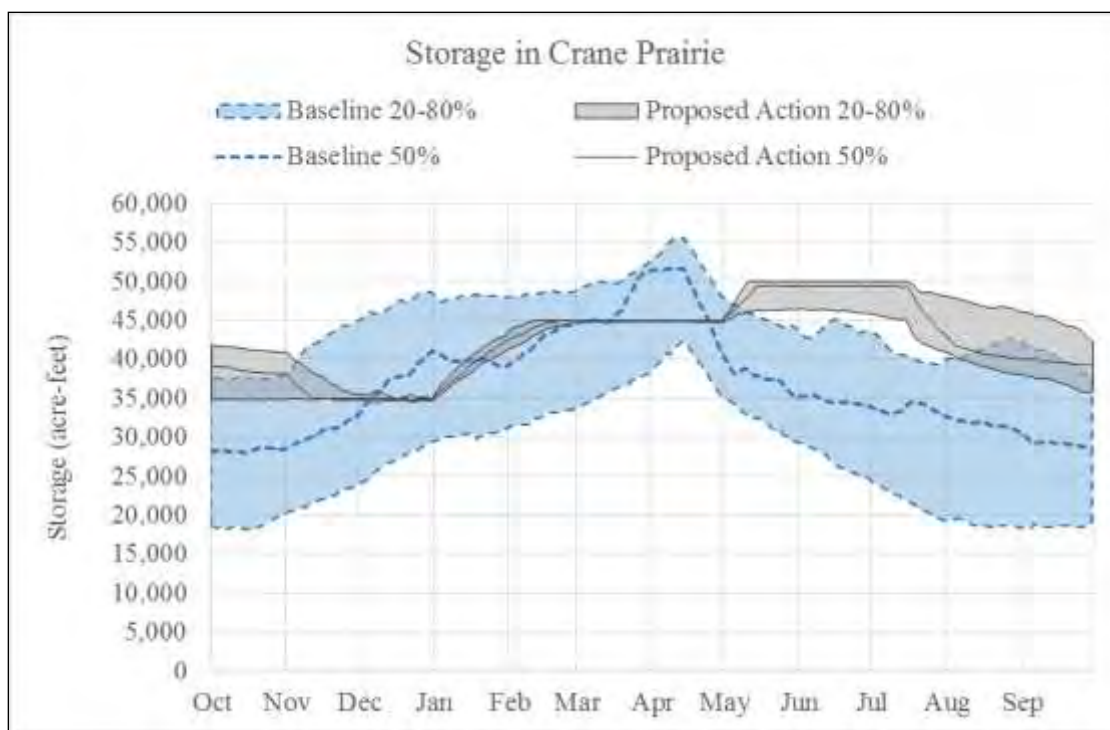


Figure 12. RiverWare modeled OSF Proposal (proposed action in 2017) and Baseline for storage in Crane Prairie.

therefore, it appears that historical operations affected the extent of available Oregon spotted frog habitat at different times of the year.

Reservoir management (i.e., the timing and duration of volumes of water) influences the quality of habitat for spotted frogs within the reservoir, and seasonal fluctuations in water surface elevations at Crane Prairie have had direct impacts to spotted frogs. Reservoir storage volumes in excess of 50,000 acre feet resulted in water expanding into unsuitable, upland habitat for spotted frogs. At near capacity reservoir volumes (>50,000 ac. Ft.), water extended into lodgepole pine forest and was outside of the sedge vegetation that protects egg masses and rearing tadpoles. These effects to spotted frogs were observed in 2015 at reservoir volumes of 54,535 and 54,980 (Figure 14) at two locations along the north shore of Crane Prairie where large numbers of egg masses were located on March 30 and April 3, 2015. In some areas, egg masses were free floating in deep water and exposed to winds that swept egg masses towards the center of the reservoir, thereby exposing them to potential predation by fish. In other areas, egg masses were deposited in shallow water in the upland edges of the reservoir. As described above, these areas did not contain suitable vegetation to support the development of egg masses and tadpoles. Furthermore, some of the areas were heavily shaded, which slows the hatching of the eggs. On May 13, 2015, the breeding locations were revisited to determine whether or not they remained inundated at storage volumes of 48,286 acre feet. These areas were dry and a long distance from the water edges (Figure 15). In 2015, the May drawdown at Crane Prairie for downstream irrigation led to unsuccessful breeding efforts and emerging tadpoles perished under this water management scenario.



Figure 13. Crane Prairie Reservoir at 26,500 acre feet of water on September 30, 2015.

The overwintering period (October to February) for spotted frogs in the reservoirs is also one in which there may be limited habitat that results in reduced survival of juvenile, sub adult and adults spotted frogs. As reservoirs are drawn down through the summer and fall, the once inundated wetlands become devoid of water and frogs are exposed to predation by terrestrial animals such as sandhill cranes, which are often seen in the wetlands inhabited by spotted frogs at Crane Prairie. In late September and October when reservoir volumes are lowest, overwintering sites for spotted frogs are limited to the reservoir or along the tributaries where the rivers flow into the reservoir. What remains for overwintering habitat, particularly within the reservoir itself, is laden with non-native predaceous fish resulting in reduced survival through this life stage. A telemetry study of spotted frogs at Crane Prairie was conducted by USGS in the fall and early winter of 2018. The study confirmed that most frogs are utilizing the reservoir for overwintering and that greater than 90 percent of locations were within the water (Pearl et. al. 2020 *In Review*).

A small reservoir pool that is void of vegetation that serves as cover for spotted frogs through winter may negatively influence mortality of spotted frogs. In 2015, we believe that the heavy draw down of Crane Prairie to water volumes below 27,000 acre feet in August of 2015 combined with continued low storage volumes (<30,000 acre feet) until mid-December 2015



Figure 14. Crane Prairie NE Bay Breeding Site on March 30, 2015 at 54,535 acre feet of storage (left); Crane Prairie NW Bay breeding site on April 3, 2015 at 54,980 acre feet of storage (right).



Figure 15. Crane Prairie NE Bay Breeding Site re-visited on May 13, 2015 at 48,246 acre feet of storage shows areas where breeding sites are dry.

reduced overwintering survival of spotted frogs. Spring breeding surveys in 2016 found low egg mass counts compared to the prior years of 2013 and 2015 (Table 11), and no spotted frogs were encountered near the breeding locations or within other suitable habitats within the reservoir. Furthermore, the breeding habitat at approximately 40,000 acre feet in mid-March was vastly reduced compared to past years. In the fall/winter seasons (October 1 to March 15) that preceded the years of high breeding counts, the reservoir volumes at the beginning of the storage season (Oct 1) were approximately 30,000 acre feet and reached volumes of between 48,000 and 50,000 acre feet by early March.

Based on limited observations of site conditions and breeding surveys, reservoir operations were modified in 2016 to improve habitat conditions for spotted frogs and increase survival as early conservation measures of the DBHCP. Effectiveness of these conservation measures has been assessed to determine if these changes are beneficial to the species.

In 2017 post 2016-Settlement, breeding conditions observed on April 21, 2017 at 46,630 acre feet were favorable for spotted frogs compared to prior years. Eggs were deposited in water depths more suitable for egg development (ranging from 5 to 12 inches) and oviposition sites were within wetland vegetation. Water was not withdrawn from Crane Prairie until after July 15 to allow spotted frogs to metamorphose before drawing upon irrigation water in the reservoir.

The Service visited Crane Prairie on July 17, 2017 to observe water levels in the wetlands at a storage volume of 46,038 acre feet. Wetlands were sufficiently inundated with water and the spotted frog habitat appeared to be highly suitable (Figure 16).



Figure 16. Crane Prairie reservoir wetlands at 46,038 acre feet of storage on July 17, 2017.

Breeding counts in 2018 and 2019 were higher than past counts, indicating that modifications to the water management (e.g., earlier filling and later withdrawal of irrigation water) are yielding a positive OSF population response at Crane Prairie reservoir. Figure 17 exhibits highly suitable breeding conditions at Crane Prairie in 2019. Breeding counts in 2019 were the highest on record at 915 egg masses.

Wickiup Reservoir

Wickiup Reservoir encompasses an area of approximately 10,000 acres and although spotted frog surveys have been limited within this geographic area, there have been observations of Oregon spotted frogs at various locations within the reservoir over a number of years.

In 1996, Oregon spotted frogs were found in a toe-drain ditch at the base of Wickiup Reservoir, where flows enter the Deschutes River via the ditch below the dam (Hayes 1997b, p. 8). In 2001, eggs, juveniles, and adult Oregon spotted frogs were moved to constructed ponds in nearby Dilman Meadow, a wetland that drains into the Deschutes River, 2.6 miles below the Wickiup Reservoir outflow (C. Pearl and J. Bowerman, pers. comm. 2005; Adams et al. 2006, p. 12). The original site at the base of the dam no longer provides viable habitat.

In 2013, six egg masses were located on the southern end of the reservoir. Prior to that detection, spotted frog observations were limited to the northeastern area of the reservoir with less than 10 egg masses observed over several years (C. Pearl, pers. comm. 2010). The expansiveness of the reservoir and the large distance between known oviposition sites indicate that spotted frogs could



Figure 17. Crane Prairie reservoir Oregon spotted frog breeding habitat on April 24, 2019 at 48,201 acre feet.

have a broad distribution in the reservoir. However, the small number of egg masses encountered indicates that the adult breeding population may be very small. We cannot be conclusive about population size within the reservoir without further surveys and investigation. We suspect that much of the habitat within the reservoir is unsuitable for spotted frogs to complete their lifecycle due to the large fluctuation of water volume and elevation for irrigation storage and release.

Influence of Hydrology on Spotted Frogs and Critical Habitat

Wickiup Reservoir has a maximum physical capacity of 200,000 acre-feet, and storage water rights for 200,000 acre-feet. All rights to store water in Wickiup Reservoir are held by NUID. Wickiup Reservoir storage and water elevations and exceedance values (80, 50 and 20 percent) from 1980 to 2009 are depicted in Figure 18 (Figure 11 in USFWS 2017). In general, Wickiup Reservoir begins to fill in October and reaches maximum storage (186,680/197,420/200,130 AF representing the 80/50/20 percent exceedance storage values) during the spotted frog's breeding period in the spring. Storage releases typically commence in mid-April and the reservoir is

drawn down to its minimum storage volume (between 27,580 and 104,840 acre-feet, representing the 20th- and 80th-percentile minimum storage values respectively) by October (Figure 18; Figure 11 in USFWS 2017).

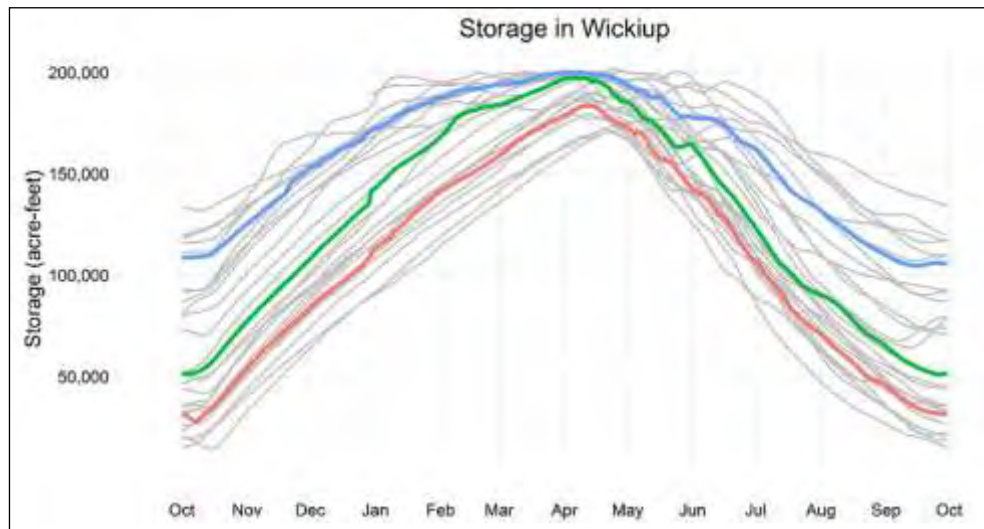


Figure 18. Storage in Wickiup Reservoir. Gray lines represent single-year traces for the period spanning 1980 - 2009. Colored lines represent the daily 20th-, 50th, and 80th-percentile exceedance values for the same period.

Reservoir management influences the quality of habitat for spotted frogs within the reservoir. When the reservoir is at maximum volume (~200 K acre feet), optimal (i.e., shallow depths less than 12 inches within emergent vegetation) breeding habitat for spotted frogs is limited. If spotted frogs breed within the reservoir, developing larvae are at risk to the dropping water level within the reservoir as releases occur. The minimum volumes of water that remain in the reservoir from October into the winter provide what may be marginal overwintering habitat for spotted frogs since these areas are predominately unvegetated with little refugia from the abundance of non-native fish that reside in the reservoir. Figure 19 shows the vast reduction in surface area inundated at between the spring and fall seasons at Wickiup Reservoir.

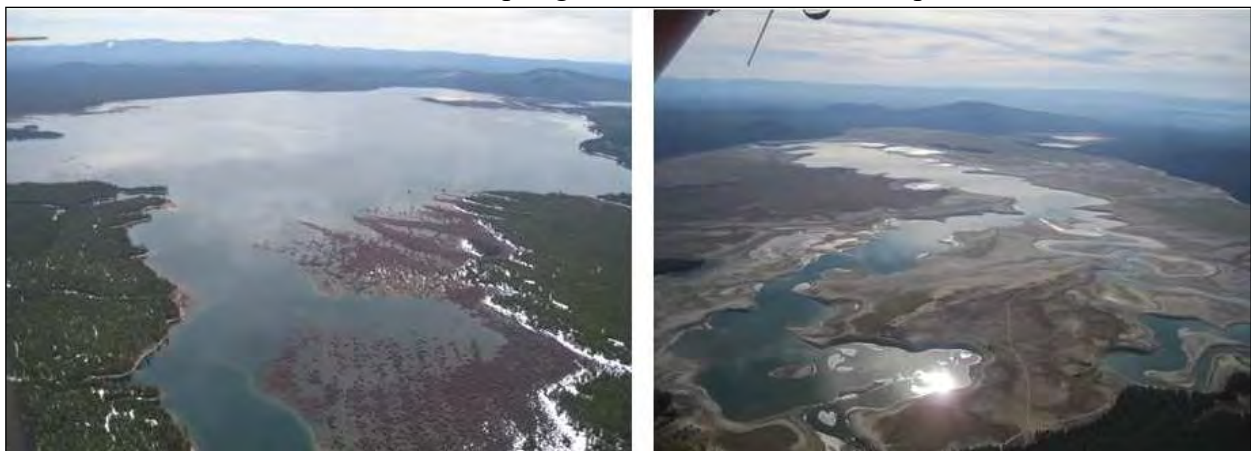


Figure 19. Wickiup Reservoir aerial photos on March 18, 2016 at 169,500 acre feet (left) and on September 30, 2015 at 19,704 acre feet (right).

Deschutes River Sites between Crane Prairie and Wickiup Reservoirs

The Deschutes River between the reservoirs provides some habitat for OSF and may influence connectivity between Crane Prairie and Wickiup reservoirs. Few breeding surveys have been conducted in this reach of the Deschutes River for spotted frogs. A small seasonally wetted breeding site (~1.6 acres) was detected on the west side of the river in 2014 (Figure 20) and has been consistently used as an oviposition site in most years since that time (Table 12).

Table 12 Breeding counts for the Oregon spotted frog population along the Deschutes River between Crane Prairie Dam and Wickiup Reservoir.

Breeding site	2014	2015	2016	2017	2018	2019
Deschutes River – Wickiup Arm	7	28	5	0	5	7

In 2017, no breeding was detected at this site. In 2019, no breeding was detected at the usual oviposition site which was dry. However, further searching during 2019 survey efforts located an oviposition site closer to the Deschutes River, indicating that the location of the oviposition site may vary depending on site inundation and suitability for breeding.

Observations of water levels and egg mass development at this site indicate that the breeding attempts are not successful. The seasonal wetting of the floodplain appears to be influenced by the storage of water in Wickiup Reservoir. The area does not remain inundated through the metamorphosis period and egg mass stranding has been observed (i.e., 2014 – 2016).

Since 2017, a hydrological evaluation of this site was conducted to assess the timing and duration of habitat inundation and the relationship between Wickiup Reservoir storage volumes and inundation of the Wickiup Arm breeding site. A key finding of hydrological studies conducted was that the Wickiup Arm spotted frog breeding site is mostly influenced by storage volume in Wickiup Reservoir (Vaughn 2018). Vaughn (2018) found that the Wickiup Arm breeding site was no longer inundated when reservoir volumes dropped below 142,000 acre feet. Despite Wickiup storage being between 134,000 and 135,000 acre feet and the known breeding site being void of water, spotted frogs deposited egg masses in an area near to the known breeding site within suitable habitat adjacent to the Deschutes River.

4.3.1.2.3 Oregon Spotted Frog Sites below Wickiup Dam

Spotted frogs occur in riverine wetlands and oxbows along the Deschutes River between Wickiup Dam and the city of Bend, OR, though their distribution is relatively sparse within this 61-mile river reach. The sparse distribution of spotted frogs is likely the result of the seasonal storage and release of water from Wickiup Dam, which has dramatically altered hydrological regimes within the Deschutes River and floodplain wetlands and renders many of the wetlands unsuitable for spotted frogs to complete their lifecycle (explained below). Current water management results in transitory inundation of wetlands that under a historic condition remained inundated and may have provided connectivity between sites.



Figure 20. Deschutes River spotted frog breeding location between Crane Prairie and Wickiup Reservoirs.

Wetland habitats along this reach of the Deschutes River that provide consistent and concentrated breeding activity are used by a relatively small number of frogs. Currently there are four known areas along this stretch of the Deschutes River where breeding activity is concentrated and consistent annually: La Pine State Park sloughs (including Dead Slough, Benchleg Pond and La Pine S.P. SW Slough), Sunriver, Slough Camp (East and SW Slough Camp sites) and the Old Mill (Les Schwab Amphitheater (LSA) Marsh and Old Mill pond) (Figure 7 above). Dilman Meadow, which drains to the Deschutes River approximately 2.6 miles below Wickiup Dam (~224 RM), hosts a population of translocated spotted frogs that is considered to be unaffected by the storage and release of water from Wickiup Dam. However, it is suspected that the storage volume of Wickiup Reservoir may influence the groundwater source at Dilman.

Due to a lack of genetic information, it is unclear if each of these concentrated locations of spotted frogs along the Deschutes River are distinct populations. However, given the large distance and isolation between sites due to the large fluctuations in Deschutes River flows, we refer to the frogs at each of these sites as its own population for the purpose of this analysis. Future genetic work is necessary to shed light on the degree to which each of these groups function as an independent population.

In addition to the above-mentioned sites, occasional, small breeding efforts are detected within other wetland and oxbow areas along the Deschutes River where hydrological conditions are sufficient to support overwintering of adult spotted frogs prior to the breeding season. There are likely some small breeding areas on private land that are not yet known because private lands are mostly unsurveyed.

Wetlands along the river outside of breeding areas are important for dispersal and connectivity between populations. Summer surveys of these wetland habitats for Oregon spotted frogs are limited. However, in the few summer survey efforts conducted to date, adult and juvenile spotted frogs have been detected in wetlands adjacent to known sites and in small wetlands that are a substantial distance (~12 miles) from known sites (e.g., site in the Lava Island to COID Diversion reach). These findings underscore the importance of all wetlands along the Deschutes River in providing for conservation and recovery of spotted frogs. We suspect that the high irrigation flows during summer in the Deschutes River may provide conditions that facilitate this movement and dispersal. However, we expect that there is limited survival of dispersing animals since most of the riparian wetlands are de-watered at the onset of the storage season and remain dry through winter. Research that aims to better understand population demographics and survival in this reach of the Deschutes River is needed.

In order to describe spotted frog habitats downstream of Wickiup Dam, we have divided the Deschutes River into seven analysis reaches: Reach 1 is Wickiup Dam to its confluence with the Fall River, Reach 2 is the confluence with the Fall River to its confluence with the Little Deschutes River, Reach 3 is the confluence with the Little Deschutes River to Benham Falls, Reach 4 is Benham Falls to Dillon Falls, Reach 5 is Dillon Falls to Lava Island Falls, Reach 6 is Lava Island Falls to the COID diversion, and Reach 7 is the COID diversion to the Colorado Avenue Bridge (Figure 21). All reaches, except Reach 5, have known Oregon spotted frog sites. Table 13 depicts spotted frog sites within the analysis reaches and approximate location along the river by river mile (RM). These sites are described in detail below by analysis reach. In the next section, we discuss the condition of the Deschutes River at the broad scale because it is the river that provides function for the spotted frog sites.

Historical and Current Condition of the Deschutes River below Wickiup Dam

In order to describe spotted frog habitat in the context of regulated storage and release of water, we must first describe the hydrogeology of the Upper Deschutes River basin and the physical changes to the river and adjacent wetlands that have occurred since the construction of Wickiup Dam in 1943. This fundamental explanation is necessary because it is the physical configuration of the river and the variation in the timing and duration of flow volumes within its channel (described in terms of cubic feet per second (CFS)) that support the ecological function of wetlands inhabited by spotted frogs.

A description of the river system must also include a discussion of unregulated (i.e., flows prior to dam construction) hydrology, since it was under that historical flow regime that the river and wetlands formed. Furthermore, there are limits to the amount of water that the basin can provide to the Deschutes River even in the absence of the reservoir system.

Prior to the construction of the reservoir system, the Deschutes River was described in a 1914 USGS report as “remarkably uniform” (USGS 1914, p. 12). The inherent volcanic geological

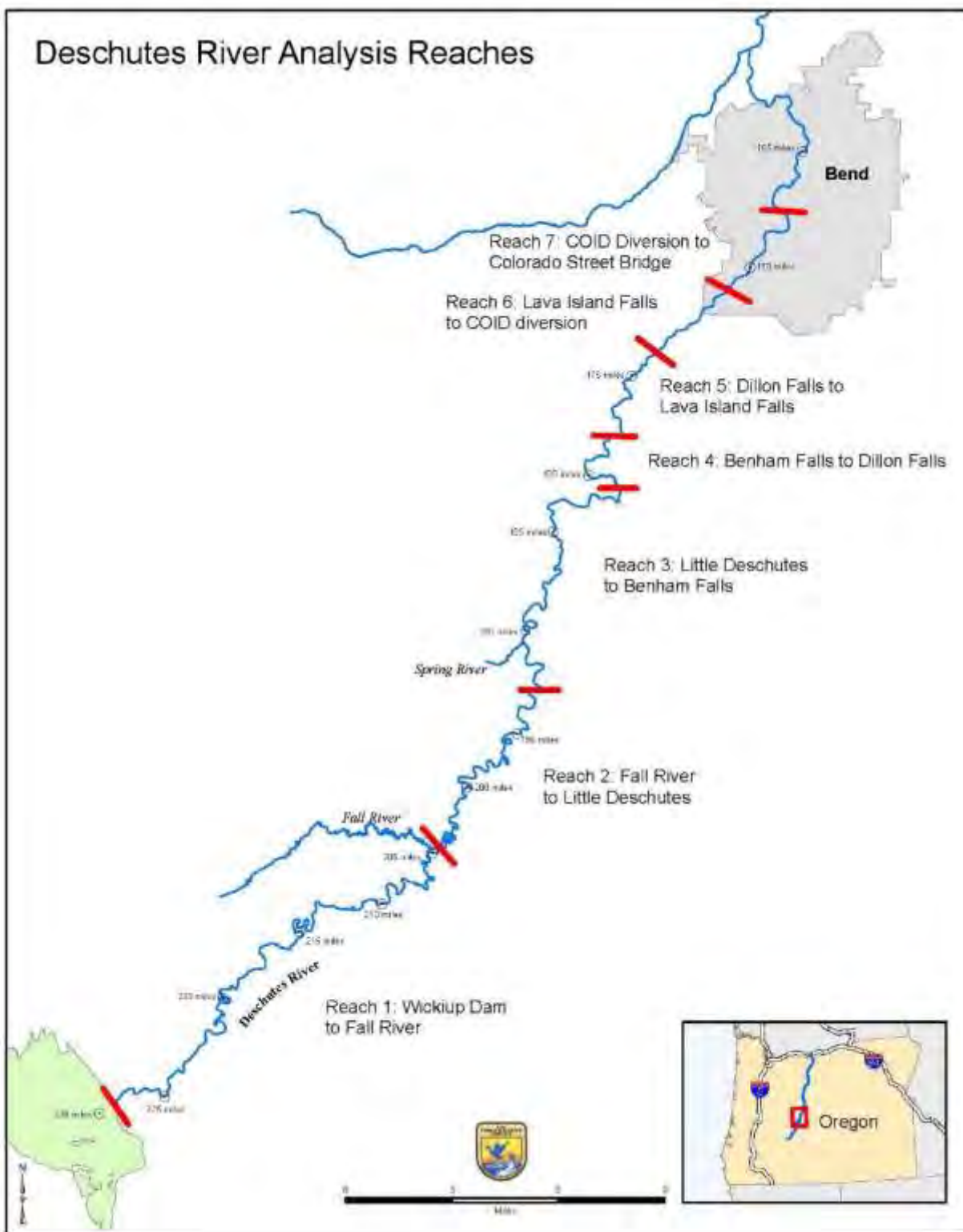


Figure 21. Deschutes River analysis reaches for Section 7 consultation.

nature of the Upper Deschutes River basin contributed to this consistent, relatively stable flow in the Deschutes River (USFS 1996, Gannett 2001). The Upper Deschutes River basin is primarily spring-fed, whereby snowmelt runoff is absorbed by pumice sands over porous volcanic rock, and infiltrates directly into the ground water system. As a result of large volumes of subsurface flow, the Upper Deschutes River basin has few tributaries most of which are spring-fed (USFS 1996, p. 132).

In between Wickiup Dam and Bend, OR, the Deschutes River has few tributaries: the Fall, Little Deschutes, and Spring Rivers. These tributaries augment flows in the Deschutes River downstream of the Fall River at approximate 205 RM. In the 22-mile reach of the Deschutes River between Wickiup Dam and the Fall River, flow is dependent on releases from the dam and it is within this reach that the effects of changes to the hydrological regime due to operation of the reservoir system are most extreme.

The change in hydrologic regime associated with the storage and release of irrigation water from Wickiup Reservoir has significantly altered flows in the Deschutes River and the way the river interacts with its floodplain. Storage of water in the reservoirs resulted in winter flows as low as 20 cfs at the WICO gauge prior to the 2016 settlement agreement that increased winter flows to 100 cfs. Summer flow releases for irrigation can be as high as 1,800 cfs at the WICO gauge. Wetland inundation along the river corresponds to the fluctuating hydrograph resulting from storage and release operations. Wetlands are dewatered and riverbanks are exposed during the storage season. These habitats are then inundated during the summer irrigation season by large volumes of water. Figure 22 depicts the Deschutes River at approximate river mile 179 in the fall when wetlands are dewatered.

Table 13 Oregon spotted frog sites within the analysis reaches and approximate location along the Deschutes River by river mile (RM).

River Reach	Sites within analysis reach	~ River Mile (RM)
1: Wickiup to Fall River	Bull Bend ¹	221
	Dead Slough	208
	Benchleg Pond (private)	206.5
	La Pine SP SW Slough	205.5
2: Fall River to Little Deschutes	Private land ¹	202
	Island Loop (private)	195
3: Little Deschutes to Benham Falls	Sunriver	188 – 191.5
4: Benham to Dillon Falls	SW Slough Camp	180
	East Slough Camp	179 - 180
	S. Ryan Ranch ¹	179
6: Lava Island Falls to COID diversion	Private Preserve **	172
7: COID Diversion to Colorado Street Bridge	Old Mill - LSA Marsh	167.5 - 168

¹ One time breeding event with single egg mass observed.

* Pre-metamorphic frogs

** Juvenile frogs



Figure 22. Photo depicts Deschutes River and adjacent wetlands in the Benham to Dillon Falls reach on October 12, 2016 with flows of 117 at WICO and 570 at BENO.

The hydrograph as a result of regulated flows is vastly different than that of the historical unregulated system that depicted relatively stable year round flows immediately downstream of Wickiup Dam (Figure 23; Figure 16 in USFWS 2017). Estimates of the historical unregulated flow regime of the Upper Deschutes River vary between studies depending on the period of record, gauging location, the statistical approach used for analysis, and observational records (Golden and Alyward 2006; USGS 1914; LaMarche and Eklund 2003; Bureau of Reclamation *in progress*). For the purposes of this opinion, we use seasonal monthly averages and the hydrographs to characterize the magnitude of change in flow that has occurred since the reservoir systems have been in operation.

The reservoir-regulated flows that release large volumes of water during the irrigation season and store it through winter have resulted in physical changes to the river channel geomorphology downstream of Wickiup Dam. The river channel, once a low-gradient system with relatively stable flows and well-established vegetation that stabilized the streambanks, has been scoured by the large volumes of water that it now conveys for irrigation. The streambanks, consisting of fine volcanic and glacial sediments held together with riparian vegetation, have been severely eroded, resulting in a channel that is now estimated to be 20 percent larger than it was prior to the change in flow regime (USFS 1996). The widened channel in many areas is unvegetated, a result of the erosive processes that have occurred in the past and continue as water is stored and released. The photos in Figure 24 depict low winter flows in the Deschutes River downstream of Wickiup Dam, the enlarged and eroding channel and mudflats.

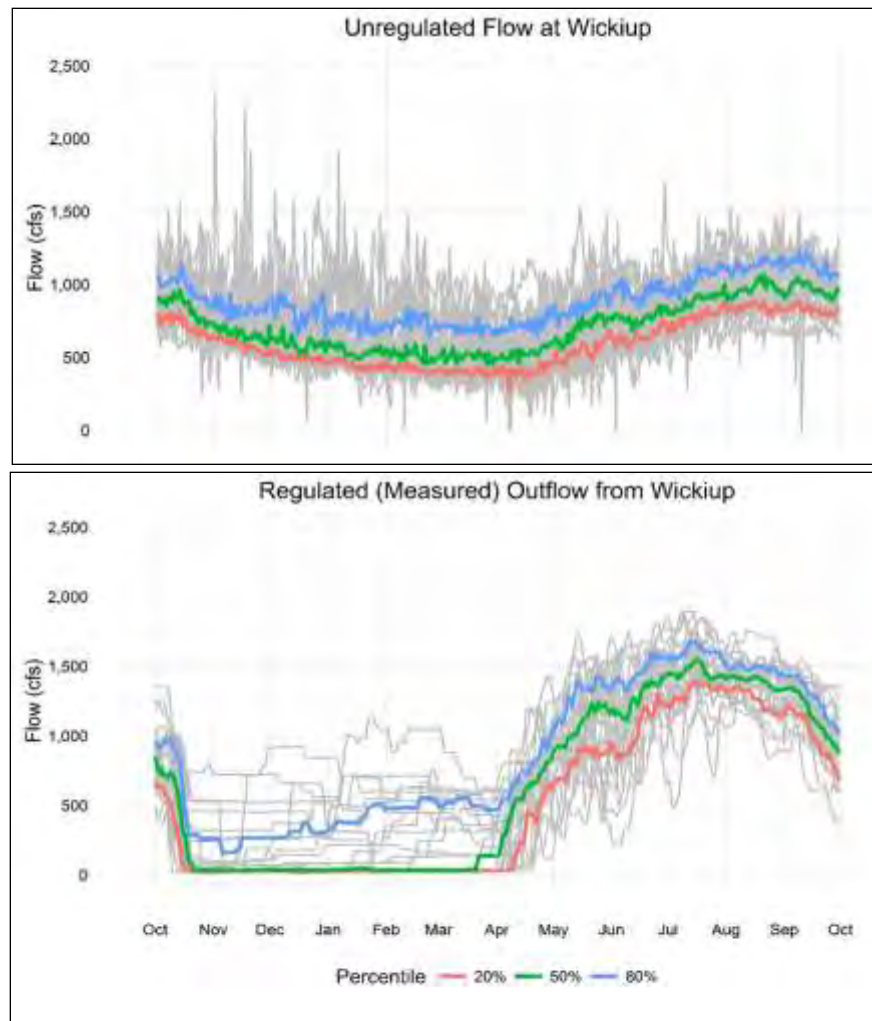


Figure 23. RiverWare-modeled unregulated versus regulated (measured) flows out of Wickiup Dam (WICO gauge). Gray lines represent single-year traces for the period spanning 1980 through 2009. Colored lines represent the daily 20th-, 50th-, and 80th-percentile exceedance values for the same period.



Figure 24. Photos of the Deschutes River channel condition during low winter flows from Wickiup Dam.

The widening of the river channel affects the way water is distributed spatially on the landscape. Essentially, lower volumes of water do not reach areas that the same volumes would have reached via conveyance through the historical channel. Wetland habitats have shifted in distribution and the vegetative characteristics of these wetland and riparian areas is dependent on the volume, timing, and duration that water is present.

The reservoir regulated flow regime has increased the frequency and duration in which the river exceeds bankfull flows during summer. Irrigation season flows result in increased depth of inundation in slough habitats adjacent to the river. Because this occurs during the vegetation growing season, wetland vegetation is deeply inundated and unable to survive. Therefore, existing wetland habitats may exhibit large areas that are unvegetated and, at low flows (October through April), water intersects exposed sediment.

The area of spatial extent of inundation of sloughs along the river has increased due to high flows, as well. Under the current water management, high flows have created wetlands in areas where they may not have been in the past.

Influence of Hydrology of Spotted Frogs and Critical Habitat

All of the physical and hydrological changes to the river and adjacent wetland habitats, described above, influence the distribution and survival of spotted frogs within this reach of the Deschutes River. The regulated flows that affect the hydroperiod (i.e., the seasonal pattern of timing and inundation of water) of wetlands disrupt the spotted frog's life cycle in several ways. Figure 25 (Figure 3-1 RDG 2017) depicts the average mean daily flows for 2000 to 2014 from Wickiup Dam within the context of the spotted frog life cycle.

At the onset of the irrigation water storage season in early October, Deschutes River flows may drop to as low as 100 cfs and wetlands without groundwater support are dewatered and unsuitable for the overwintering period of the spotted frog life cycle. The vast reduction in acreage as a result of the fall ramp down occurs at a time when frogs must move to overwintering habitat to survive the extremes of a Central Oregon winter. The rate at which the flows drop during the storage season is abrupt and frogs are left stranded without water and

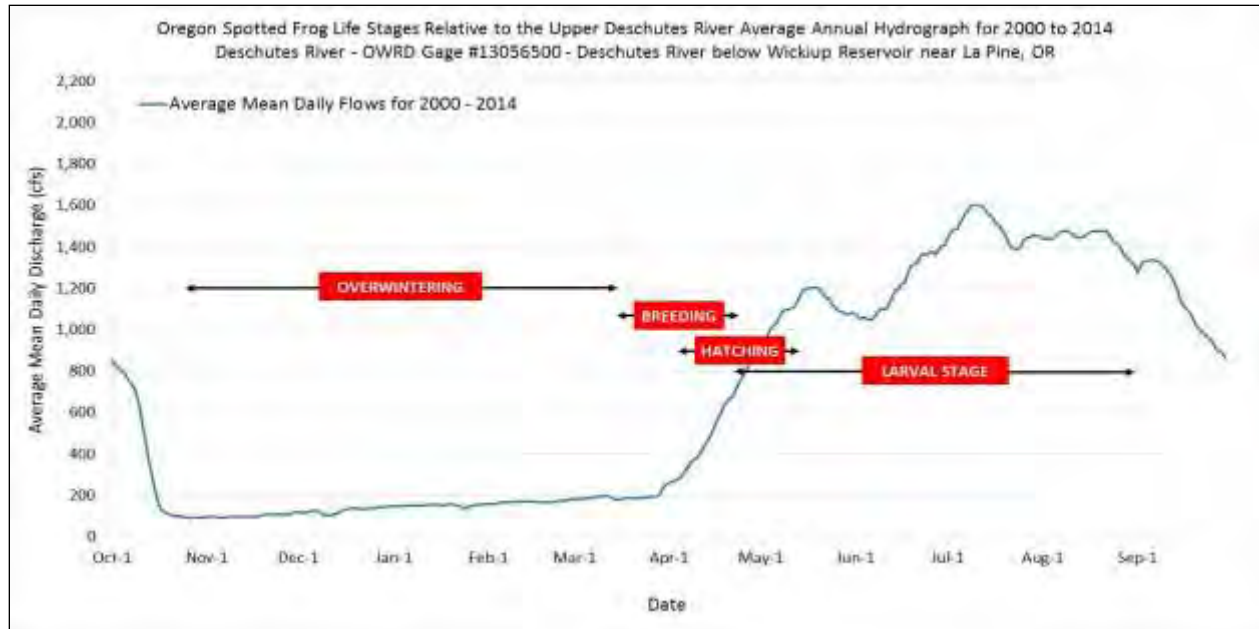


Figure 25. (Figure 3-1 RDG 2017). Oregon spotted frog life stage timing relative to average daily flows from Wickiup Dam from 2000 to 2014.

hiding cover from predators. Low water during the winter storage season has the potential to reduce winter survival of juvenile, sub-adult, and adult frogs and impact connectivity among seasonally used habitats and between breeding populations. Brown trout that reside in the river may be concentrated into areas where spotted frogs seek overwintering habitat when the flows in the river are reduced.

High summer flows (up to 1,800 cfs at WICO) vastly increase the surface area of inundation in most wetlands along the Deschutes River. In areas where spotted frogs are breeding, the high flows intersect an abundance of emergent vegetation that provides excellent rearing habitat for spotted frog tadpoles. However, frogs that move into suitable habitat at high flow are more likely to be stranded as flows are reduced for the storage season.

Early irrigation season flows in April correspond with the breeding period for Oregon spotted frogs and often flows are not sufficient to inundate large areas and reach emergent vegetation. Therefore, the breeding efforts are concentrated into small areas. The preferred shallow water depths that spotted frogs tend to seek may be outside of emergent vegetation that provides cover for eggs and hatching tadpoles and may be so shallow that stranding of these life stages may occur. The eggs and hatching tadpoles also are exposed to weather conditions such as freezing and overheating.

Although we have described ongoing effects to spotted frogs and their habitat in a general sense, monitoring work continues to improve our understanding of the specific flows that have the greatest benefit or impact to spotted frogs. This monitoring is especially important as the Service and Applicants implement the DBHCP and conservation actions that support Oregon spotted frog into the future.

Deschutes River Flows and Ongoing Effects to Spotted Frogs and Critical Habitat

Wickiup Ramp Down Study (2014)

In October 2014, a monitoring opportunity provided insight into how specific flows affect riverine and wetland habitats along the Deschutes River between Wickiup Dam and Lava Island Falls (approximately 53 miles). A staged ramp down of the Deschutes River was conducted by Oregon Water Resources Department (OWRD) in cooperation with the Deschutes Basin Board of Control (DBBC) and partners within the community (Trout Unlimited, ODFW, Deschutes River Conservancy, etc.) to allow stranded fish to be salvaged from a side channel at Lava Island Falls (RM 174.5). The USFWS and Forest Service, as part of the collaborative effort, selected 20 locations along the river between Wickiup Dam and Lava Island Falls to conduct a photo monitoring study over the staged ramp down to determine how the system, including wetlands, responded to various flows (Figure 26). Water elevation surveys also were conducted by the Forest Service as part of the 2014 Wickiup Ramp Down study.



Figure 26. Photo monitoring locations along 53 miles of river between Wickiup Dam and Lava Island Falls.

The purpose of the monitoring effort was to make general observations of river discharge and assess the corresponding physical and ecological processes associated with decreasing flow rates.

Methods for the ramp down study included six controlled flow releases from Wickiup Dam, each lasting two days to allow the river to equilibrate to Lava Island Falls (Gritzner, J., pers. comm. 2014). Flow rates chosen for the staged ramp down were intended to replicate various ecological flows identified in previous studies (Hardin-Davis 1991; USFS 1994), as well as to determine approximate river flow rates required to maintain flows through the Lava Island side channel to avoid fish stranding during the fish salvage efforts. Approximate flow rates (+/-45 cfs) controlled at Wickiup Dam were 700, 500, 300, 200, 100, and 50 cfs.

The entire study area had been proposed for Oregon spotted frog critical habitat designation at the time of the 2014 Wickiup Ramp Down study. Therefore, the photo monitoring of the river,

proposed critical habitat, and wetland and slough sites that were known to be inhabited by spotted frogs, allowed us to record the influence of various flows on spotted frog habitat. Select photos from the staged ramp down are indexed by river reach in Table 14 and included in Appendix C to exhibit the changes in these habitats at the onset of the irrigation storage season in the fall.

Table 14 Index of photos from Wickiup Experimental Ramp Down in 2014 at various flows recorded at the WICO and BENO gauges.

River Reach	Site location	WICO	BENO
Wickiup Dam to Fall River	Bull Bend	1168-47	
	Bull Bend breeding	1168-47	
	Dead Slough River	886-47	
	Dead Slough Inlet	886-47	
	La Pine State Park SW Slough	1168-47	
	La Pine State Park SW Slough (panoramic)	47	
Fall River to Little Deschutes	Silver Fox oxbow	975-47	
Little Deschutes to Benham Falls	Benham Wetland	886-229	1445-790
Benham to Dillon Falls	East Slough Camp pond	936-47	1442-586
	East Slough Camp revisit 12/9/14	50	664
	East Slough Camp revisit 2/ 11/15	127	941

Some general observations documented during the ramp down were that water receded from wetlands in the Wickiup to Fall River reach at higher flows than those downstream of the confluences with the Little Deschutes River. As the river dropped to 700 cfs at WICO, the flow exchange with the wetlands was towards the river and mudflats were beginning to be exposed (Gritzner pers. comm. 2014). This was an important observation since the wetlands without water cannot support spotted frogs through winter. Water receding from the vegetation towards the river degrades functional habitat for spotted frogs. Spotted frogs must move out of the vegetated cover of wetlands to remain in the water, which is primarily within the river channel as flows decrease. In the river channel and outside of vegetative cover, spotted frogs are at risk to predation.

At 500 cfs at WICO, water surface elevations are reduced by approximately 0.5 ft in the upper reaches above the confluence with the Little Deschutes River and 0.4 ft in the reaches below Benham Falls (Gritzner, pers. comm. 2014). More areas along the river and within slough habitats were exposed as mudflats, except the pond at East Slough, which lags due to slow permeability. The ramp down monitoring observed a large decrease in area inundated between 500 and 300 cfs. Below 500 cfs, water receded rapidly (i.e., within a 2 day period) from most wetlands (Appendix C). Although the ramp down study continued to monitor the river conditions as flows dropped below 300 cfs, few wetlands with groundwater persisted below these flows. As flows decreased, the river became the only place for spotted frogs to overwinter.

Ongoing Hydrological Monitoring of Spotted Frog Sites Downstream of Wickiup Dam

While the ramp down monitoring effort in 2014 highlighted the significant change in habitat along 53 of the 61 miles of Deschutes River where spotted frogs occur during the fall, additional site monitoring has been conducted to ascertain hydrological condition at other times of the year.

In order to further refine our understanding of the specific volumes of flow that are significant to habitat function for spotted frogs throughout the year, hydrological monitoring, as described above, is ongoing.

Table 15 outlines the flows at the WICO and BENO gauges that strongly influence the function of wetlands inhabited by spotted frogs. The flows in Table 15 correlate with inundation area that provides good habitat for spotted frogs. However, spotted frogs habitat does exist when flows are below these thresholds.

Additional and specific hydrological details that pertain to how a site functions are included below within spotted frog site descriptions. Spotted frog breeding sites are described below within the context of the regulated water regime in analysis reaches of the Deschutes River identified in Figure 21 above.

Table 15 Known breeding sites by analysis reach along Deschutes River and flows that begin to reduce habitat function (based on visual observation).

River Reach	Site location		WICO	BENO	BENO minus COID diversion and 7% loss
1: Wickiup Dam to Fall River	Bull Bend*		<900		
	Dead Slough				
	La Pine SP SW Slough				
2: Fall River to Little Deschutes	Private RM 202 ¹		unk		
	Island Loop (private)				
3: Little Deschutes to Benham Falls	Sunriver		Water begins to enter weirs above 1,580 at WICO and 1,900 at BENO		
4: Benham to Dillon Falls	SW Slough Camp			N/A	
	East Slough Camp	East Slough Camp (duck blind marsh)		<1200	
		North East Slough Camp		<1600	
		East Slough (Lily Pad pond)		1400-1600	
		East Slough Transducer Pond		<1500-1600	
	S. Ryan Ranch ¹			unk	
6: Lava Island Falls to COID diversion	Private Preserve RM 172			unk	
7: COID Diversion to Colorado Street Bridge	Old Mill - LSA Marsh				

¹ One time breeding event with single egg mass observed.

* Pre-metamorphic frogs

** Juvenile frogs

Deschutes River Spotted Frog Habitat between Wickiup Dam and the Fall River (Reach 1)

In between Wickiup Dam and the confluence of the Fall River, the wetland and riverine habitats receive water directly via flow releases from Wickiup Dam, and only an occasional spring contributes water to the river channel along this 22 mile reach of the Deschutes River (USFS 1994). Therefore, flow releases from the dam have a direct influence on maintaining suitable habitat for spotted frogs. The effects of the dramatic change in the hydrograph are most profound in this reach of the river and wetland habitat is limited.

Prior to 2018, there were two known locations along this river reach, approximately 20 miles downstream of Wickiup Dam within La Pine State Park, where spotted frog breeding had been detected over several years: Dead Slough and La Pine State Park SW Slough. In 2018, an additional breeding site was located in a spring-fed pond on private land that is not affected by the storage and release of water at Wickiup Dam. Another area, referred to as Bull Bend located 6 miles downstream of Wickiup Dam on National Forest land, may occasionally support spotted frogs as indicated by a single breeding effort in 2013 (Figure 27). Two recent studies, discussed below, highlight the effect that WICO flows have on the spotted frog sites within the riverine sloughs and wetlands. A description of the sites and spotted frog habitat utilization within the sites are described in detail below.

The 2014 Wickiup Ramp Down study, described above, documented the change in habitat conditions with decreasing flows from approximately 700 to 50 cfs at the spotted frog sites mentioned above (Appendix C). In general, the photographic sequence of the draw down study highlights the loss of suitable habitat for spotted frogs as water receded below the wetland vegetation line and towards the river. At 700 cfs, the recession of water from wetlands was already occurring within the Deschutes River reach between Wickiup Dam and the Fall River. Wetland oxbows that are spring supported or hold residual water through winter provide overwintering habitat for spotted frogs. However, these winter sites are devoid of cover and within open water that is mostly unvegetated. Although the river maintains water in the winter, even at flows of 29 cfs at the WICO gauge, there is little shelter from predators such as brown trout that reside in the river.

A recent instream flow study by River Design Group (RDG June 2017, 53 pp.) and funded by the Deschutes Basin Study Work Group modeled flows in the Bull Bend and Dead Slough areas of the Deschutes River to assess the relationship between streamflow and the adjacent wetland habitats. Habitat conditions for Oregon spotted frog and redband trout, both native aquatic species in this reach of the Deschutes River, were the subject species of these analyses. A 2-dimensional hydraulic and habitat model developed using suitability criteria for each species was used to look at a range of flows (20 to 1,800 cfs) along the two 1-mile stretches of river at Bull Bend and Dead Slough. The objectives of the study that pertain to Oregon spotted frogs were to (1) determine the potential increases or reductions in spotted frog overwintering and breeding habitats within the range of flows identified above; and (2) determine how flows, particularly high summer flows, effect emergent riparian vegetation.

Although the RDG study provided some useful information on a range of flow conditions within the Bull Bend and Dead Slough areas, we are careful in our interpretation of the modeled results, particularly the computed Weighted Useable Areas curves for spotted frog breeding and overwintering habitat in the RDG study, explained below. The riparian vegetation assessment portion of the study, however, is significant to understanding the current condition of the river and adjacent wetland habitat under the influence of the regulated flow regime that is high in the summer and low in the winter.

The utilization of an instream flow assessment methodology for Oregon spotted frog presents some challenges since the model is essentially using physical attributes (i.e., water depth, water velocity, substrate composition) to describe the quality of the habitat as per the suitability indexes. Yet, there are other habitat features that characterize the quality and suitability of habitat for Oregon spotted frogs such as the availability of year-round water within slough wetlands, presence of micro habitat features created by muskrats and beavers (e.g., lodges, channels, dens), shelter from predators, and close proximity between breeding and overwintering habitats. These temporal, spatial, and biological elements of habitat are not assessed within the model developed for the RDG study. Furthermore, the outputs of an instream flow model are highly dependent on well-developed habitat suitability criteria. As explained above, Oregon spotted frogs are not entirely dependent on the physical attributes used to develop habitat suitability criteria that is assessed through the instream flow methodology. We describe the relevant findings of the RDG study at both Bull Bend and Dead Slough below.

Bull Bend

Five pre-metamorphic spotted frogs were detected in the Bull Bend area (~RM 221) (Figure 27) in August 2013 (Bowerman, pers. comm. 2013a). Given that spotted frogs have limited mobility prior to gaining legs at metamorphosis, we conclude that frogs bred in this location in the spring of 2013. Breeding surveys conducted since 2013 at Bull Bend have not detected Oregon spotted frogs or evidence of breeding. We suspect that although wetlands appear to be suitable in this area during the summer, winter flows are too low to sustain a population of Oregon spotted frogs.

The detection of pre-metamorphic spotted frogs at Bull Bend in 2013 provides an example of occasional breeding efforts that occur along the river, described above, and indicates that there is potential for spotted frogs to utilize this area for breeding in spring seasons following wet winters⁷ when flow releases from Wickiup Dam increase flows in the Deschutes River. We assume that increased winter flows in 2012 to 2013, ranging from above 500 cfs to 300 cfs in December through March (Figure 28), may have facilitated movement of spotted frogs from Dilman Meadow to wetlands in the Bull Bend area, an approximate distance of 3 miles.

⁷ The winters of 2012 and 2013 were wet and flow releases from Wickiup Dam ranges between 500 and 300 cfs from December 2012 through March 2013. The Service suspects that the wet conditions may have provided better conditions for overwintering and movement and facilitated a breeding effort at the Bull Bend location.



Figure 27. Image of Dilman Meadow and Bull Bend spotted frog breeding locations within Reach 1 of the Deschutes River.

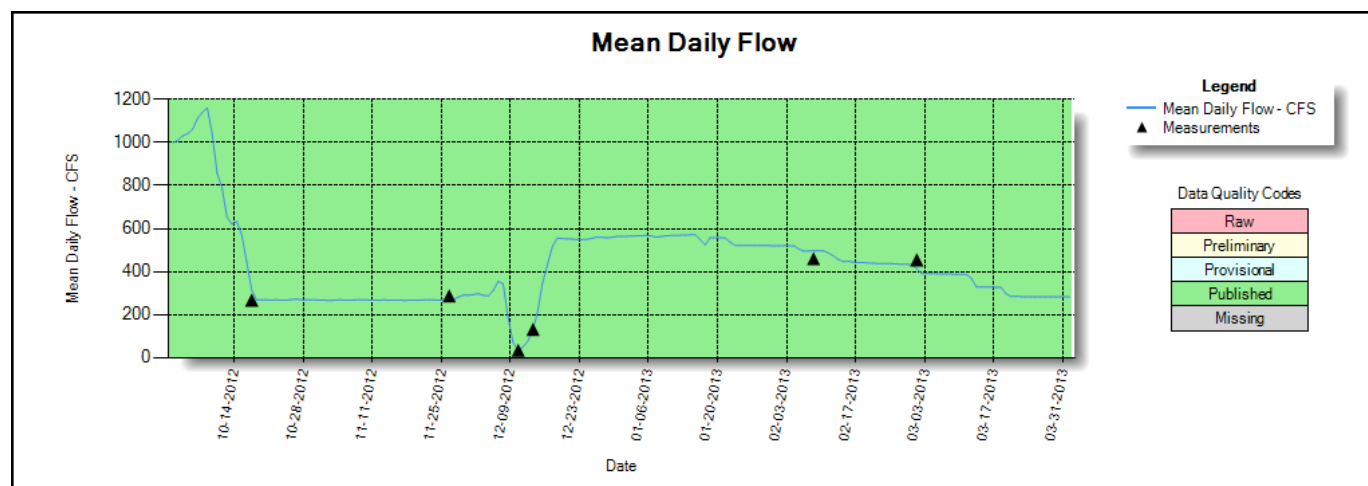


Figure 28. Hydrograph for flows at Wickiup Dam between October 1, 2012 and March 31, 2013.

The Bull Bend wetlands are typically dry during the spring breeding season from mid-March to mid-April (Figure 29). At this time, flow releases from Wickiup Dam are not sufficient to inundate wetlands, primarily due to the low demand for irrigation water by downstream users.

The 2014 Wickiup Ramp Down Study, described earlier, observed rapid changes in water levels in this area at the onset of the water storage season in October (Appendix C). As flows dropped to 700 cfs surface water from wetlands began draining to the river and dropped outside of wetland vegetation (Gritzner, pers. comm. 2014). Remaining overwintering habitat is within the Deschutes River, where spotted frogs are at risk of predation.



Figure 29. March 18, 2014 – WICO at 287 (top); April 6, 2016 – WICO at 606 (middle); April 14, 2015 - WICO at 753 (bottom)

The RDG study (2017) discussed earlier, modeled flows out of Wickiup and found that flows greater than 800 cfs were necessary to inundate wetlands in the Bull Bend area (RDG 2017, p. 36). The characterization of suitable overwintering habitat for spotted frogs in the Bull Bend area in the RDG study resulted in WUA curve with a steep increase in overwintering habitat suitability between 20 and 100 cfs and then a flattening of the curve as flows approached 600 cfs (Figure 30 as depicted in Figure 4-4 in RDG 2017). However, we note that the overwintering habitat is primarily within the river channel at these flows and that overwintering suitability increases along the edges of the channel and in closer proximity to breeding habitat as flows increase from 20 to 500 cfs (Figure 31 as depicted in Figure 4-3 RDG 2017).

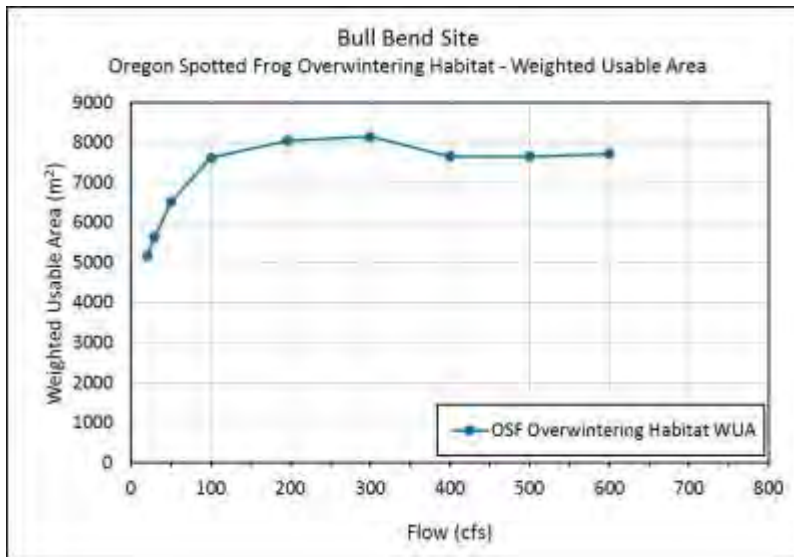


Figure 30. (From Figure 4-4 in RDG 2017). Oregon spotted frog Weighted Useable Area in the Bull Bend area.



Figure 31. (Figure 4-3 in RDG 2017). Oregon spotted frog overwintering habitat suitability in the Bull Bend study site, from left to right: 20 cfs, 300 cfs, and 500 cfs.

La Pine State Park Sloughs – Dead Slough and SW Slough and spring-fed pond on private land

Wetlands sloughs adjacent to the Deschutes River in the vicinity of La Pine State Park (including some private ownership), from approximate river mile 208 to 205 are inhabited by Oregon spotted frogs (Figure 32). Two breeding locations, referred to as Dead Slough and La Pine S.P. SW Slough, were first documented in 2013 by the US Geological Survey (Table 16). Both sites experience an unnatural hydroperiod due to the regulated storage and release of flows from Wickiup Reservoir, described below. Another small site (i.e., “bath tub”), located upstream and across from Dead Slough on the north side of the river, is occasionally utilized by spotted frogs for breeding. This site appears to be a small spring-fed pool (Figure 32). In 2018, Oregon spotted frog breeding was detected in a small spring-fed pond on private land in between the two La Pine State Park sloughs.



Figure 32. Oregon spotted frog breeding locations within La Pine State Park sloughs along Deschutes River.

Table 16 depicts the egg mass counts for the La Pine State Park sloughs (Dead Slough and La Pine SP SW Slough) and the private pond (Benchleg Pond). Egg masses observed in the “bath tub” site are included with the Dead Slough counts. Egg mass counts indicate that Dead Slough has an approximate minimum adult breeding population of 180 spotted frogs based on the 2019 survey. Located approximately two miles downstream of Dead Slough, the La Pine SP SW Slough appears to support few breeding adult spotted frogs. In most years, no more than two egg masses have been located since 2013. In 2018, seven egg masses were located within the slough (Table 16).

Table 16 Egg mass counts in Dead Slough and La Pine SP SW Slough from 2013 to 2019

Breeding site	2013*	2014**	2015***	2016*	2017*	2018	2019
Dead Slough (including “bath tub” site)	19	28 (2)	17	45	64	55	89
La Pine SP SW Slough	2	0	2	2	1	7	2
Benchleg Pond	-	-	-	-	-	18	14

*USGS survey; ** Oregon Parks staff survey; ***USFWS, Forest Service and Oregon Parks staff survey

Influence of Hydrology on Spotted Frogs and Critical Habitat

Dead Slough and the La Pine SP SW Slough are strongly influenced by flow releases from Wickiup Dam. Both sloughs retain water through winter. Dead Slough is spring supported and maintains a connection to the Deschutes River throughout winter even at the lowest flows from Wickiup Dam. Flows from Dead Slough to the Deschutes River are approximately 1 cfs during

the winter months. Although the latter site retains water through winter, the source of winter water in the La Pine SP SW Slough is undetermined.

In the spring prior to irrigation season flow releases, spotted frogs breed in shallow water that is unvegetated. Egg masses are exposed to wind and high water temperatures in the shallow water. Adult breeding frogs are at risk of predation by herons and raccoons. Figure 33 depicts Dead Slough at 290 cfs and 550 cfs flows at the WICO gauge on March 6 and April 15, 2015, respectively and shows an increase in lateral inundation of habitat as flows increase. However, the water's edge does not reach the vegetation until approximately 800 cfs (Figure 34). In instances where flows at Wickiup remain below 800 cfs at Dead Slough, emerging tadpoles are subject to predation by garter snakes and risk over exposure to environmental elements such as freezing and high water temperatures.



Figure 33. Dead Slough prior to and during breeding period in 2015 at 290 cfs (left) and 550 cfs (right) flows at the WICO gauge.



Figure 34. Emerging tadpoles at Dead Slough, at 796 cfs on May 2, 2016, without access to emergent vegetation that provides hiding cover and thermal protection.

The rise and fall of flows from WICO can impact spotted frogs during the breeding season as was observed in the spring of 2016. Egg masses were deposited near the outlet channel of Dead Slough at around 600 cfs. During warm weather, flows were ramped up to accommodate irrigation demands to approximately 725 cfs at WICO and egg masses moved into the outlet and toward the river. Flows were then dropped to nearly 600 cfs and egg masses and tadpoles were



Figure 35. Outlet of Dead Slough on April 18, 2016 where egg mass and tadpole stranding was observed following a rise and drop in flows at the WICO gauge.



Figure 36. Outlet of Dead Slough on May 2, 2016 at 796 flows at WICO where tadpoles were observed in isolated pools near the river.

stranded in the channel and remaining shallow pools (Figure 35). On May 2, 2016, the area was revisited at nearly 800 cfs and tadpoles were observed in isolated pools (Figure 36).

At the La Pine State Park SW Slough, there is minimal breeding habitat that is suitable for spotted frogs in the spring. Egg masses are deposited into pools of residual water from the previous winter where there is no wetland vegetation. The egg masses are exposed to wind and predation within the oxbow. Figure 37 depicts the typical site conditions within this site during the spring breeding season.



Figure 37. La Pine State Park SW Slough egg mass and the typical site conditions during the spring breeding season.

In the fall, the rapid rate of ramp down results in a drop in water levels in Dead Slough and the downstream slough within the State Park. The 2014 Ramp Down study, described above, documented the change in habitat conditions with decreasing flows from approximately 900 to 50 cfs at Dead Slough and from 1168 to 50 cfs at La Pine SP SW Slough (Appendix C). The photo series from the 2014 ramp down study show a rapid drop (i.e., flow decreases at WICO occurred every two days) in water levels within these two sloughs. Water was no longer in contact with vegetation after the drop to approximately 700 cfs. The wetland area within the SW Slough was void of water by 500 cfs. At Dead Slough there was a dramatic decrease in inundated surface area below 500 cfs (Appendix C).

The rapid change in water levels can increase the risk of predation by leaving frogs without water and vegetative cover to hide in. Frogs must find suitable overwintering locations that may be some distance away from where they are at the time of the ramp down. Figures 38 and 39 depict over wintering habitat conditions within the sloughs at La Pine State Park. Recent Telemetry work in the fall of 2016, tracked spotted frogs to overwintering locations in Dead Slough. All of the chosen overwintering locations were inundated with water into the winter period (Pearl et. al. 2018).

The recent hydraulic modeling by River Design Group (2017) describes the change in inundation at Dead Slough at flows ranging from 20 to 1,800 cfs. The modeled characterization of suitable overwintering habitat for spotted frogs in the Dead Slough resulted in a gradual increase in WUA



Figure 38. Overwintering habitat condition within sloughs at La Pine State Park at the onset of storage season in October.



Figure 39. Winter aeriels of the Dead Slough (left) and La Pine SP SW Slough (right) prior to the onset of the breeding season on March 18, 2016 with WICO at 28 cfs.



Figure 40. (Figure 4-10 in RDG 2017): Oregon spotted frog calculated Weighted Useable Area in the Dead Slough.

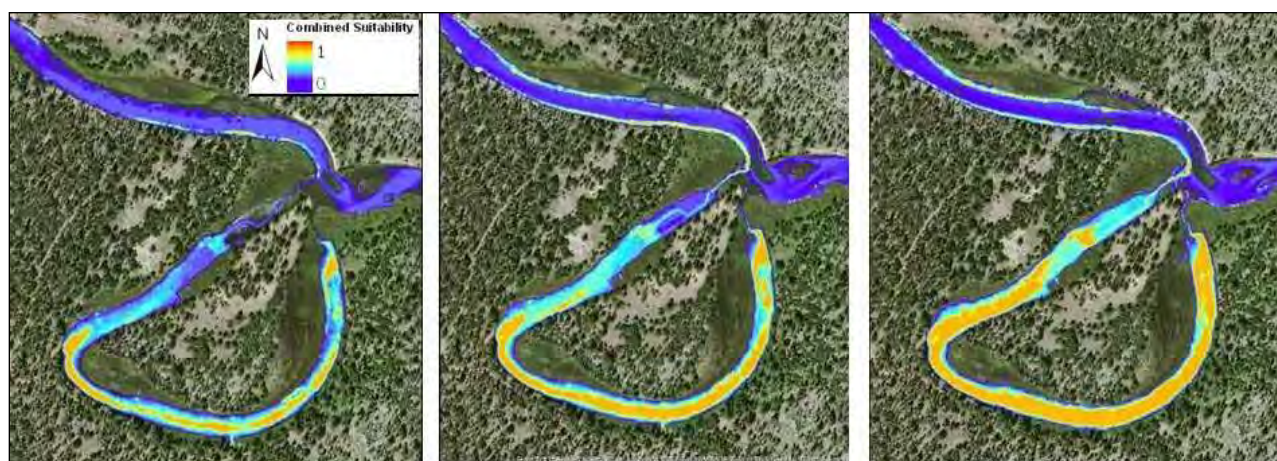


Figure 41. (Figure 4-9 in RDG 2017). Oregon spotted frog overwintering habitat suitability within the Dead Slough study site, from left to right: 20 cfs, 300 cfs, and 500 cfs.

(i.e., weighted useable area) for spotted frogs between 20 and 600 cfs at the WICO gauge with an inflection in the curve at 400 cfs when water in the slough receives water from the river (Figure 40; Figure 4-10 in RDG 2017). Figure 41 (Figure 4-9 in RDG 2017) spatially depicts Oregon spotted frog overwintering suitability at Dead Slough at modeled flows of 20, 300 and 500 cfs.

Dead Slough represents the only population of Oregon spotted frogs within the Deschutes River reach between Wickiup Dam and the Fall River (~22 miles). Therefore, maintaining the Dead Slough population is important to survival and recovery of spotted frogs. The Service and USGS worked through a Science Support Partnership project to gain additional information about this population. A mark recapture effort was conducted to assess how spotted frogs are utilizing the

slough habitat and the river under the influence of the regulated storage and release operations for irrigation at Dead Slough. The USGS utilized telemetry to track spotted frogs at this site between September and December of 2016 in an attempt to better understand habitat selection for the overwintering period. The telemetry study showed that spotted frogs are primarily using aquatic habitat within the slough for overwintering (Pearl et. al. 2018).

Deschutes River Spotted Frog Habitat- Fall River to Little Deschutes outlet at Sunriver (Reach 2)

The Deschutes River reach between the outlet of the Fall River and the Little Deschutes River is primarily under private ownership. Therefore, there have been few breeding surveys conducted in this approximately 12-mile stretch of the river. Two small riverine sites have recent evidence of spotted frog breeding. However, given that this reach of the river has an abundance of oxbow habitats, we assume that there are additional small breeding sites on private land along this reach of the Deschutes River.

In 2016, a single egg mass was detected in a small slough on the west side of the river just downstream of the Fall River at approximately river mile 202. An aerial flight photo, taken on March 18, 2016, indicates that this riverine wetland had water through the winter of 2015-2016, even though flows at the WICO gauge were 28 cfs. No egg masses were detected at this site in 2017, despite improved water conditions of 100 cfs at WICO and a wet winter (Figure 42). We observed evidence of toad predation by raccoons at this location and we suspect that the combination of shallow water and lack of cover do not provide refuge from predators and good overwintering conditions for spotted frogs. The input of additional water from the Fall River (~120 cfs) may improve some habitat downstream from its confluence with the Deschutes River. However, the additional flow from the Fall River is not large enough to result in a significant improvement to habitat conditions for OSF.

Another small OSF breeding site within the Deschutes River reach between the Fall and Little Deschutes River outlets is located in an area known as Island Loop (approximate river mile 195). Island Loop is located approximately 2.5 miles upstream of the outlet with the Little Deschutes River and is essentially an old riverine oxbow that has been developed (Figure 43). Few egg masses have been detected at this location over the years. In 2015, a single egg mass was located but appeared to be at risk of stranding (Bowerman, pers. comm. 2016). In 2017, between 6 and 8 egg masses were located within this wetland (Bowerman, per. comm. 2017a) on private land. In 2018, the Service located 4 egg masses at a single oviposition site within a small, groundwater spring within the Island Loop wetland. On April 18, 2019, the Service observed the beginning of breeding at this site within the same area. A week later fifteen egg masses had been deposited at four oviposition sites and egg mass stranding was evident within tire ruts within the wetland. Deschutes River flows at the WICO gauge were approximately 600 cfs and had not yet begun to inundate the floodplain wetland where spotted frogs had bred.



Figure 42. Winter aerial with WICO at 28 cfs and 100 cfs in March 2016 (left) and 2017 (right), respectively.



Figure 43. Location of spotted frog breeding sites along the Deschutes River, near the outlet of the Little Deschutes River on private land.

Deschutes River Spotted Frog Habitat between Little Deschutes River Outlet and Benham Falls (Reach 3)

Reach 3 includes Sunriver and wetlands habitats along the Deschutes River extending to Benham Falls. This reach is approximately 11.5 miles long.

Sunriver

Sunriver, located just downstream of the confluence of the Deschutes River and the Little Deschutes River (approximate 187.5 to 191.5 RM), hosts the largest population of Oregon spotted frogs in the Upper Deschutes River subbasin downstream of Wickiup Dam. Spotted frog habitat in Sunriver consists of excavated ponds and the Sun River, an old riverine oxbow along the Deschutes River that connects ponds and water features within the 3,300-acre community (Figure 44). Although these habitats are influenced by the storage and release of water from Wickiup Dam (i.e., the water levels drop and rise), a system of weirs has been managed by Sunriver Owners Association via assistance from the Sunriver Nature Center to maintain water levels within wetlands and ponds throughout winter for many years. Habitats in this area are geographically positioned to receive groundwater inputs via the Little Deschutes River, further improving the winter conditions for spotted frogs. Figure 45 depicts overwintering habitat in Sunriver when flows at the WICO gauge are 28 cfs and BENO flows are 744 cfs. The persistence of water through winter has been considered a key factor in the persistence of a robust population of Oregon spotted frogs in Sunriver. Hydrological monitoring in 2018 determined that Deschutes River flows in the spring do not flow through the weirs into Sunriver until flows at river gauges WICO and BENO are above, 1,580 and 1,898, respectively (Figure 46).

The Sunriver population of spotted frogs has a long survey history (i.e., 2000 to 2020). The final listing rule (79 FR 51658) included an estimated minimum adult breeding population of 1,454 spotted frogs, based on 2012 egg mass surveys. Egg mass surveys between 2014 and 2017 indicated that there had been a significant reduction in the adult breeding population in Sunriver since the ESA listing (J. Bowerman data 2000-2019; Table 17). The total egg mass counts in 2016 and 2017, at 369 and 355 respectively, were among the lowest counts in the survey history. The lowest count in 2004 was attributable to failure of the weir system during the winter of 2001 to 2002. The recent reduction in egg mass numbers appeared to correlate with an increasing number of American bullfrogs in Sunriver (Bowerman, pers. comm. 2017b).



Figure 44. Oregon spotted frog breeding habitat in Sunriver, OR.



Figure 45. Aerial photo of Sunriver spotted frog habitat on March 18, 2016 when flows are 28 and 744 cfs at the WICO and BENO gauges, respectively, shows extent of overwintering habitat due to weir management.

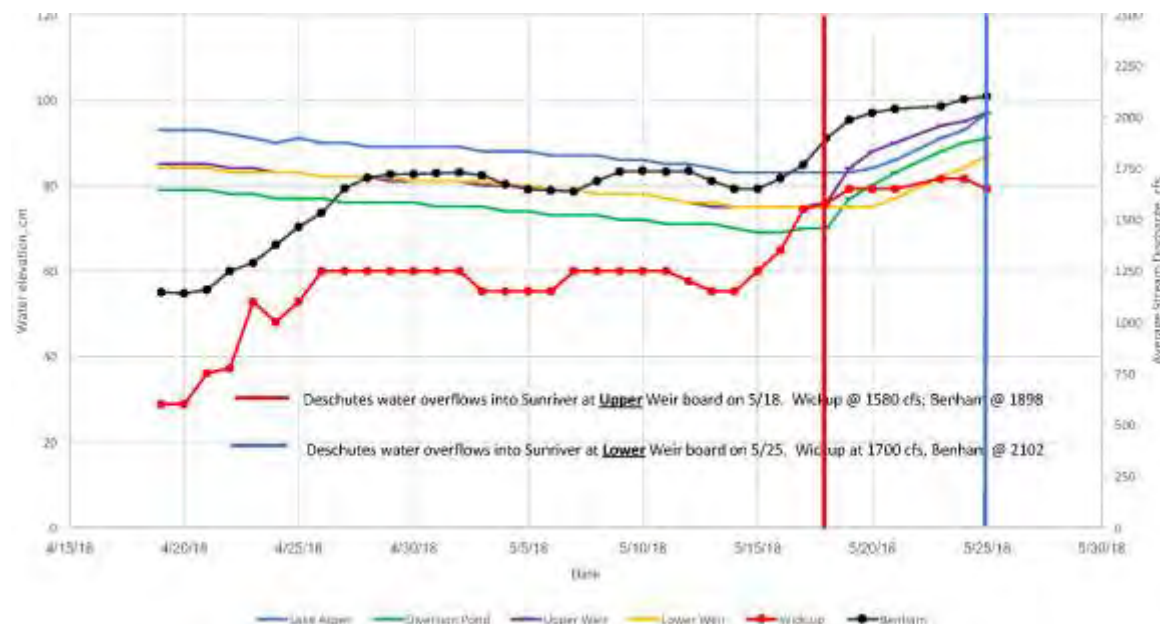


Figure 46. Hydrological evaluations of weirs in Sunriver relative to flows at WICO and BENO.

Bullfrogs began to colonize Lake Aspen in Sunriver in 2008, and the first breeding population was confirmed in 2010.

Bullfrogs appeared to be increasing in numbers despite some active management to eliminate them. Bullfrog control efforts by private landowners and hired consultants have been underway since 2017 and spotted frog breeding counts rebounded in 2018 and 2019 (i.e., 764 and 680, respectively). Continued population monitoring will determine effectiveness of spotted frog conservation efforts in Sunriver that include managing winter water levels through use of weirs, and reducing invasive species such as bull frogs and reed canarygrass.

In addition to egg mass counts, Oregon spotted frog spring and fall migration data in and out of Lake Aspen has been collected since 1999. The movement data provide important information about habitat utilization and the number of spotted frogs within the Sunriver waterways. Other biological data (i.e., sex, age class, weight, length) also is collected at the time of capture which provides additional demographic information on spotted frogs in Sunriver.

Table 17 Number of egg masses counted in Sunriver wetlands from 2000 to 2019.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
# egg masses	619	1182	698	477	282	637	1163	631	797	1132	1031	740	727

Year	2013	2014	2015	2016	2017	2018	2019
# egg masses	880	579	644	369	355	764	680

Since 2010 the number of spotted frogs captured in migration surveys has vastly decreased compared to earlier years. The decline in captures indicates that bull frogs are likely having an effect on spotted frogs in Sunriver. Active management to remove bull frogs is necessary in

order to conserve spotted frogs in Sunriver. Although Sunriver has been the largest population of spotted frogs downstream of Wickiup Dam, the rapid decline in egg masses as well as individuals counted in the migration surveys indicate that persistence of spotted frogs in Sunriver is threatened by bull frogs left untreated. This population of spotted frogs is essential to the conservation and recovery of spotted frogs downstream of Wickiup Dam.

The Sunriver Owners Association and Sunriver Resort have worked with the Service to develop draft management plans that describe spotted frog conservation efforts. Currently, we rely on volunteer efforts to continue the important work that has been ongoing for many years. The Service is planning to develop a Safe Harbor Agreement to ensure spotted frog conservation work continues on these private lands along the Deschutes River.

Wetlands between Sunriver and Benham Falls

Wetlands between Sunriver and Benham Falls (~RM 188 to 181, respectively) have had few spotted frog breeding or summer surveys over the years and we do not know how spotted frogs may be using these habitats. When the water is high in the Deschutes River and wetlands are inundated during the summer, spotted frogs have been found using wetlands along the Deschutes River in the vicinity of Sunriver. Further downstream, many of the wetlands along this 6.5-mile reach of the river are only accessible via boat and are therefore difficult to access during breeding surveys when the river is low. These wetlands have also been difficult to hydrologically assess for the same reason. Monitoring per the 2014 Ramp Down (e.g., Benham Wetland; Figure 47; Appendix C) and aerial flights conducted since that time indicate that many of these wetlands are dewatered during the storage season. An 11-acre wetland referred to as the Benham Wetland, located just upstream of Benham Falls, is dewatered when flows at the BENO gauge drop below 1,100 cfs (Appendix C). We assessed the hydrological condition of this wetland in the spring of 2016 to see if flow releases of 600 cfs from WICO could influence inundation of this site. We determined through an aerial flight that when flows are above 1,200 cfs at BENO, the site is inundated (Figure 48).

Other wetlands within this reach of the river should be assessed for winter inundation. Currently, we know that at least one of these off channel wetlands maintains water through winter (Figure 48). However, further studies are necessary to understand how flows in the river influence these habitats.

Although wetlands between Sunriver and Slough Camp do not currently have any known occurrences of spotted frogs, there are numerous ponds and wetlands that may provide for dispersing spotted frogs in the summer season when flows are high in the river (Figure 47 above). Therefore, these wetlands, an approximate 33 acres of suitable habitat (not including the river area), are important for spotted frogs that may disperse from Sunriver to Slough Camp or other suitable habitat along the river.



Figure 47. Wetlands showing potential Oregon spotted frog habitat along Deschutes River between Sunriver and Slough Camp.



Figure 48. Aerial flight photos of large wetland upstream of Benham Falls with flows at BENO gauge of 744 (left) and 1274 cfs (right) early in the spotted frog breeding season and winter inundation of wetland upstream of Benham Falls during low flows in Deschutes River.

Deschutes River Spotted Frog Habitat between Benham and Dillon Falls (Reach 4)

Wetlands and riverine habitats along the approximate 3-mile reach (178 to 181 RM) of the Deschutes River between Benham and Dillon falls provide important habitat for Oregon spotted frogs. Lands along this reach of the river are on the Deschutes National Forest. The Slough Camp area wetlands currently support spotted frogs. The Ryan Ranch wetland, less than 0.5 mile downstream of Slough Camp, is a historic spotted frog site that has recently been restored by the US Forest Service (Figure 49). Spotted frogs within this reach of the Deschutes River are isolated by long distances from populations upstream at Sunriver (~7 river miles) and downstream at the Old Mill (~11.5 river miles). Water falls on either end of the reach may further reduce connectivity between populations along the Deschutes River. The wetlands



Figure 49. Oregon spotted frog wetland sites between Benham and Dillon Falls.

inhabited by spotted frogs in this reach of the river exhibit a complex hydrology both naturally and under the regulated water management regime, described below.

Slough Camp

The Slough Camp area has two main wetlands inhabited by Oregon spotted frogs: a 9-acre marsh located on the west side of the river (i.e., SW Slough Camp) and a 47-acre wetland complex on the east side of the Deschutes River (i.e., East Slough Camp) (Figure 49). The SW Slough Camp spotted frog site is spring supported and is mostly influenced by snow-melt and precipitation. This wetland does not receive water from the Deschutes River until the flows for irrigation are high. In many years the SW Slough Camp site will remain inundated throughout the year. However, drought conditions, as observed in 2020, may cause the site to go dry as early as July. Conversely, East Slough Camp wetlands experience dramatic fluctuations in the area of inundation due to the storage and release of water from Wickiup Reservoir. Hydrological variability within the East Slough Camp wetland complex is described in detail below.

Oregon spotted frogs were first detected at Slough Camp in 2010 on the east side of the river (East Slough). In September 2010, approximately 42 frogs were found (21 adults with 3 being positively identified as breeding females and 21 juveniles). Breeding was confirmed in 2011 when 33 egg masses were located by the Forest Service at East Slough and 5 were located in a wetland south of the parking area at Slough Camp (SW Slough). Surveys on both sides of the

river in 2012 and 2013 yielded 14 and 41 egg masses, respectively. Table 18 shows annual egg mass counts since 2011 at SW Slough and East Slough. To date, the highest breeding counts observed were in 2017 at both sites (Table 18) (USGS 2017-2020 data). Based on breeding counts to date, the Slough Camp population of spotted frogs is estimated to contain less than 200 breeding adults.

Table 18 Annual Slough Camp egg mass counts since 2011.

Breeding site	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SW Slough Camp	5	14	41	8	8	18	27	20	12	7
East Slough Camp	33			10	39	67	100	58	106	75

Breeding in the Slough Camp area has been observed as early as March 17 in the SW Slough Camp wetland on the west side of the river. Within the East Slough Camp complex the commencement of breeding has been observed as early as the first week in April and as late as the first week in May. Based on observations in the timing of the onset of egg mass depositions, we suspect that spotted frog breeding may sync with the availability of water at the East Slough wetland complex. The hydrology within the East Slough Camp complex is strongly influenced by the storage and release of water from Wickiup Dam combined with inputs from the Little Deschutes River, 12 miles upstream, and is often lacking water until late April. Therefore, breeding habitat is limited in early April when breeding season typically commences. Typically, areas that retain water through winter are the first places that spotted frogs are able to oviposit in. When the area wets up, we have observed spotted frog egg masses in areas that had been dry earlier in the season.

In some years, when there is a delay in the flow releases for irrigation, spotted frogs may deposit egg masses in shallow water from snowmelt that gradually dries up if the river is still low due to irrigation storage. Subsequently, egg masses can strand.

Figure 50 depicts the distribution of oviposition sites within the Slough Camp wetlands since 2012. The location of oviposition sites is likely also influenced by the spatial and temporal variability in inundation of these wetlands.

Overwintering at this location may be difficult for Oregon spotted frogs due to the rapid drop in water elevation at the onset of the irrigation water storage season in October. Figure 51 (left) shows a large wetland area within the East Slough Camp wetland complex in the fall at the onset of the storage season, described below. In the fall of 2016, the OSF Technical Team for the HCP conducted visual observations at East Slough Camp to assess the rate of drawdown within the wetlands and observe potential stranding of spotted frogs. Juvenile spotted frogs were observed on mudflats along the Deschutes River, west of the draining marsh at East Slough (Figure 51, right). A gravid female (i.e., carrying eggs) spotted frog and numerous juveniles also were observed within a de-watered beaver channel on the south end of the wetland complex.



Figure 50. Oregon spotted frog oviposition sites within Slough Camp from 2012 to 2017.



Figure 51. East Slough Camp marsh is de-watered in October as irrigation storage season begins (left). Juvenile spotted frogs are observed along Deschutes River mud flats as wetlands drain (right).

To gain a better understanding of how spotted frogs select overwintering locations within the Slough Camp area, the USGS has used telemetry to track spotted frogs in the fall season as water draws down (Figure 52). Telemetry data gathered in 2011 and 2016 indicate that spotted frogs in the Slough Camp wetlands used a range of habitat types for overwintering, including distinctive features such as springs, beaver channels and semi-terrestrial habitat types (i.e., lava crevices) (Pearl et al. 2018). Data indicate that spotted frogs in the East Slough Camp Marsh seek overwintering sites within the large lava flow adjacent to the marsh (Figure 53). Most adult spotted frogs within the Slough Camp area are using non riverine habitats for overwintering.



Figure 52. Oregon spotted frog with USGS telemetry transmitter at East Slough Camp.

Hydrology of Slough Camp Wetlands and Influence on Spotted Frog Critical Habitat

The wetlands inhabited by spotted frogs in the Slough Camp area exhibit a complex hydrology both naturally and under the regulated water management regime. In order to understand this complex hydrology and how it influences spotted frog biology and habitat both temporally and spatially, a variety of monitoring techniques have been and continue to be implemented by the Service and agency partners. These efforts are described in general terms above and in detail below. The OWRD gauge at Benham Falls (BENO) is used to assess how flows in the river affect the wetlands in this reach of the river.

As stated above, the SW Slough Camp wetland, on the west side of the river (Figure 48), is supported by groundwater and retains water year round, except during drought conditions. This wetland is less influenced by the storage and release of water than other wetlands within this river reach. The East Slough Camp wetland has a complex hydrology and is strongly influenced by storage and release operations. Some ponds within the wetland complex retain water throughout the winter and others drain as the Deschutes River flows are reduced at the onset of the irrigation storage season at Wickiup Reservoir. The vast majority of wetlands are without water through the winter (Figure 53).



Figure 53. Aerial photo of East Slough Camp complex on March 18, 2016 with flows at WICO of 28 cfs and BENO at 744 cfs.

In order to better understand how the regulated flows affect these wetlands, the Service has worked with the Forest Service, USGS and DBBC consultant to conduct hydrological monitoring. Using aerial and time-lapsed photos, ground observations, and transducer equipment, data collected are compared with Benham gauge (BENO) flows to correlate changes in surface inundation of wetlands with river flows.

Photo monitoring of the East Slough Camp wetland conducted by the Service and Forest Service since 2012 has helped us to gain a better understanding of how Oregon spotted frog habitat is affected by the hydrograph of the river and inputs from the environment. This photo monitoring has been conducted on the ground during the irrigation ramp up in the spring, ramp down in the fall, and through the summer season. Time lapse cameras have been deployed throughout the East Slough Camp wetland complex to assess the timing of inundation relative to the spotted frog's lifecycle.

The photo monitoring is important in that it captures when the water is above the ground surface and gives us an idea of the spatial extent of inundation within the wetlands. For example, Figure 54 shows the northern end of the East Slough Camp Marsh in mid-May prior to when the marsh is fully inundated (top) and after the marsh becomes full inundated (bottom). Through these observations we are able to determine the flows that are necessary to fully inundate the marsh. It appears that approximately 1,600 cfs at the BENO gauge is necessary to fully inundate the northern portion of East Slough. We also determine that the change in water level is rapid (approximately 24 hours) when the flow at BENO is at or above 1,600 cfs (Figure 54). A similar observation was observed at the East Slough Camp transducer pond in April 2015.



Figure 54. North end of the East Slough Camp Marsh over a 24-hour period in mid-May 2016 with flows at BENO between 1,590 and 1,620 cfs in mid-May prior to when the marsh is fully inundated (top) and after the marsh becomes fully inundated (bottom).

In 2016 and 2017, aerial flights were conducted before and after April 1 to observe spatial inundation of wetlands along the Deschutes River. Figure 53, above, shows the East Slough Camp wetland complex prior to the irrigation season on March 18, 2016 with flows at WICO of 28 cfs and BENO at 744 cfs. On April 7, 2016 another aerial flight observed the wetting of the large marsh at East Slough Camp (Figure 55) with flows at WICO of 604 and BENO at 1,274. These aerial photographs depict a large difference in spatial inundation within the East Slough Camp wetland complex before and after irrigation season begins in the spring which coincides with the spotted frog breeding season.

As previously described, transducers that monitor water elevations in the ground and at the surface of wetlands have been installed throughout the Slough Camp area (Figure 56). Preliminary data from the network of transducers within the Slough Camp wetlands further inform our understanding of the current hydrological condition (Vaughn 2017).



Figure 55. Aerial flight photograph of East Slough Camp marsh on April 7, 2016 with flows at WICO and BENO of 604 and 1,274, respectively.



Figure 56. Location of transducers within the Slough Camp wetlands.

In general, the transducer data collected to date affirm that the water levels within the wetlands at East Slough Camp are predominately influenced by the flows in the Deschutes River and the water levels within the wetland at SW Slough Camp are largely independent from river flow (Vaughn 2017). The data also corroborate our methods of tracking flows at the BENO gauge as a means of assessing the wetted condition of the East Slough Camp wetlands.

The network of transducers throughout the East Slough Camp wetland complex is important in helping us understand the variability of the hydrology within this large wetland complex. Transducers detect changes in water levels within the ground before water reaches the surface.

Therefore, we are able to see where groundwater may be influencing the hydrological condition of the wetlands and where the rise in river flows influences the groundwater within the wetlands. We note that most of these wetlands do not have a direct surface connection to the river and the rise in water levels within the wetlands comes from below the ground surface.

Transducer data showed rise in groundwater levels in an Oregon spotted frog breeding pond (1065047) within five days of flows increasing at the BENO gauge following flow increases at Wickiup Dam (WICO gauge) (Vaughn 2017, p. 7). Transducer data indicate that water levels reached the estimated ground surface of the wetland (1065047) at 4040.83 feet (Vaughn 2017) on April 21, 2016 roughly 6 days after flows reached 1,430 at the BENO gauge. Our time lapse photos of the same location affirm that water is reaching the surface in this portion of the East Slough wetland at 1,400 cfs at BENO as indicated by the transducer data. However, the Service photographed this wetland on April 21, 2016 and the photo shows that the wetland is still minimally inundated (Figure 57). Although transducer data and time lapse photos show that water is reaching the surface, the water must rise in order to inundate a greater surface area of the wetland that will interface with the sedge vegetation to provide suitable habitat for Oregon spotted frogs.



Figure 57. East Slough Camp Oregon spotted frog breeding pond on April 21, 2016 shows spatial extent of surface water inundation. Transducer data indicate that water level is at the surface of the wetland.

Figure 58 shows the same pond on May 5, 2016 when flows at the BENO gauge are 1,560 cfs and the spatial extent of inundation has increased to intersect the emergent vegetation. The time delay in response of the water table to BENO gauge flows observed in the transducer data for this site would indicate that flows above 1,500 cfs (i.e., BENO flows 5 days earlier than the photo) will inundate emergent vegetation within this pond at East Slough Camp. We typically see these flow that inundate the pond towards the end of the breeding season in late April or early May at the BENO gauge.



Figure 58. Increased spatial inundation within Transducer Pond 1 (1065047) on May 5, 2016 when flows at the BENO gauge are above 1,500 cfs.

As described earlier, the spatial inundation of wetlands within the East Slough Camp wetland complex is vastly reduced from the fall through winter season. We assume that areas that remain inundated through winter are very important to spotted frog overwintering and survival. Data from four transducers (2051593, 2051581, 2051101 and 2051162) indicate that water remained within these wetlands through the winter of 2015 to 2016 within the East Slough Camp marsh (Vaughn 2017). Aerial photos corroborate these results as shown in Figure 53, above. Aerial flights and on the ground photo monitoring provide us with some information regarding the spatial extent of inundation.

We use Arc GIS to calculate the acreage of East Slough Camp that is affected by storage and water release operations. The East Slough Camp wetland complex is approximately 52 acres based on our calculations within Arc GIS. However, we must estimate the acreage of inundated habitat that remains through winter and into spring before the water levels rise within the wetland complex as a result of irrigation releases from Wickiup Dam.

Using ArcGIS and aerial photos taken in March in 2016 and 2017, we estimate that less than 5 acres (approximately 10 percent) of the 52 acres remain inundated through winter. These acres represent residual water in the Lily Pad pond, small ponds where Transducers 1 and 2 are located, mid pond, and NE Slough Camp (Figure 59). We know from several years of photo monitoring that the Lily Pad Pond and NE Slough Camp retain water in dry winters and that the areas where Transducers 1 and 2 are located dry up at the surface. Continued monitoring of this wetland complex combined with ongoing research by the USGS in coordination with the Service has enhanced our understanding of how spotted frogs are persisting in this location along the Deschutes River. Using telemetry data obtained in 2011 and 2016, USGS determined that frogs at East Slough Camp are using the interstices in the lava to overwinter (Pearl et. al. 2018). It is assumed that the lava provides thermal refugia and likely retains water beneath the surface through winter.



Figure 59. Sites within the Slough Camp wetland complex.

Ryan Ranch

The Ryan Ranch wetland, located approximately 0.5 river-miles downstream of Slough Camp, is a slough basin floodplain of the Deschutes River. This wetland was historically occupied by spotted frogs; specimens of spotted frogs were collected in 1949 from Ryan Ranch (Hayes 1994). In 1947, a berm constructed along the Deschutes River prevented river water from accessing the floodplain at this site, which reduced the timing and duration of water within the wetland and the suitability of habitat for spotted frogs. Spotted frogs have not been detected in the large wetland as the degraded condition has persisted until recently. However, a dead spotted frog and a single egg mass were detected in a nearby, small wetland just south of Ryan Ranch and north of Slough Camp on the west side of the Deschutes River in 2013, indicating that spotted frogs may occasionally utilize floodplain wetlands other than the Slough Camp wetlands mentioned above within Reach 4 of the Deschutes River.

In 2019 the US Forest Service completed the Ryan Ranch Restoration Project, which reconnected the river with its floodplain. Prior to implementation of the project, the inner basin of the Ryan Ranch wetland held a seasonal water table above the surface until late May or early June in most years. By re-establishing the connection to the river, the Ryan Ranch wetland is likely to provide year-round emergent freshwater marsh habitat over approximately 65 acres.

Recent surveys have not detected spotted frogs at Ryan Ranch. However, the close proximity of the Ryan Ranch Project to the Deschutes River within 0.5 river-miles of the Slough Camp spotted frog population and the documented presence of spotted frogs in the vicinity of Ryan

Ranch referenced above indicates a high potential for Ryan Ranch to be occupied by spotted frogs in the future now that hydrologic conditions have been improved. Monitoring at East Slough Camp, conducted in the fall of 2016, showed juvenile spotted frogs present along the Deschutes River just upstream of Ryan Ranch when wetland habitats were dewatered (Figure 51 above) at the onset of the irrigation storage season. This area may now provide a suitable refuge for spotted frogs that are displaced during the irrigation storage season when the East Slough Camp wetland is dewatered.

Reed canarygrass, a threat to spotted frog habitat, is present within the Ryan Ranch wetland. Work to reduce the encroachment of reed canarygrass within the Ryan Ranch wetland will be necessary to improve habitat suitability for Oregon spotted frogs. Surveys for spotted frogs will continue in the Ryan Ranch wetland to determine occupancy.

Dillon Falls to Lava Island Falls (Reach 5)

Currently we do not know of spotted frog use of wetlands in this reach of the Deschutes River. Although this reach of the river does not currently have any known breeding sites, there are numerous ponds and wetlands that may provide for dispersing spotted frogs in the summer season when flows are high in the river (Figures 60, 61, and 62). Therefore, these wetlands are important in the big picture of connectivity on the landscape. Most of these wetlands do not retain water when flows are reduced during the irrigation storage season. If these areas were to remain inundated year-round, these wetlands would provide approximately 34 acres of additional habitat for spotted frogs.

Arnold Irrigation District diversion occurs at approximate River Mile 174.5. Therefore flows in the summer in this reach include the flows at the BENO gauge minus the amount that is diverted for irrigation at this diversion. Aerial flight photos conducted in April of 2016 and 2017 indicate that many of these wetlands are inundated when flows are between 1,200 and 1,500 cfs (Figures 61 and 62). Additional hydrological evaluation is needed to determine the flow thresholds that influence inundation of wetlands in this reach.



Figure 60. Ponds on wetlands adjacent to the Deschutes River between Dillon and Lava Island Falls that provide suitable habitat for OSF during the summer when flows are high in the river.



Figure 61. Ponds adjacent to Deschutes River with flows of 1,274 at the BENO gauge on April 7, 2016.



Figure 62. Wetlands within the Dillon Falls to Lava Island Reach of the Deschutes River (Reach 5) with flows of 1,530 at the BENO gauge on April 21, 2017.

Lava Island Falls to COID Diversion (Reach 6)

The stretch of river between Lava Island Falls and the COID Diversion (~174 and 171.3 RM) has limited habitat for spotted frogs and was not included in the critical habitat designation due to it being a large distance (i.e., > 6.2 miles) from known populations at Slough Camp and the Old Mill. However, in September of 2016, four juvenile spotted frogs were located within a small wetland on private land upstream of the COID diversion (Bowerman pers. comm. 2017c) (Figure 63). This finding emphasizes the importance of seasonal wetland habitats along the river for dispersal between populations. The site was dewatered during the winter of 2016-2017. The Service conducted up follow-up surveys here in 2018 and 2019. No spotted frogs were observed. We suspect that this site is occasionally suitable and could be an important habitat for connectivity between populations in the future. The site will continue to be monitored by the Service and partners with permission from the private landowner.



Figure 63. Yellow polygon depicts location of juvenile spotted frogs detected in September 2016 on private land near river mile 172.

Deschutes River COID Diversion to Colorado Bridge (Reach 7)

Old Mill Area of Deschutes River

The downstream most extent of Oregon spotted frog distribution within the Upper Deschutes River subbasin is located in the vicinity of the Old Mill District (~167.5 RM), in Bend, Oregon, approximately 11.5 miles downstream of Slough Camp and approximately 4.5 miles downstream of the site on private land where juveniles were located in 2016 (Figure 63 above). The Oregon

spotted frog was historically known to occur 34 miles downstream of the Old Mill District where NW Lower Bridge Way crosses the Deschutes River (Hayes. 1997a). In 2013, breeding surveys were conducted downstream from the Old Mill District between the Colorado Street Bridge and Tumalo State Park, a distance of 7.8 miles (Biota Pacific and Smayda Environmental 2013). Oregon spotted frogs were not detected during these surveys.

Spotted frogs were first discovered in this location in the Old Mill area in 2012 within a man-made storm water retention pond (i.e., Old Mill Pond). Shortly thereafter, spotted frogs were also detected in a riverine marsh (i.e., LSA Marsh), on the west side of the Deschutes River across from the Casting Pond (Figure 64). At that time, the Service began working with the landowners of the Old Mill properties on a Candidate Conservation Agreement with Assurances (CCAA) to identify important conservation actions for spotted frogs within the Old Mill area. Annual population monitoring has been conducted under the CCAA agreement since that time.



Figure 64. Oregon spotted frog breeding sites within the Old Mill District, Bend, OR.

Breeding data indicate that spotted frogs use both the pond and marsh for breeding. Egg mass counts were highest in 2013, the first spring after frogs were detected in the Old Mill area (Table 19), particularly in LSA Marsh. After a series of mortality events, egg mass counts have not yet recovered to the abundance observed in 2013. In 2019, twelve egg masses were observed in the Old Mill Pond, which had produced no egg masses in 2015 and 2016 and only two egg masses in 2017.

Two known mortality incidents have occurred in recent years, one of which may account for the low breeding counts in 2015 and 2016. During the winter of 2012 and 2013, low water levels in the Casting Pond as a result of low precipitation combined with harsh winter conditions resulted in mortality of an approximated 29 frogs that had attempted to overwinter within rocks beneath a man-made walkway within the pond. Three frogs with radio transmitters and six frogs with PIT-tags installed the prior fall were among the aggregation of dead frogs. At least four live frogs were also recovered from the excavation effort that discovered the overwintering hibernaculum within the Casting Pond (Bowerman, pers. comm. 2013b, 2013c and 2013d). Juvenile and adult frogs lost to this mortality event would have accounted for lack of breeding individuals in 2015 and 2016.

A second mortality incident occurred in May of 2015 when the LSA Marsh was accidentally dewatered during removal of a downstream dam. Water was restored to the marsh within days of the incident. However, the location where five egg masses had been deposited in April was void of water during the larval development phase and we suspect that there were no surviving recruits from that breeding effort. Juveniles from the 2014 breeding effort were concentrated in a nearby beaver channel and appeared to be unharmed (Bowerman, pers. Comm. 2015). Breeding counts from 2016 through 2018 were precariously low. In 2019, egg mass counts in the Old Mill Pond were close to the count observed in 2013. However, breeding within the LSA Marsh continues to be limited. Through a Candidate Conservation Agreement with Assurances established with the Old Mill District property owners prior to the ESA listing in 2014, habitat enhancement work in the LSA Marsh is being conducted to improve the former breeding areas for Oregon spotted frog.

Table 19 Oregon spotted frog breeding counts in the Old Mill area.

Breeding site	2013	2014	2015	2016	2017	2018	2019	2020
Casting Pond	12	5	0	0	2	2	13	8
LSA Marsh	29	9	5	5	0	1	1	0

Trapping and pit tagging of spotted frogs, conducted in the Old Mill area in 2012 and 2013, provides some information on population structure (i.e., size, sex, age). Initial fall trapping surveys in 2012 indicated that there were 30-50 adults and over 200 juveniles using the Casting Pond and LSA Marsh. Mark and recapture estimates and egg mass counts into 2013 indicated that there were over 100 breeding adults and approximately 945 juvenile spotted frogs using habitat within the LSA Marsh and Casting Pond (Bowerman, pers. comm. 2014a). Oregon spotted frogs in the Old Mill District have not reached an abundance in recent years similar to what was observed in 2012 and 2013.

Telemetry and mark/recapture studies conducted between the winter of 2012-2013 and 2015 provide information on spotted frog seasonal habitat utilization within the Old Mill area. Data indicate that some spotted frogs move between the LSA Marsh and Casting Pond and that summer foraging territories exist within the riparian habitat on both sides of the river (Bowerman pers. comm. 2013e). The telemetry data also indicate that spotted frogs use the river during the

winter (Bowerman, pers. comm. 2014b) and provide important information about overwintering site selection. In fact, it was the telemetry work that led to the discovery of the overwintering sites in 2013 within the Casting Pond and the unfortunate discovery of the mass of dead frogs, described above.

Hydrology in the Old Mill Area

Although this reach of the river is influenced by the storage and release of water from Wickiup Dam, the low end of the hydrograph is tempered by the damming effect of the Colorado Street Bridge. Hydrology data collected along the river in the Old Mill area to support the construction of the Bend Water Park provide useful information about the baseline hydrology at that location.

Following the incident that de-watered the LSA Marsh in 2015, a preliminary Operations and Maintenance Plan for the Colorado Avenue Safe Passage Project incorporated habitat conservation criteria for Oregon spotted frog that included maintaining water elevations in the marsh. A staff gauge was installed near the marsh by Bend Parks and Recreation District and daily staff gauge readings are recorded to comply with water level criteria designed to maintain spotted frog habitat year-round.

The BENO gauge is the nearest gauge to this part of the Deschutes River. However, the Arnold and Central Oregon diversions withdraw significant amounts of water downstream of the BENO gauge but upstream of the Old Mill area of the Deschutes River, and this section of the Deschutes River is also a losing reach, so it loses surface flows to ground water. Therefore, flows in this reach are lower than those for the Deschutes River at Benham Falls. Historical flows in this reach of the river were estimated for the DBHCP (DBHCP 2020, p. 8-192) by subtracting daily average diversions at the Arnold Diversion and Central Oregon Diversion from daily average flows at Benham Falls (BENO). To account for seepage losses between Benham Falls and Bend, 89 cfs were also subtracted from the daily average flows (Gannett et al. 2001) (Figure 65. Modified from Figure 8-95 in DBHCP 2020).

Monitoring of surface water elevations within the LSA Marsh has been conducted to ascertain how water management may influence important habitat for spotted frogs in the Old Mill. In late April 2018, pressure transducers were installed within the LSA Marsh and the Deschutes River within the Old Mill to understand the relationships between Deschutes River flow, river stage and water depth within the wetland. Data collected from late April 2018 to early April 2019 showed a strong correlation between river flow and water depths within the LSA Marsh. Water depths followed the seasonal fluctuation consistent with the storage of water in the winter and release of water into the Deschutes River the summer (DBHCP 2020, pp. 8-192-193). The wetland remained inundated throughout the year, and water depth ranged from a low of 1 foot in mid-November to a high of 2.3 feet in July. Analysis of these data within the DBHCP (2020) determined that water depths within the LSA Marsh were relatively stable within seasons. Between seasons (i.e., spring through summer; summer to fall and to winter) elevational changes in the wetland were less than 2.2 inches. The DBHCP analysis also noted that during the Oregon spotted frog breeding season (April and May), when eggs and larvae are particularly sensitive to changes in water depth, the average daily change was 0.5 inch and the maximum daily change

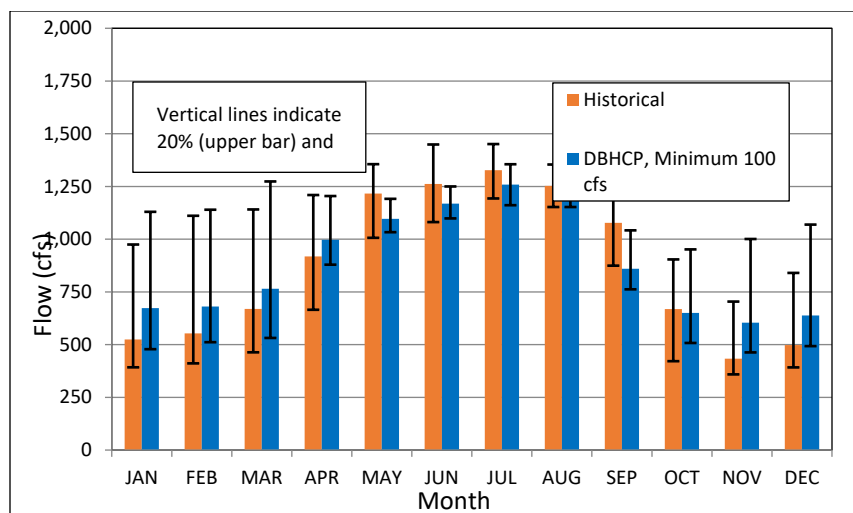


Figure 65. (Modified from Figure 8-95 in DBHCP 2020). Monthly medians of estimated daily average flows in the Deschutes River at Colorado Street for historical (1981-2018) conditions.

was an increase of 1.6 inches when releases from Wickiup Reservoir ramped up at the beginning of the irrigation season. Drops in water elevation by 1.3 inches were observed in May when flows were reduced to accommodate changing irrigation demand. However, water depths in the wetland increased by 7 inches from late April to the end of May (DBHCP 2020, pp. 8-192-193).

Given that this population of spotted frogs has declined in recent years due to what we believe are circumstances outside of regulated flows, OSF population monitoring will continue within the Old Mill and habitat enhancement work that reduces encroachment of cattails into the LSA Marsh will be conducted under the CCAA agreement with landowners at the Old Mill.

4.3.2 Status of the Spotted Frog in the Little Deschutes River Subbasin

Oregon spotted frogs are distributed throughout wetland, pond, and riverine habitats along the Little Deschutes River which flows north for approximately 92 miles from its headwaters in Klamath County to its convergence with the Deschutes River one mile south of Sunriver and approximately 20 miles south of Bend, Oregon. The Little Deschutes River subbasin drains an area of approximately 1,020 square miles and includes two tributaries to the Little Deschutes River that are occupied by Oregon spotted frogs: Crescent Creek and Long Prairie Creek (also referred to as Long Prairie Slough).

The Little Deschutes River subbasin geology is characterized by large areas of deposited ash and pumice from the eruption of Mt. Mazama (Crater Lake) about 6,800 years old. Lava flows from the Cascades Mountains to the west and Newberry Crater to the east formed the La Pine Basin with characteristically flat topography, highly permeable and rapidly draining soils with high water tables through which the Little Deschutes River flows. The floodplain of the Little Deschutes River is broad within an abundance of riverine oxbows and marsh habitat that is highly suitable for Oregon spotted frog.

At the time of listing (79 FR 51658), there were approximately 23 known breeding locations within five watersheds (10th Field Hydrologic Unit Code (HUC)) in the subbasin: Upper, Middle,

and Lower Little Deschutes River; Crescent Creek; and Long Prairie⁸. Currently there are 28 locations through the expansive Little Deschutes River subbasin where breeding has been detected (Figure 66; Tables 20 and 24). However, the number of breeding sites identified during listing and currently are considered to be an under representation of the distribution and abundance of spotted frog breeding sites as 70 percent of the Little Deschutes River subbasin is in private ownership and only a portion of the lands have been surveyed for spotted frogs.

Within the Little Deschutes River subbasin, we refer to monitored sites or breeding locations rather than populations where these sites occur along Crescent Creek, Long Prairie, and the Little Deschutes River. We lack genetic work that would facilitate our understanding of population groupings. Therefore, we assume that there is connectivity between most of these breeding locations along these river corridors where they are in close proximity (<3.1 miles) to each other and there is suitable habitat between them. Big Marsh, a large headwater wetland that drains into Big Marsh Creek and then into Crescent Creek, is the only site that we refer to as a population in our description of spotted frog sites in the Little Deschutes River subbasin below.

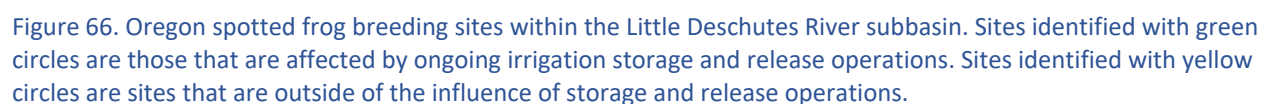
4.3.2.1 General Threats

Threats to Oregon spotted frogs identified in the 2014 Listing (79 FR 51658) within the Little Deschutes River subbasin include, but are not limited to, habitat loss and/or modification due to land conversions (primarily agriculture), hydrologic changes (*e.g.*, dams, ditches, and water control structures), shrub encroachment, invasive reed canarygrass, and introduced predators (bullfrogs and cold water fish). Grazing may also pose a threat through trampling and reduced water quality when livestock are allowed access to water occupied by frogs. Climate change may play a role in this subbasin overtime as the snow-dominant system changes to a mixed snow-rain-dominant system resulting in reduced peak spring streamflow, increased winter streamflow, and reduced late summer flow (Littell *et al.* 2009).

Tumalo Irrigation District operates Crescent Dam to store and release water in Crescent Lake for irrigation purposes. These water management operations affect a portion of the Little Deschutes River subbasin where spotted frogs occur: Crescent Creek from the Crescent Lake Dam to the confluence with the Little Deschutes River and from the Little Deschutes River at the confluence with Crescent Creek to the outlet at the mainstem Deschutes River. Unregulated portions of the Little Deschutes River subbasin contribute flow to areas that are affected by the storage and release operations at Crescent Dam. Of particular significance are Big Marsh Creek, which flows into Crescent Creek approximately 6 miles downstream of the dam, and the Upper Little Deschutes River located upstream of the confluence with Crescent Creek.

Figure 66, below, depicts the known spotted frog locations that are unaffected and affected by dam operations in yellow and green, respectively. The following sections describe the status of spotted frogs in the areas that are unaffected and affected by Crescent Lake Dam operations, respectively.

⁸ https://www.fws.gov/wafwo/species/osf/OSF_Final%20Listing_Threats%20Synthesis.pdf



4.3.2.2 Spotted Frog Sites/Populations in Areas Unaffected by the Proposed Action

Approximately 13 of the 28 monitored breeding locations are either upstream of or outside of the influence of managed flow releases from Crescent Lake Dam and are therefore not affected by the proposed action (Figure 66; Table 20). Two of these sites drain to Crescent Creek: Big Marsh and Black Rock Lava Pond. Six of these sites are located in the Upper Little Deschutes River watershed, upstream of the confluence with Crescent Creek. Long Prairie drains to the Little Deschutes River in the area of La Pine, OR and has approximately five known breeding sites.

The contribution of these spotted frogs sites to those within the area affected by water management is important. We assume that an aquatic connection and dispersal distances within 6.2 miles (10 kilometers) (based on distances described in critical habitat delineation) allow for the influx of individuals from populations within the Crescent and Little Deschutes system to immigrate into areas affected by water management. The Long Prairie breeding locations although close via distance are disconnected by drains and ditches that are associated with an irrigation system supplied by the Walker Basin Canal. Only the lowest reach of Long Prairie is connected to the Little Deschutes River.

Table 20 Spotted frog sites or populations by river mile locations within drainages that are not affected by the Deschutes Project.

Watershed (HUC 10)	Waterbody or drainage	Site Name/Population	River Mile (RM)
Crescent Creek	Big Marsh Creek	Big Marsh	7-12.5
	Crescent Creek	Black Rock Lava Pond	14
Upper Little Deschutes River	Little Deschutes River	LD Marsh S. Shore	95.5
		5830 Rd (LDR10) USGS Dogleg-Upstream HWY58	88-89
		Hwy 58 area sites (Upper oxbow, Mowich log pond)	86.5-87.5
		5830 Road dogleg3	84-86
		Odell Pasture; 100 road mill pond and oxbows	70-71
		LDR 62 road oxbow, floodplain pool, gravel pit, beaver	60-61.5
Long Prairie	Long Prairie Creek	Long Prairie marsh (La Pine HS)	0-0.5
		Long Prairie Hwy 97 City Hall*	1.5
		Long Prairie Pond (Private)*	2.5
		Long Prairie upper BLM*	6.5
		Long Prairie Private site*	6.5

*Site hydrology is affected by ditching.

The final rule included a minimum population estimate of approximately 6,628 adult breeding spotted frogs in the Little Deschutes River subbasin based on limited breeding surveys conducted on public and private land in 2012 (Final Rule Vol. 79 No. 168 p.51666). We note that the adult population at Big Marsh was estimated to be approximately 5,324 adults at that time, comprising 80 percent of the adult breeding population within the Little Deschutes River subbasin at the time of listing. The vast acreage of existing wetland complexes and suitable habitat for Oregon spotted frogs along the mainstem Little Deschutes River and Crescent Creek indicate that the

minimum adult breeding population of spotted frogs in the Listing is an underestimate for the Little Deschutes River subbasin.

Big Marsh, a 2,000-ac (809 ha) wetland located within headwaters at 4,760 feet (1,451 m) elevation on the Deschutes National Forest, has the largest monitored population of spotted frogs in the Little Deschutes River subbasin and possibly range-wide. Table 21 depicts breeding surveys since 2002.

Table 21 Big Marsh Oregon spotted frog Egg Mass Survey Data, 2002 to 2019.

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2017	2018	2019
490	694	173*	1,254	1,736	2,611	427*	25**	1,514	1,265	2,662	3,071	1,087	3,618	1,686	1,796	1,443

*Incomplete survey.

**Incomplete late season survey. Masses already hatched.

Several hydrological restoration efforts have occurred at Big Marsh over the years (i.e., 2000, 2004, 2006, and 2007) and we have seen a positive response in egg mass counts in the years that followed these efforts. Based on egg mass surveys the population has increased from a low estimated at 980 breeding individuals (male and female) in 2002 to a high of 7,236 breeding individuals in 2015 (Table 21). The positive response in the adult population of spotted frogs indicates that hydrological restoration efforts have been effective in improving habitat conditions for spotted frogs. Additional hydrological restoration activities were completed at Big Marsh in 2016 and egg mass counts since that time have been lower than the highest count in 2015 (USFWS 2015a, p. 17). However, the marsh is less accessible to surveyors due to changes in inundation as a result of the restoration project, which may influence the breeding counts in recent years.

Maintaining a healthy Big Marsh population is important to the conservation of the spotted frog because it may be a source population for downstream habitats within Big Marsh Creek, Crescent Creek, and the Little Deschutes River. Big Marsh is not affected by irrigation storage and release, which influences and in some cases adversely impacts habitat for spotted frogs along the entirety of Crescent Creek and approximately 60 miles of the Little Deschutes River downstream of its confluence with Crescent Creek.

Upstream of the confluence with Crescent Creek, the Little Deschutes River has approximately six locations where breeding has been monitored over the years. These sites have relatively short distances between them as indicated by river mile locations in Table 22. In some cases these areas cover 1-2 miles of the river floodplain where breeding has been detected. Large sites typically have higher breeding counts than the small areas located at the highest elevations in the watershed. However, conducting breeding surveys at the high elevations is difficult due to inaccessibility via the road system due to heavy snow that remains when the breeding season begins in April. Accordingly, the breeding counts that we have completed may be inaccurately low. The largest egg mass counts of these monitored sites have been observed at the LDR 62 Rd location, upstream of the Crescent Confluence by less than one mile. Breeding counts at this location in 2012 indicate there were approximately 300 breeding adult spotted frogs using this section of the Little Deschutes River on BLM administered lands (Table 22). Spotted frogs at

Table 22 Oregon spotted frog sites and breeding counts within Little Deschutes River subbasin upstream of the confluence with Crescent Creek outside of affected area.

River Mile	Site Name	Breeding Count	Approximate acreage	Ownership
95.5	LD Marsh S. Shore	3 (2013)	1.14	US Forest Service
Tributary enters at 88.5	Hemlock Creek Marsh	5 (2013)	12.11	
88-89	5830 Rd (LDR10) USGS Dogleg-Upstream HWY58	2 (2012); 2 (2013); 11 (2016)	35	
86.5-87.5	Hwy 58 area sites (Upper oxbow, Mowich log pond)	1 (2012); 7 (2013); 1 (2015); 3 (2018)	21.1	
84-86	5830 Road dogleg3	22 (2016); 17 (2017); 40 (2018); 50 (2019); 12 (2020)		
70-71	Odell Pasture; 100 road mill pond and oxbows	27 (2012); 26 (2013); 4 (2015); 53 (2016); 1 (2017); 13 (2018); 7 (2019)	32.5	US Bureau of Land Management
60-61.5	LDR 62 road oxbow, floodplain pool, gravel pit, beaver	164 (2012); 121 (2013); 3 (2016); 1 (2017); 13 (2018); 7 (2019)	28	

this location contribute to spotted frog distribution and abundance in the area along the Little Deschutes River that is affected by the proposed action.

In 2019, the Service consulted with the Deschutes National Forest on the Upper Little Deschutes River Restoration (ULDR) Project, a project spanning 18 miles of the Little Deschutes River between river miles 70 and 88, upstream of the confluence with Crescent Creek (USFWS 2019). The ULDR Project implemented riparian and hydrological restoration actions to improve habitat for Oregon spotted frog beginning in 2020. Spotted frog breeding surveys and hydrological monitoring pre and post implementation have been and will continue to be conducted.

Long Prairie Creek Sites

Historically, it was likely that Oregon spotted frogs existed over much of Long Prairie, a marshy tributary of the Little Deschutes River that is now bisected by Highway 97. In terms of river miles, the Long Prairie drainage is approximately 17 miles. However, the Long Prairie area has been drained and modified extensively. A system of irrigation ditches receives water via the Walker Basin Canal which diverts water from the Little Deschutes River downstream of the confluence with Crescent Creek. This irrigation delivery system is independent of the water storage and release operations being analyzed in this Opinion.

Currently, Oregon spotted frogs occur along the lower 6.5 miles of Long Prairie. There are five known breeding locations where spotted frogs have been monitored in recent years. Due to the abundance of private lands that have not been surveyed for spotted frogs, it is difficult to determine the status of spotted frogs inhabiting Long Prairie. Two of these sites both of which are in private or partially private ownership, Long Prairie Pond and Long Prairie marsh (La Pine

Table 23 Oregon spotted frog sites and breeding counts outside of affected area within Long Prairie.

River Mile	Site Name	Breeding Count	Approximate acreage	Ownership
0-0.5	Long Prairie Beaver pond marsh (La Pine HS)	1 (2006); 204 (2013); 157 (2017); 36 (2018)	6.93	BLM (some private in 2013 and 2017)
1.5	Long Prairie Hwy 97 City Hall	4 (2017)	1.44	private
2.5	Long Prairie Pond	133 (2013)	25.5	private
6.5	Private site (RM 6.5)	2 (2012)	11	private
6.5	Long Prairie upper BLM	20 (2001)	4.47	BLM

HS), have had large breeding counts in recent years (Table 23), which indicates that spotted frogs are persisting and abundant in these locations.

Given that the Long Prairie area has been ditched and modified, we assume that these sites are not connected, except for the lowest end of the reach at the confluence with the Little Deschutes River. Bull frogs also have been detected in all known spotted frog sites on Long Prairie.

4.3.2.3 Spotted Frog Sites/Populations in Areas Affected by the Proposed Action

Approximately 15 monitored Oregon spotted frog breeding sites occur within the geographic area affected by the Proposed Action: five adjacent to Crescent Creek and ten along the Little Deschutes River downstream of its confluence with Crescent Creek (Table 24; Figure 66 above). These sites, located along Crescent Creek and the Little Deschutes River, are within the area that is hydrologically influenced by the storage and release of water from Crescent Lake Reservoir.

Monitoring of these sites has been mostly sporadic until recent years. Therefore, breeding counts are limited. In 2011 and 2012, the Service contracted with the USGS to conduct spotted frog breeding counts within this geography, primarily for the purposes of determining distribution of the species. At the time, the Service was working on the proposed listing and critical habitat determination for the species. With assistance from the USGS, we determined that spotted frogs were distributed throughout the entire reach of the Little Deschutes River downstream of the confluence with Crescent Creek and within approximately 25 of the 30 miles of Crescent creek. Spotted frogs have not been detected within the 5-mile reach of Crescent Creek directly downstream of Crescent Lake Dam. Currently, known sites within Crescent Creek are downstream of its confluence with Big Marsh Creek, an important tributary as we discuss hydrological conditions below.

Table 24 Spotted frog breeding locations along Crescent Creek and the Little Deschutes River influenced by storage and release operations at Crescent Lake Dam.

Watershed (HUC 10)	Waterbody or drainage	Site Name	River Mile (RM)
Crescent Creek	Crescent Creek	Crescent Creek above Highway 58	22 – 22.5
		Crescent Creek below Highway 58	21.5
		Crescent Upper Oxbow (Private)	9-9.5
		Crescent Creek 62 RD (Private)	3-7
		Crescent Creek BLM oxbows and adjacent private	0-2
Middle Little Deschutes River	Little Deschutes River	Middle Little Deschutes complex 1 (Private)	56-57
		Middle Little Deschutes complex 2 (Private)	49-51
		South Masten Road	41-42
		Leona Park	~35
Lower Little Deschutes River	Little Deschutes River	Oxbows behind La Pine High School(BLM/Private)	~30-31
		Rosland Park	~27-28
		Riverside oxbow (private)	~21
		Casey Tract	~13-15
		Thousand Trails (private)	~4-6
		Crosswater (N. driving range pond, bullfrog pond, Fairway 2) (private)	0-2

4.3.2.3.1 Ongoing Water Management and Hydrological Influences on Spotted Frog Critical Habitat

Crescent Lake is operated as a reservoir to capture and store runoff in the Crescent Creek watershed (upstream of RM 29) in the fall, winter and spring (typically October through June) and release water from storage during the irrigation season (typically July through September). Reservoir operations result in flows downstream of Crescent Dam that are lower than natural (unregulated) conditions during the storage season (fall, winter and spring) and higher than unregulated conditions during the irrigation season (summer). Figure 67 shows the monthly median flows in Crescent Creek below the dam (CREO gauge) and in the Little Deschutes River in La Pine, OR (LAPO gauge), respectively, under regulated (i.e., actual recorded flows) and unregulated conditions (i.e., simulated flows for period between 1983 and 2014) (Figure 67. Figure 4-17 in DBHCP (2020), p. 4-21).

There has been a significant change in the hydrographs within Crescent Creek and the Little Deschutes River (to a lesser extent) as a result of reservoir storage and release operations and these actions affect the timing of inundation in wetland habitat for Oregon spotted frog. The low winter flows have the potential to reduce the availability of overwintering habitat for Oregon spotted frogs. However, the spring-fed nature and high water table within the Little Deschutes

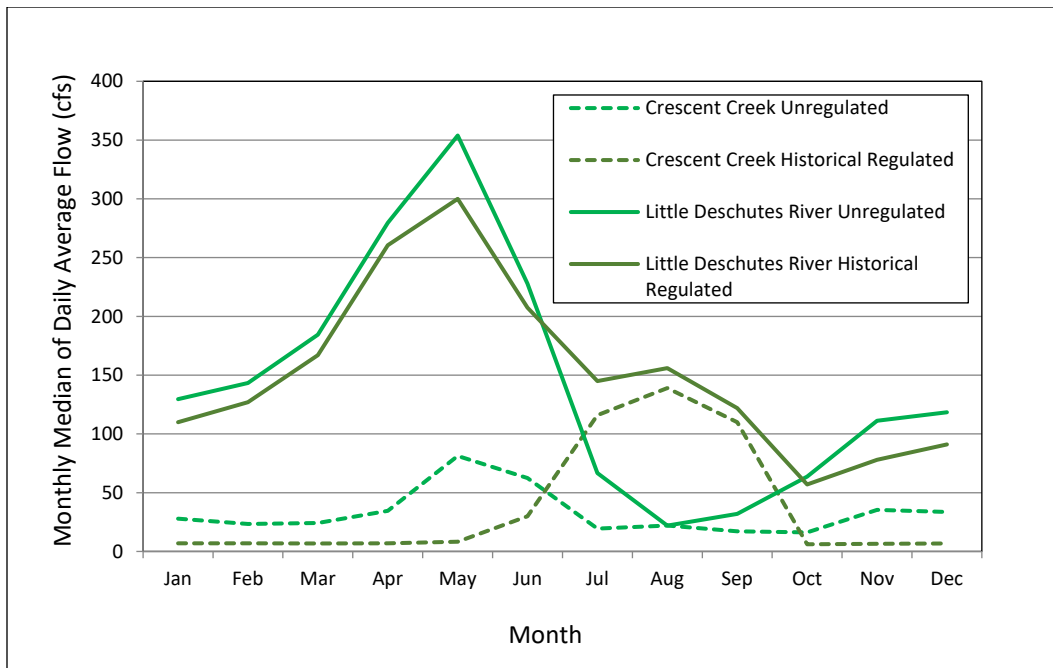


Figure 67. (Figure 4-17 in DBHCP 2020). Monthly median flows in Crescent Creek (RM 29) and the Little Deschutes River near La Pine (RM 26) from 1983 through 2014. Source: R2 and Biota Pacific 2016.

River subbasin likely buffer the effect of the reduction in flows due to storage. The greatest disparity between the unregulated and regulated hydrographs occurs in the summer when flows in the rivers are high due to irrigation flow releases at a time when under the unregulated condition flows would be lowest. The high summer irrigation flows in the rivers maintain water elevations in riverine oxbows and wetland habitats occupied by Oregon spotted frogs at higher levels than in the unregulated condition.

In addition to seasonal changes in flow, operation of the reservoir (which involves the release of water at a constant rate) moderates natural fluctuations in flow that occur on a daily or weekly basis due to precipitation events and snowmelt (Biota Pacific 2017). Consequently, the dynamic disturbance processes such as flood events that create oxbow habitat are reduced within the system downstream of the Crescent Lake dam on Crescent Creek. This effect of the dam is less evident in Crescent Creek below the Big Marsh Creek confluence, and on the Little Deschutes River which is unregulated above the confluence with Crescent Creek.

In general, the effects of reservoir operation on Oregon spotted frogs in Crescent Creek and Little Deschutes River are those that occur directly or indirectly through changes in the timing and magnitude of flow on a daily, seasonal and year-to-year basis. Changes in flow have the potential to cause changes in water surface elevation (depth) in wetlands occupied by Oregon spotted frogs. Changes in water surface elevation influence conditions for breeding, summer rearing/feeding and overwintering in wetlands inhabited by spotted frogs. The hydrological effect of storage and release from Crescent Dam are described in the description below of spotted frog sites within Crescent Creek and the Little Deschutes River.

Crescent Creek Sites

Crescent Creek is approximately 30 miles in length between the outlet at the Little Deschutes River and the Crescent Lake Dam. Spotted frog breeding locations are concentrated on the lower 9 miles of Crescent Creek which is mostly on private land. A small riverine segment (~1 mile) of Crescent Creek on BLM administered lands has been monitored since 2013. Another one mile stretch of Crescent Creek (21.5 to 22.5 RM) that flows through lands administered by the Forest Service contains two small breeding locations that have been monitored consistently since 2013 (Figure 68). In addition to these five known breeding locations along the river, the Black Rock Lava Pond represents another breeding location that drains into Crescent Creek at approximately river mile 14. This site is outside of the area influenced by storage and release from Crescent Lake Dam.

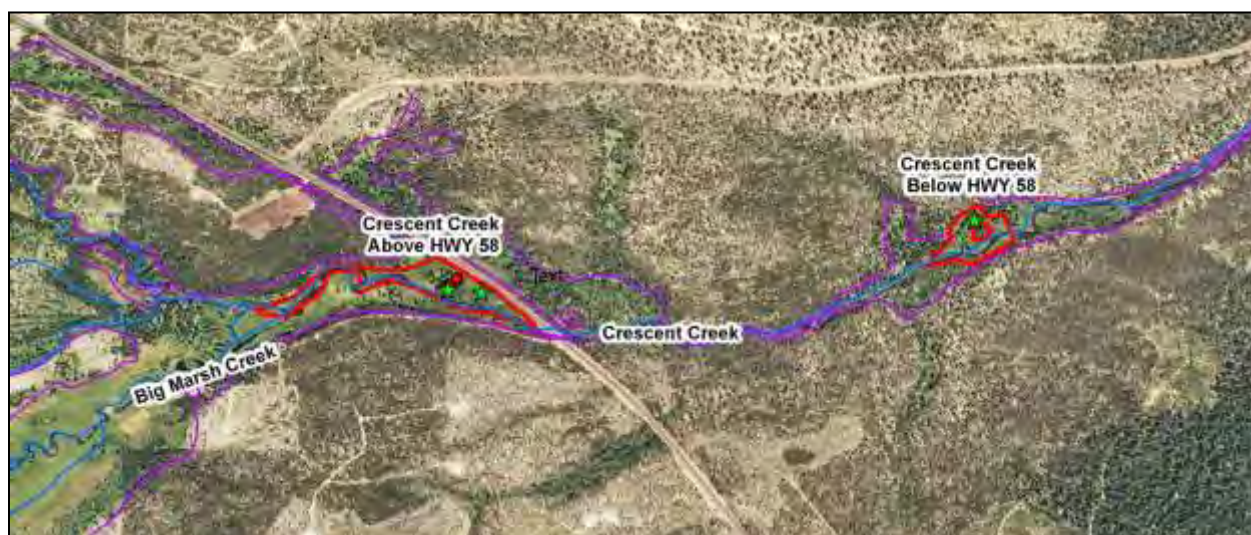


Figure 68. . Spotted frog breeding locations on national forest land along Crescent Creek between river miles 21.5 and 22.5.

Breeding surveys along Crescent Creek have been sporadic until recent years. The lower 18 miles of Crescent Creek are predominately private land. Therefore, we are unable to conduct breeding surveys within the mid to lower river reach unless we are granted permission to access private land. Currently, only three of these five sites along Crescent Creek are consistently monitored: two sites on national forest land upstream and downstream of Highway 58 (between RM 21.5 and 22.5) and another site located near the mouth of the creek on BLM land (RM 0-2) (Table 25).

Most of the habitats where Oregon spotted frog breeding has been detected on or near the floodplain of Crescent Creek are characterized as oxbows and sloughs which typically form where the creek has a low gradient (Figure 69). On the lowest monitored reach of Crescent Creek, spotted frog egg masses have been observed within riverine emergent wetlands within the creek (Figure 70). Spotted frogs also have been observed basking on sandbars along the creek in mid-summer.

Table 25. Egg Mass Counts on Crescent Creek

Breeding site on Crescent Creek	Acres	Total egg mass counts										
		2006	2009	2011	2012	2013	2014	2015	2016	2017	2018	2019
Above Highway 58 (RM 22 – 22.5)	9.6		22	14	24		4	17	13	23	23	12
Below Highway 58 (RM 21.5)	4.44					15	9	7	6	6	7	12
Upper Oxbow (Private) (RM 9-9.5)	20				35							
62 RD (Private) (RM 3-7)	233				62							
BLM oxbows and adjacent private (RM 0-2)	48	21				42		18	9	12	23	10



Figure 69. Slough habitat at Crescent Creek Highway 58 sites (22 and 21.5 RM)



Figure 70. Riverine wetland habitat at Crescent Creek BLM site (1.5 RM) on April 11, 2014.

Influence of Water Management on Crescent Creek Spotted Frog Sites

Upper Crescent Creek basin (above Crescent Dam) provides about 40 percent of the average annual flow in Crescent Creek (Biota Pacific 2017). Big Marsh Creek, the largest tributary to Crescent Creek, enters about 6 miles downstream of Crescent Dam at RM 23 and contributes another 26 percent to average annual flow. Much of the remaining 36 percent of the annual flow in Crescent Creek enters between Crescent Dam and Big Marsh Creek (Gannett et al. 2001). Reservoir operations influence approximately 40 to 50 percent of the total flow within Crescent Creek on an annual basis downstream of the confluence with Big Marsh Creek (Biota Pacific 2017). An important point to note here is that flows at the CREO gauge do not directly correspond to surface water levels and the extent of inundation of wetlands. Big Marsh Creek provides substantial volumes of water to Crescent Creek in the spring and there has not been a hydrological gauge to measure hydrological inputs to Crescent Creek from Big Marsh Creek until recently. In 2019, the TID installed a gauge to help monitor the seasonal flows from Big Marsh Creek into Crescent Creek. The hydrological response of wetlands to changes at the CREO gauge is most noticeable in the late summer and fall when flows out of Big Marsh Creek are low.

Water storage at Crescent Lake results in average monthly fall, winter, and spring flows at the Crescent Dam gauge (CREO) that are lower than unregulated flows (Figure 67) in October through May. Suitable habitat for Oregon spotted frog is reduced during this period. We assume that spotted frogs seek oxbow habitat that remains inundated through winter such as those at known breeding locations upstream and downstream of Highway 58 between river miles 21.5 and 22.5 on Crescent Creek (Figure 69). However, where spotted frogs utilize wetlands on the

creek such as the BLM site at RM 1.5, overwintering may occur in Crescent Creek when wetlands are dewatered during the storage season. Utilization of the river for wintering increases the risk of predation on spotted frogs by brown trout, which are abundant in the Little Deschutes River and in the lower reaches of Crescent Creek.

The abrupt change in inundation of wetlands that occurs at the onset of the storage season (Sept to Oct) can strand frogs in unsuitable habitat and leave them vulnerable to predation. Daily average flows in Crescent Creek and the Little Deschutes River historically dropped as much as 100 cfs in a matter of days when irrigation releases from Crescent Lake Reservoir ceased for the season in late September or early October (Figure 67).

In the fall of 2015, the Tumalo Irrigation District slowed the ramp down rate and maintained flows of approximately 30 cfs from the fall through winter in an effort to lessen potential impacts to spotted frogs due to irrigation storage. In theory this is a good approach for facilitating movement to and maintaining overwintering habitat for spotted frogs. Figure 71 shows Crescent Creek spotted frog sites at RM 22.5 and RM 1.5 on October 25, 2015 when flows are reduced to approximately 30 cfs. Although water had receded from vegetation at the site near RM 22.5, the oxbow habitat remained inundated and juvenile spotted frogs were observed in the water. The spotted frog site at RM 1.5 also remained inundated at flows of approximately 30 cfs at the CREO gauge.

A network of transducers that monitor surface water elevations in wetlands were installed in the three monitored spotted frogs site locations (RM 22.8, RM 21.9 and RM 1.7) and within the river channel above and below the Crescent Creek confluence with Big Marsh Creek beginning in 2015. Transducer data improved our understanding of how the storage and release of water at Crescent Dam influences water surface elevation in wetlands occupied by spotted frogs.



Figure 71. Crescent Creek spotted frog sites at river miles 22.5 and 1.5 on October 25, 2015 when flows are reduced to approximately 30 cfs.

Rating curves for Crescent Creek at RM 22.8 and RM 1.7 were developed using transducer data and show that all of the monitored sites are influenced by the changes in flow at the CREO gauge (Biota Pacific 2017). However, the magnitude of the influence is variable seasonally.

Hydrological data collected at monitored frog sites show that the largest influence of the flow releases from Crescent Dam is during the three summer months of July, August, and September.

Biota Pacific estimated that median water surface elevations of wetlands adjacent to Crescent Creek can increase from 4.9 to 7.8 inches during these summer months. From October through June, water surface elevations may be reduced by 0.3 to 2.3 inches (Biota Pacific 2017, p. 17-19).

Sites on Crescent Creek may experience low water during spring breeding and early rearing seasons since water is held in Crescent Lake until July. Egg mass stranding was observed at the Forest Service site downstream of Highway 58 in 2013 when the flow below Crescent Dam was 10 cfs and at the BLM site on the lowest reach of Crescent Creek in 2014 when the flow below Crescent Dam was 7.5 cfs (Figure 72). In the later instance, the Tumalo Irrigation District allowed an additional 14 cfs past the dam to improve habitat for spotted frogs.

Stranding of egg masses is not entirely due to irrigation storage. Rather, the stranding at times is due to natural flood events (i.e., rain on snow or snowmelt upper watershed) that vastly inundate the floodplain causing spotted frogs to seek shallow areas on the floodplain to deposit eggs. The duration of flood water on the floodplain is often short-lived and egg masses or hatching tadpoles can strand at these shallow deposition sites. In cases where oxbows are deep enough to intersect the water table or base elevations of the adjacent river, egg masses can develop and metamorphose.

On April 24, 2014, Tumalo Irrigation District increased the flow below Crescent Dam to 22 cfs when informed of the stranding. Figure 73 shows improved hydrological condition in the wetland where frogs breed. Additional precipitation also helped to wet the area.

Although additional flow releases in the spring can improve breeding conditions, particularly after a dry winter, these additional dam releases could decrease breeding habitat suitability in the



Figure 72. Oregon spotted frog egg mass stranding in Crescent Creek BLM wetland (1.5 RM) at 7.5 cfs on April 8, 2014.



Figure 73. Oregon spotted frog site on BLM land near RM 1.5 on April 24, 2014 when flows at CREO gauge were increased to 22 cfs from 7.5 cfs.

short-term, where natural flooding is occurring on the floodplains due to high amounts of precipitation and run-off from Big Marsh Creek. The Service observed high water levels and less suitable breeding and rearing conditions for spotted frogs along Crescent Creek during the spring of 2017 after a winter of high snowfall. In 2019, high flows resulted in egg mass deposition within wetlands that were draining by mid-May and tadpole stranding was observed in the lower reaches of Crescent Creek. The variability in annual, seasonal conditions that has been observed through monitoring underscores the importance of timing the water releases to coincide with the life cycle of the Oregon spotted frog.

Summer irrigation flows vastly increase the volume of water in the river channel and within some wetlands and oxbows along Crescent Creek. In the unregulated condition, average monthly flows at the Crescent Dam gauge (CREO) were 20 cfs and below in July, August, and September. Average monthly flows within the regulated system are now between 100 and 140 cfs during summer months (Figure 67 above). The high summer flows create an abundance of inundated wetlands that are highly suitable for spotted frogs. Figure 74 shows a Crescent Creek oxbow at 65 cfs during summer and high quality habitat for Oregon spotted frog. Figure 75 shows the lower Crescent Creek site at RM 1.5 with flows of 115 cfs at the CREO gauge.

Although the summer flows create highly suitable habitat for spotted frogs, we do not know how suitable these areas are for spotted frogs when flows are reduced at the onset of the storage season. Habitat monitoring should be conducted in the fall to observe the change in wetland conditions at the onset of the storage season. Continued monitoring is necessary to determine how the timing and volumes of flow releases from Crescent Lake Dam may be affecting Oregon spotted frogs and their habitats. Furthermore, telemetry studies such as those described above by USGS could inform our understanding of spotted frog movement and habitat preferences in Crescent Creek.



Figure 74. Oregon spotted frog site on private land near RM 1.5 on July 7, 2014 when flows at CREO are 65 cfs.



Figure 75. Oregon spotted frog site on BLM land (RM 1.5) on September 15, 2015 when flows at CREO are 115 cfs.

Little Deschutes River Sites Downstream of Crescent Creek Confluence

The Little Deschutes River flows approximately 60 miles between the confluences with Crescent Creek and the mainstem Deschutes River near Sunriver, OR. This reach of the river is almost completely within private lands. Only two small blocks of BLM land are present within this reach of the Little Deschutes River where spotted frog monitoring has occurred. Another two parcels of lands administered by the City of La Pine have also been occasionally surveyed for spotted frogs.

The Service's ability to monitor private lands along the Little Deschutes River is highly dependent upon our relationship with private landowners. We have had a long standing relationship with the owners of Crosswater Golf Course through a partnership with the Sunriver Nature Center and Observatory. Breeding counts have been conducted on private property within Crosswater development since the early 2000s, similar to those at Sunriver, described above. Table 26 represents a portion of those breeding counts and those within other sites along the

Little Deschutes River. The USGS has conducted most of the breeding counts within the Little Deschutes River system over the years.

Without thorough breeding surveys and other more rigorous population monitoring, it is difficult to assess the status of spotted frogs within the Little Deschutes River subbasin. Therefore, in addition to breeding counts, continued habitat and threats assessment work is needed at all spotted frog sites.

Table 26 Breeding counts along the Little Deschutes River below Crescent Creek confluence.

Breeding site	Egg mass counts										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Middle Little Deschutes complex 1 (Private)				8							
Middle Little Deschutes complex 2 (Private)				15							
Masten Rd.										2	2
Leona Park (City of La Pine)				88					38	10	
Oxbows behind La Pine High School (BLM/Private)	5							3	20	12	
Rosland Park (City of La Pine)				15					0	3	
Riverside oxbow (private)				10	19			15	10	17	3
Casey Tract				23	33	25	43	21	6	19	7
Thousand Trails (private)				10				1	0		
Crosswater (private)	197	149	113	101	156	47	61	65	13	38	17

Spotted frog habitat is abundant along the Little Deschutes River system within riverine oxbows and sloughs. **Figure 76** depicts the abundance of oxbow habitat in an aerial flight conducted on April 21, 2017 with flows at the LAPO gauge of 469 cfs. As described earlier, the Little Deschutes River is characterized as shallow gradient with a broad floodplain consisting of emergent vegetation and willows (*Salix* spp.), with mature lodgepole pine (*Pinus contorta*) on the surrounding uplands. The inherent geology results in a high water table (UDWC 2002). Beaver are active within the Little Deschutes River system and maintain inundated oxbows in many areas that enhance the suitability of these areas for Oregon spotted frogs. In addition to the natural habitats, Oregon spotted frog breeding sites also occur within man-made ponds on private lands (i.e., Crosswater and Thousand Trails) near Sunriver, OR.



Figure 76. Aerial photo showing abundance of Oregon spotted frog habitat along the Little Deschutes River on April 21, 2017 with flows at the La Pine gauge (LAPO) of 469 cfs.

4.3.2.3.2 Influence of Water Management on Little Deschutes River Spotted Frog Habitat

Average monthly fall, winter, and spring flows at the La Pine gauge (LAPO) are slightly lower compared to flows in an unregulated condition (Figure 67 above) due to water being held in Crescent Lake during the storage season (Oct – May). The fall ramp down reduces inundation of wetlands between September and October at which point frogs may be vulnerable to predation. Frogs must either move to overwintering locations or remain in residual pools of water after ramp down.

We assume that spotted frogs overwinter in oxbows and ponds that hold water through winter. Given that the Little Deschutes River flows have been reduced by storage, the frogs are likely to be using the river, as well. Utilization of the river for wintering increases the risk of predation on spotted frogs by brown trout, which are abundant in the Little Deschutes River.

Sites on the Little Deschutes River, located downstream of the Crescent Creek confluence, do not typically experience low water during spring breeding season due to water being held in

Crescent Lake until July because spring rains in the upper Little Deschutes system contribute significant flows to the system. The difference between the unregulated and regulated average monthly flows at the LAPO gauge is relatively small during the spring breeding period (March – April) (Figure 67). Egg mass stranding has been observed at sites along the Little Deschutes River during the spring. However, the stranding at times is due to natural flood events (i.e., rain on snow or snowmelt from the Upper Little Deschutes watershed) that vastly inundate the floodplain and spotted frogs are forced to seek shallow areas on the floodplain to deposit eggs. The duration of flood water on the floodplain is often short-lived and egg masses or hatching tadpoles can strand at these shallow deposition sites. In cases where oxbows are deep enough to intersect the water table or base elevations of the adjacent river, then egg masses can develop and metamorphose.

Summer irrigation flows vastly increase the volume of water in the river channel and within some wetlands and oxbows along the Little Deschutes River. In the unregulated condition, average monthly flows at the La Pine gauge (LAPO) were 50 cfs and below in July, August, and September. Average monthly flows within the regulated system are now between 100 and 150 cfs during summer months (Figure 67). In addition to storage and release of water from Crescent Lake, a large irrigation ditch (Walker Basin Canal) pulls water (~28 cfs) from the Little Deschutes downstream of the confluences with Crescent Creek and supplies irrigation water to Long Prairie. Irrigation water supplied via this canal is not within the action area.

Habitat monitoring is necessary to further elucidate the change in wetland conditions related to storage and release of water from Crescent Dam. To date, we do not have sufficient hydrological monitoring of spotted frog sites on the Little Deschutes River system.

In the fall at the onset of the storage season, a drop in water elevation within the river and oxbows is noticeable. In September 2019, the Service and USGS observed low water levels in floodplain oxbows of the Little Deschutes River while monitoring and tagging Oregon spotted frogs. Bull frogs and mature spotted frogs were observed preparing to winter in the same floodplain oxbow where water levels had receded due to the onset of the irrigation storage season. Concerned that the bullfrogs could prey upon the adult spotted frogs while concentrated into a small wintering area, the Services made an effort to remove the bull frogs to reduce the threat to spotted frogs. The threat of bullfrogs to persistence of Oregon spotted frogs is high along the lower Little Deschutes River.

4.3.2.4 Other Threats

Despite an abundance of habitat for spotted frogs in the Little Deschutes River system, there are prevalent threats in addition to the water management. Bullfrogs and reed canarygrass appear to be increasing in abundance. Our assessment of these threats is currently only qualitative. During the ESA listing process in 2014, we identified where each of these threats were present within the 23 spotted frog breeding locations in the Little Deschutes River subbasin ([Threats Matrix](#)).

The ESA listing identified bull frogs as a high threat to Oregon spotted frogs based on their presence at 8 of 23 (35 %) sites assessed. Currently, bullfrogs have been detected up to river mile 41.5 on the Little Deschutes River. A recent survey of the Gilchrist Log pond and Little

Deschutes River between river miles 67 and 68 in Gilchrist, OR found no bullfrogs and numerous spotted frogs (Rombough 2019). We assume that higher elevation sites maintain cool water temperatures that are not suitable for bullfrogs. However, the full extent of bullfrog distribution on the Little Deschutes River upstream of river mile 41.5 is not known.

Only 13 of the 23 spotted frog breeding sites were surveyed for reed canarygrass at the time of the ESA Listing. The invasive grass was observed at 8 of 13 spotted frog sites surveyed. Additional survey work is needed to assess the condition of spotted frog sites and the presence of reed canarygrass and bull frogs within spotted frog breeding sites on the Little Deschutes River. Treatment of these invasive species will be necessary to maintain suitable habitat for Oregon spotted frogs over time.

4.3.3 Conservation Role of the Action Area for Spotted Frogs

The Action Area encompasses a large portion of the range of the Oregon spotted frog and contains a significant portion of the known population and a significant portion of remaining habitat for this species.

The Action Area covers about 65 percent of the Upper Deschutes and Little Deschutes river subbasins, which collectively encompass about 35 percent of the current range of the Oregon spotted frog. At the time of listing in 2014 (79 FR 51658), the Service attempted to quantify the number of breeding adults within each occupied subbasin range-wide to provide some relative abundance information on the species. In the Final Rule, the minimum number of breeding adult spotted frogs that were enumerated within the Upper Deschutes and Little Deschutes river subbasins accounted for about 50 percent of those enumerated within the range of the species, highlighting the importance of these two subbasins for the conservation of the Oregon spotted frog with respect to its numbers and distribution.

The Oregon spotted frog is broadly distributed within the Action Area. However, the known numbers of individual spotted frogs in the Action Area are lower than those in portions of these subbasins that are not affected by irrigation water storage and release operations associated with the proposed action. For example, Big Marsh, which is not within Action Area and is not affected by water storage and release operations, represents about 80 percent of the estimated minimum breeding adult population of the Oregon spotted frog within the Little Deschutes River subbasin.

Habitat loss, degradation, and fragmentation threaten the continued existence of the Oregon spotted frog (79 FR 51658). The Action Area provides an abundance of habitat that is essential to ensuring a persistent spotted frog population in this portion of its range. Based on the principles of conservation biology (Groom et al. 2006), the Service concludes that maintaining and increasing population viability and expanding spotted frog distribution within the Action Area are essential to the recovery of the species. Past and present irrigation water storage and release operations within the Action Area have degraded the condition of the Oregon spotted frog population by significantly altering habitat conditions to an extent that is causing incidental take of the species.

4.3.4 Status of Oregon Spotted Frog Critical Habitat in the Action Area

The Deschutes Project occurs within critical habitat units (CHU) 8 (Upper Deschutes River) and 9 (Little Deschutes River) of Oregon spotted frog critical habitat (Table 27). These CHUs combined encompass approximately 35,065 acres of critical habitat for the Oregon spotted frog and represent 54 percent of the range-wide acreage of designated critical habitat (65,038 acres).⁹ Of these 35,065 acres, approximately 22,688 acres of critical habitat (35 percent of critical habitat acreage range-wide) are within the geographic area influenced by the Deschutes Project (Figure 77), including private irrigation district actions that store and release water for irrigation.

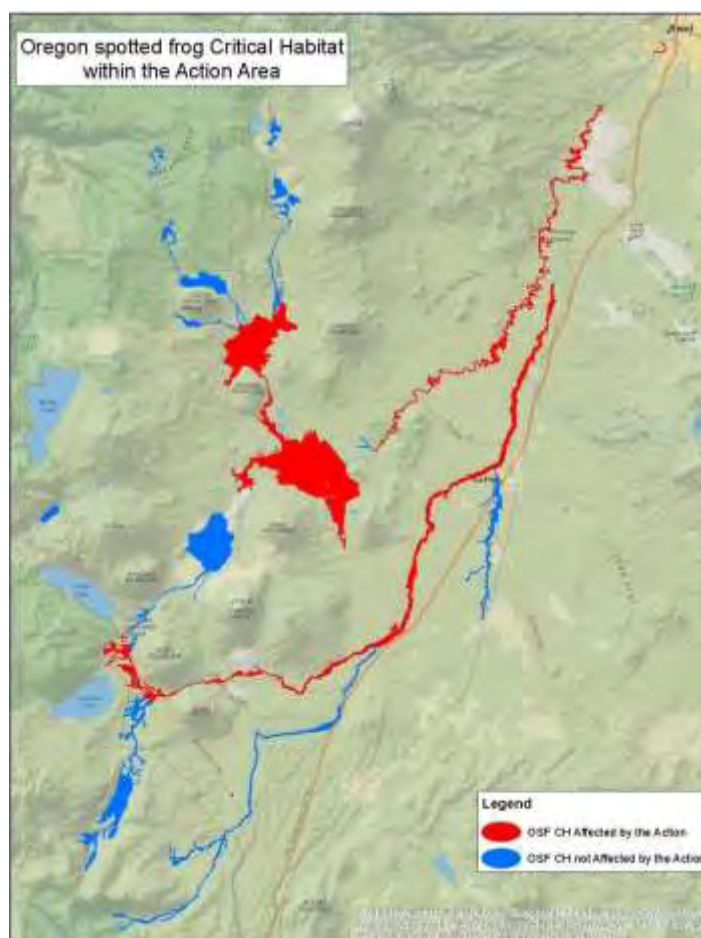


Figure 77. Oregon spotted frog critical habitat in the Upper Deschutes and Little Deschutes River CHUs likely to be affected by the Deschutes Project (in red) compared to unaffected critical habitat.

⁹ Critical habitat acres and percentages of critical habitat do not include the approximately 30 miles of Oregon spotted frog critical habitat designated in Washington State.

Table 27 Oregon spotted frog critical habitat by unit and subunit within and outside of the area affected by the Deschutes Project.

CH Unit	CH Subunit	CH Acres	Affected Acres	Percent (%) Affected	Unaffected Acres	Percent (%) Unaffected
8. Upper Deschutes River	8A – Below Wickiup Dam	2,001	1,960	98	41	2
	8B – Above Wickiup Dam	22,031	15,365	70	6,666	30
Upper Deschutes River Total		24,032	17,325	72	6,707	30
9. Little Deschutes River		11,033	5,362	49	5,671	51

The terminology adopted by National Wetland Inventory (NWI; Cowardin et al. 1979) was used to describe the wetland habitat types within delineated critical habitat in ArcGIS and to estimate acreages of habitat types included in the description of each CHU below. The wetland habitat types include freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, lake, and riverine (Cowardin et al. 1979).

4.3.4.1 Critical Habitat Unit 8: Upper Deschutes River

This unit includes 24,032 ac (9,726 ha) located in Deschutes and Klamath counties, Oregon, in the Upper Deschutes River subbasin. The Upper Deschutes River unit extends from headwater streams and wetlands draining to Crane Prairie and Wickiup reservoirs and to the main stem of the Deschutes River downstream to Bend, Oregon. This unit also includes Odell Creek and Davis Lake. Approximately 23,213 ac (9,394 ha) of CHU 8 are managed by the USFS Deschutes National Forest. A subset of the acreage managed by the Deschutes National Forest within Wickiup and Crane Prairie reservoirs is managed by the Districts in close coordination with the Reclamation.

The Upper Deschutes River CHU consists of two subunits: Below Wickiup Dam (Subunit 8A) and Above Wickiup Dam (Subunit 8B). These subunits are affected differently by the operation of the Deschutes Project. The description of each subunit and ongoing impacts to critical habitat by land management activities are described below for each subunit.

4.3.4.1.1 Critical Habitat Subunit 8A

Subunit 8A includes 2,001 ac (810 ha) of the Deschutes River and associated wetlands downstream of Wickiup Dam to Bend, Oregon, beginning at the outlet of an unnamed tributary draining Dilman Meadow. Approximately 875 acres of critical habitat (44 percent of subunit 8A) are within the Deschutes River corridor between river mile 167.5 and 228. The acres of critical habitat within this subunit affected by the operation of the Deschutes Project are 1,960 ac (793 ha), consisting of 468 ac (189 ha) of freshwater emergent wetland, 507 ac (205 ha) of freshwater forested/shrub wetland, 74 ac (30 ha) of freshwater pond, 37 ac (15 ha) of lake, and 875 ac (354 ha) of riverine habitat. The acres of critical habitat not affected within this subunit include 41 ac (17 ha) consisting of 37 ac (15 ha) of freshwater emergent wetland and 4 ac (2 ha) of freshwater forested/shrub wetland.

Within subunit 8A, approximately 1,182 ac (479 ha) are managed by the USFS Deschutes National Forest, 185 ac (75 ha) are managed by Oregon Parks and Recreation Department, 45 ac (18 ha) are managed by Deschutes County, and 589 ac (238 ha) are privately owned. Some private lands within Sunriver and at the Old Mill are excluded from critical habitat and the Service is actively working with these private landowners on conservation actions for spotted frogs. The entirety of subunit 8A is affected by the storage and release of water from Wickiup Dam by the Districts.

All of the following essential physical or biological features of spotted frog critical within this subunit are currently being impacted by hydrologic modification of river flows, reed canary grass, non-native predaceous fish, and bullfrogs. The functional capability of critical habitat subunit 8A to support recovery of the Oregon spotted frog has been degraded or reduced by the storage and release of water caused by the Deschutes Project. Specific details regarding the condition of the PCEs within CHU 8A are provided in the “Historical and current condition of the Deschutes River below Wickiup Dam” section of the Environmental Baseline for the Oregon spotted frog.

Nonbreeding, breeding, rearing, and overwintering habitat (PCE 1) – Table 28 displays the habitat characteristics that define PCE1. Within this subunit, PCE 1 is degraded and breeding and overwintering habitats are adversely affected by the storage of water from October to April of each year caused by the Deschutes Project. Spotted frog breeding habitat is generally limited to a subset of critical habitat acres that hold water through the winter. A precise acreage of the habitat that remains during the storage season is not available. However, the Service has conducted aerial flights periodically and during different seasons to quantify the amount of critical habitat that is reduced by storage operations under the Deschutes Project.

Table 28 PCE 1 habitat characteristics for spotted frog nonbreeding, breeding, rearing, and overwintering habitat (81 FR 29335-29396).

Habitat Type	Habitat Characteristics
Nonbreeding	• Total surface area with less than 50 percent vegetative cover • An absence or low density of non-native predators
Breeding and Rearing	• Inundated for a minimum of 4 months per year • If ephemeral, areas are hydrologically connected by surface water flow to a permanent water body • Shallow-water areas, less than or equal to 12 inches (30 cm), or water of this depth over vegetation in deeper water • Herbaceous wetland vegetation (i.e., emergent, submergent, and floating-leaved aquatic plants), or vegetation that can structurally mimic emergent wetland vegetation through manipulation • Shallow-water areas with high solar exposure or low (short) canopy cover • An absence or low density of non-native predators
Overwintering	• Inundated from October through March

A thorough description of habitat conditions within the action area is provided in the “Historical and current condition of the Deschutes River below Wickiup Dam” section above. In summary, flow releases from Wickiup Dam in early April have the potential to improve the condition of PCE 1 (i.e., breeding habitat) but the flows are often not sufficient to improve breeding conditions (i.e., to provide for shallow water areas in contact with emergent vegetation). Rearing

habitats (PCE 1) can be improved when flow releases are above thresholds identified in Table 30. However, when the timing of flow releases are too late (i.e., weeks after the hatching of spotted frog eggs occurs), emerging tadpoles are not likely to be within emergent vegetation and are at a high risk of predation. Overwintering habitat (PCE 1) is limited to those wetlands that hold water throughout the winter that does not freeze solid. Many wetlands dry up or have greatly reduced water levels during the storage season when flows released from Wickiup Dam are as low as 20 cfs.

Aquatic movement corridors (PCE 2) – Habitat characteristics associated with PCE 2 include being less than or equal to 3.1 mi linear distance from breeding areas and impediment-free relative to frog movement, including, but not limited to, hard barriers such as dams, impassable culverts, lack of water, or biological barriers such as abundant predators, or lack of spotted frog refugia from predators (81 FR 29335-29396). PCE 2 of critical habitat in Subunit 8A is degraded. The Deschutes River flows that convey water to wetlands that provide for adequate function of PCE 1 (breeding, rearing, overwintering, and nonbreeding habitat) are significantly reduced during the water storage season by the Deschutes Project. Landscape-level aquatic movement and within-site aquatic movement habitats for Oregon spotted frogs are limited for over six months of the year, every year, by the Deschutes Project. High summer flows may improve the connectivity within and between wetland habitats associated with the Deschutes River. However, under the Deschutes Project, the rapid change in flows that affects inundation of wetlands and the river corridor also adversely affect the function of PCE 2.

Refugia habitat (PCE 3) – Oregon spotted frog refugia habitat includes nonbreeding, breeding, rearing, or overwintering habitat or aquatic movement corridors with habitat characteristics that provide spotted frogs with refugia from predators (81 FR 29335-29396). Similar to PCEs 1 and 2, PCE 3 is degraded within Subunit 8A. During the water storage season of the Deschutes Project, refugia habitat is extensively reduced within critical habitat in this subunit. Spotted frog habitat that is available through the winter is limited to the Deschutes River and adjacent wetlands that either have springs or perched water that is sustained through the winter. Predators, such as the brown trout, occur within the Deschutes River and in areas where the only remaining spotted frog overwintering habitat is within the river, so there is little to no refugia habitat for spotted frogs to avoid exposure to predaceous fish.

Special management is necessary to improve existing spotted frog nonbreeding, breeding, rearing, and overwintering habitat, aquatic movement corridors, and refugia habitat in this subunit. In its current condition, the adverse effects to PCEs within subunit 8A due to the Deschutes Project, as described above, are ongoing and the capability of this subunit to properly function in support of spotted frog recovery is impaired.

4.3.4.1.2 Critical Habitat Subunit 8B

Subunit 8B includes 22,031 ac (8,916 ha) of land under USFS ownership. This subunit includes the following lakes, including associated wetlands, in the upper watersheds that flow into the Crane Prairie/Wickiup Reservoir system: Hosmer Lake, Lava Lake, Little Lava Lake, Winopee Lake, Muskrat Lake, and Little Cultus Lake, Crane Prairie and Wickiup reservoirs, and Davis Lake. The following riverine waterbodies and associated wetlands are designated as critical

habitat: the Deschutes River from Lava Lake to Wickiup Reservoir, Cultus Creek downstream of Cultus Lake, Deer Creek downstream of Little Cultus Lake, and Odell Creek from a spotted frog-occupied unnamed tributary to the outlet in Davis Lake. Approximately 15,213 acres of critical habitat in subunit 8B are within Crane Prairie and Wickiup reservoirs which are under USFS ownership but managed by the irrigation districts in close coordination with the Reclamation.

All of the essential physical or biological features of critical habitat in subunit 8B are currently being impacted by the storage and release of water for irrigation by the Deschutes Project, vegetation succession, non-native predaceous fish, and reed canary grass within and between the reservoirs in this unit.

The area affected by Deschutes Project operations in the reservoirs and in the Deschutes River and associated wetlands between the reservoirs includes approximately 15,365 acres (6,218 ha) of critical habitat (70 percent of subunit 8B). Wetland habitat types within these acres include approximately: 3,029 ac (1,226 ha) of freshwater emergent wetland, 809 ac (327 ha) of freshwater forested/shrub wetland, 3 ac (1 ha) of freshwater pond, 11,514 ac (4,660 ha) of lake, and 11 ac (4 ha) of riverine habitat.

Crane Prairie Reservoir encompasses about 4,982 acres of Oregon spotted frog critical habitat. Within the large reservoir acreage, there are approximately 629 acres of emergent wetland habitat that are important physical and biological features of the critical habitat within the reservoir. Wickiup Reservoir encompasses approximately 10,231 acres of critical habitat. There are approximately 2,376 acres of emergent wetland habitat that are important physical and biological features of the critical habitat within the reservoir. The surface area inundated by the reservoirs fluctuates with storage and release of irrigation water; those fluctuations strongly influence the condition and recovery support function of PCEs 1, 2 and 3 within this subunit.

There are approximately 6,666 ac (2,698 ha) acres of spotted frog critical habitat that are not affected by the Deschutes Project or other anthropogenic activities within this unit: 1,180 ac (477 ha) of freshwater emergent wetland, 392 ac (159 ha) of freshwater forested/shrub wetland, 39 ac (16 ha) of freshwater pond, 4,959 ac (2,007 ha) of lake, and 96 ac (39 ha) of riverine habitat.

The capability of this subunit to function in support of spotted frog recovery has been reduced by the storage and release of water as a function of the Deschutes Project, which causes significant fluctuations in reservoir levels during frog breeding and rearing periods. Specific details regarding the condition of the critical habitat within CHU 8B are provided in the “Oregon spotted frog sites above Wickiup Dam” section of the Environmental Baseline section for the spotted frog presented below.

Nonbreeding, breeding, rearing, and overwintering habitat (PCE 1) – Table 30 displays the habitat characteristics that define PCE 1. Crane Prairie and Wickiup reservoirs provide important spotted frog breeding, rearing, and overwintering habitat within critical habitat subunit 8B. However, these habitats change seasonally and spatially due to storage and release operations of the Deschutes Project. For example, breeding habitats within the reservoirs shift depending on

water elevations in the spring; ideally, spotted frog breeding areas should be located in less than 12 inches of water within emergent vegetation.

The current system of reservoir management under the Deschutes Project results in significant fluctuations in water levels within the reservoirs. For that reason, PCE 1-related frog habitats within this subunit are currently sub-optimal for spotted frogs. Water levels may be high during the spring breeding season and suitable breeding habitats may not be present within the reservoirs. As described above, Crane Prairie Reservoir volumes that exceed 50,000 acre-feet result in suboptimal spotted frog breeding habitat due to shallow water areas extending into upland vegetation rather than into emergent vegetation that is inundated at these volumes.

Under the Deschutes Project, increasing water levels during the storage season (November to March) provides spotted frog overwintering habitat within the reservoirs. However, in instances when storage volumes are so low that water levels are below emergent vegetation, the habitat available to spotted frogs for overwintering may lack adequate cover for spotted frogs to successfully survive the winter. Under the Deschutes Project, water levels in Wickiup Reservoir, in particular, fluctuate abruptly and extensively resulting in lower quality PCE 1 habitats for all life stages of the spotted frog.

Aquatic movement corridors (PCE 2) – As described above, habitat characteristics associated with PCE 2 include being less than or equal to a 3.1-mi linear distance from spotted frog breeding areas and free of impediments to movement. The reservoirs provide an aquatic connection for the species within the larger subunit, allowing for dispersal of juveniles and adults between populations of Oregon spotted frogs. PCE 2 of critical habitat in Subunit 8B is degraded. The extensive reduction in water levels, particularly in Wickiup Reservoir, in the fall decreases connectivity with wetlands along the margins of the reservoirs. Landscape-level aquatic movement by spotted frogs and within-site aquatic movement habitats for spotted frogs are limited in the fall every year due to the extensive reduction in water levels caused by the Deschutes Project.

Refugia habitat (PCE 3) – Spotted frog refugia habitat includes habitat for all life stages or aquatic movement corridors with habitat characteristics that provide refugia for spotted frogs from predators. Similar to PCEs 1 and 2, PCE 3 is degraded within Subunit 8B. Both reservoirs and the Deschutes River between the reservoirs contain populations of non-native predaceous fish, so there is little to no refugia for spotted frogs from predaceous fish, particularly when the surface area (acreage) of inundation is reduced as reservoir water levels are lowered at the end of the irrigation season.

The physical or biological features that are essential to the conservation of Oregon spotted frog within the reservoirs require special management considerations or protections to ensure that wetland habitats that support the life history requirements of the frog are subject to sufficient water levels from the breeding period through metamorphosis and are connected to overwintering habitat. Some of these areas within the reservoir may require the restoration and improvement of habitat features. Water releases from Wickiup Dam should be timed to coincide with the spotted frog breeding period and winter flow releases should improve overwintering

conditions for Oregon spotted frogs that utilize the Deschutes River and adjacent wetlands in this subunit. Regardless, improving PCEs within the reservoirs could negatively affect critical habitat in subunit 8A, downstream of Wickiup Dam, and releasing flows to improve critical in subunit 8A could negatively affect critical habitat in subunit 8B. Therefore, the entire CHU 8 must be considered when implementing actions that are designed to improve the function of critical habitat in support of spotted frog recovery.

4.3.4.1.3 Critical Habitat Unit 9: Little Deschutes River

The Little Deschutes River unit encompasses 11,033 ac (4,465 ha) in Klamath and Deschutes counties, Oregon. The Little Deschutes River CHU includes the Little Deschutes River and associated wetlands from its headwaters to the confluence with the Deschutes River, 1 mi south of Sunriver and approximately 20 mi south of Bend, Oregon. This unit includes the following tributaries, including adjacent wetlands: Big Marsh Creek, Crescent Creek, and Long Prairie Creek.

Within this unit, currently 5,288 ac (2,140 ha) are managed by the USFS Deschutes National Forest and Prineville BLM, 14 ac (6 ha) are managed by the State of Oregon, 80 ac (32 ha) are managed by Deschutes and Klamath counties, and 5,651 ac (2,287 ha) are privately owned. Private lands within the Crosswater Golf Course and Resort are excluded from the critical habitat designation (81 FR 29366 - 29368). The essential physical or biological features found in this CHU are impacted by storage and release of water from Crescent Lake, irrigation withdrawals, non-native predaceous fish, reed canary grass, and bullfrogs (81 FR 29335-29396). Specific details regarding the condition of spotted frog critical habitat in this CHU are provided in section 6.2.2 of this document:” Little Deschutes River subbasin spotted frog sites that are affected by the proposed action.”

The portion of CHU 9 that is affected by water management operations by the Tumalo Irrigation District (TID) includes the Little Deschutes River from its mouth upstream to its confluence with Crescent Creek and Crescent Creek from its mouth upstream to Crescent Lake Dam. A total of 5,363 ac (2,171 ha) of critical habitat within this CHU is affected by the TID operations. These acres consists of 2,306 ac (933 ha) of freshwater emergent wetland, 2,790 ac (1,129 ha) of freshwater forested/shrub wetland, 13 ac (5 ha) of freshwater pond, 88 ac (36 ha) of wetlands not overlapping with NWI-classified wetlands, and 166 ac (67 ha) of riverine habitat. The critical habitat affected by TID operations largely consists of wetlands associated with low-gradient meandering reaches of the Little Deschutes River and Crescent Creek which interact extensively with their floodplains.

The portion of the CHU that is unaffected by the ongoing TID operations includes the Little Deschutes River upstream of its confluence with Crescent Creek, Big Marsh Creek, and Long Prairie Creek for a total of 5,670 ac (2,294 ha). The acres that are not affected by TID water management operations include approximately: 2,442 ac (988 ha) of freshwater emergent wetland, 3,052 ac (1,235 ha) of freshwater forested/shrub wetland, 7 ac (3 ha) of freshwater pond, 62 ac (25 ha) of wetlands not overlapping with NWI wetlands, and 73 ac (30 ha) of riverine habitat.

Nonbreeding, breeding, rearing, and overwintering habitat (PCE 1) – Table 28 displays the habitat characteristics that define PCE 1. In CHU 9, PCE 1 is degraded due to the storage and release of water from Crescent Lake dam. Much of the critical habitat that is currently being affected by the Deschutes Project is privately owned and many “lots and subdivisions are in sensitive areas near the Little Deschutes River, impacting riparian and wetland habitats that are important for fish and wildlife habitat” (Upper Deschutes Watershed Council 2002). The Upper Deschutes Watershed Council (2002) also documented that the Little Deschutes River from river mile 0 to river mile 63 has an altered flow regime, high water temperatures, and degraded riparian conditions.

Aquatic movement corridors (PCE 2) – Habitat characteristics associated with PCE 2 include being less than or equal to a 3.1-mi linear distance from spotted frog breeding areas and free of movement impediments (81 FR 29335-29396). PCE 2 in CHU 9 is degraded because Crescent Creek and Little Deschutes River flows are altered by the storage and release of water from Crescent Lake under the Deschutes Project.

Refugia habitat (PCE 3) – Refugia habitat includes spotted frog nonbreeding, breeding, rearing, or overwintering habitat or aquatic movement corridors with habitat characteristics that provide protection from predators (81 FR 29335-29396). Similar to PCEs 1 and 2, PCE 3 is degraded within CHU 9. During the water storage season, spotted frog refugia habitat is reduced within the critical habitat. Brown trout, which prey on spotted frogs, are present in the Little Deschutes River and at least the lower portion of Crescent Creek below Highway 61, so there is little to no refugia habitat for spotted frogs to use to avoid exposure to predaceous fish.

4.3.5 Conservation Role of the Action Area for Spotted Frog Critical Habitat

The intended conservation role of critical habitat in the Action Area for the recovery of the Oregon spotted frog is to provide sufficient levels of the following habitats to support a resilient and persistent population of the species in this portion of its range: (1) spotted frog non-breeding, breeding, rearing, and overwintering habitat; (2) aquatic habitat to facilitate unimpeded movements of the frog; and (3) refugia habitat for protection against predatory fish.

The Upper Deschutes River and Little Deschutes River subbasins encompassed by CHUs 8 and 9 contain approximately 35,065 acres of critical habitat, representing 54 percent of the 65,038 acres of critical habitat designated range-wide. The Action Area encompasses approximately 22,688 acres of critical habitat within these two CHUs, and represents 35 percent of the critical habitat designated range-wide. The conservation function of critical habitat within the action area has been significantly altered due to past and ongoing water management associated with the Deschutes Project and other threats. Given the large extent of designated critical habitat in the Action Area, it is expected to play a significant role in the conservation/recovery of the species. Improving the conservation function of critical habitat in the Action Area is essential to meeting the recovery needs of the Oregon spotted frog.

4.3.6 Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms “climate” and “climate change” are defined by the

Intergovernmental Panel on Climate Change (IPCC). The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a, p. 78). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a, p. 78).

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007a, pp. 8–12). Therefore, we use “downscaled” projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling). With regard to our analysis for the Oregon spotted frog, downscaled projections are available.

The climate in the Pacific Northwest (PNW) has already experienced a warming of 0.8 degrees Celsius (°C) (1.4 degrees Fahrenheit (°F)) during the 20th century (Mote *et al.* 2008, p.3). Using output from eight climate models the PNW is projected to warm further by 0.6 to 1.9 degrees °C (1.1 to 3.4 degrees °F) by the 2020s, and 0.9 to 2.9 degrees °C (1.6 to 5.2 degrees °F) by the 2040s (Mote *et al.* 2008, pp. 5–6). Additionally, the majority of models project wetter winters and drier summers (Mote *et al.* 2008, p.7), and of greatest consequence, a reduction in regional snowpack, which supplies water for ecosystems during the dry summer (Mote *et al.* 2003). The small summertime precipitation increases projected by a minority of models do not change the fundamentally dry summers of the PNW and do not lessen the increased drying of the soil column brought by higher temperatures (Mote *et al.* 2003, p. 8).

Snowmelt-dominated watersheds, such as White Salmon in Washington and the Upper Deschutes, Little Deschutes, and Klamath River subbasins in Oregon, will likely become transient, resulting in reduced peak spring streamflow, increased winter streamflow, and reduced late summer flow (Littell *et al.* 2009, p. 8). In snowmelt-dominated watersheds that prevail in the higher altitude catchments and in much of the interior Columbia Basin, flood risk will likely decrease and summer low flows will decrease in most rivers under most scenarios (Littell *et al.* 2009, p. 13).

Climate change models predict that water temperatures will rise throughout Oregon as air temperatures increase into the 21st century. A decline in summer stream flow may exacerbate water temperature increases as the lower volume of water absorbs solar radiation (Chang and Jones, p. 134).

Analyses of the hydrologic responses of the upper Deschutes basin (including the Upper and Little Deschutes River subbasins) and the Klamath Basin to climate change scenarios indicates that the form of precipitation will shift from predominately snow to rain and cause decreasing spring recharge and runoff and increasing winter recharge and runoff (Waibel 2011, pp., 57–60;

Mayer and Naman 2011, p. 3). However, there is spatial variation within the Deschutes subbasins as to where the greatest increases in recharge and runoff will occur (Waibel 2011, pp., 57–60). Changes in seasonality of stream flows may be less affected by climate change along the crest of the Cascades in the upper watersheds of the Deschutes, Klamath, and Willamette River basins in Oregon, where many rivers receive groundwater recharge from subterranean aquifers and springs (Chang and Jones 2010, p. 107). Summer stream flows may thus be sustained in High Cascade basins that are groundwater fed (Chang and Jones 2010, p. 134). Conversely, Mayer and Naman (2011 p. 1) indicate that streamflow into Upper Klamath Lake will display absolute decreases in July-September base flows in groundwater basins as compared to surface-dominated basins. This earlier discharge of water in the spring will result in less streamflow in the summer (Mayer and Naman 2011, p. 12).

Although predictions of climate change impacts do not specifically address Oregon spotted frogs, short- and long-term changes in precipitation patterns and temperature regimes will likely affect wet periods, winter snow pack, and flooding events (Chang and Jones 2010). These changes are likely to affect amphibians through a variety of direct and indirect pathways, such as range shifts, breeding success, survival, dispersal, breeding phenology, aquatic habitats availability and quality, food webs, competition, spread of diseases, and the interplay among these factors (Blaustein *et al.* 2010 entire; Hixon *et al.* 2010, p. 274; Corn 2003 entire). Amphibians have species-specific temperature tolerances, and exceeding these thermal thresholds is expected to reduce survival (Blaustein *et al.* 2010, pp. 286–287). Earlier spring thaws and warmer ambient temperatures may result in earlier breeding, especially at lower elevations in the mountains where breeding phenology is driven more by snow pack than by air temperature (Corn 2003, p. 624). Shifts in breeding phenology may also result in sharing breeding habitat with species not previously encountered and/or new competitive interactions and predator/prey dynamics (Blaustein *et al.* 2010, pp. 288, 294). Oregon spotted frogs are highly aquatic and reductions in summer flows may result in summer habitat going dry, potentially resulting in increased mortality or forcing frogs to seek shelter in lower quality wetted areas where they are more susceptible to predation.

Amphibians are susceptible to many types of pathogens including trematodes, copepods, fungi, oomycetes, bacteria, and viruses. Changes in temperature and precipitation could alter host-pathogen interactions and/or result in range shifts resulting in either beneficial or detrimental impacts on the amphibian host (Blaustein *et al.* 2010, p. 296). Kiesecker *et al.* (2001a, p. 682) indicate climate change events, such as El Nino/Southern Oscillation, that result in less precipitation and reduced water depths at egg-laying sites results in high mortality of embryos because their exposure to UV-B and vulnerability to infection (such as *Saprolegnia*) is increased. Warmer temperatures and less freezing in areas occupied by bullfrogs is likely to increase bullfrog winter survivorship, thereby increasing the threat from predation. Uncertainty about climate change impacts does not mean that impacts may or may not occur; it means that the risks of a given impact are difficult to quantify (Schneider and Kuntz-Duriseti 2002, p. 54; Congressional Budget Office 2005, entire; Halsnaes *et al.* 2007, p. 129). Oregon spotted frogs occupy habitats at a wide range of elevations, and all of the occupied subbasins are likely to experience precipitation regime shifts; therefore, the Oregon spotted frog's response to climate

change is likely to vary across the range and the population-level impacts are uncertain. The interplay between Oregon spotted frogs and their aquatic habitat will ultimately determine their population response to climate change. Despite the potential for future climate change throughout the range of the species, as discussed above, we have not identified, nor are we aware of any data on, an appropriate scale to evaluate habitat or population trends for the Oregon spotted frog or to make predictions about future trends and whether the species will be significantly impacted.

4.4 EFFECTS OF THE ACTION

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

4.4.1 Effects to Oregon Spotted Frog

The following analysis evaluates the effects of the issuance of the section 10(a)(1)(B) permit for the DBHCP on the Oregon spotted frog and its designated critical habitat. Oregon spotted frogs are affected by the proposed action in the portion of the action area that includes the Upper Deschutes River basin which encompasses the Upper Deschutes River and Little Deschutes River subbasins.

As described in the environmental baseline and within the Service's 2017 and 2019 Biological Opinions for the Deschutes Project, the area affected by the DBHCP within the Upper Deschutes River subbasin includes Crane Prairie Reservoir, the Deschutes River between Crane Prairie and Wickiup reservoirs, Wickiup Reservoir, and the Deschutes River downstream of Wickiup Reservoir to the city of Bend, Oregon. The area affected by the DBHCP within the Little Deschutes River subbasin includes Crescent Creek downstream of Crescent Lake Dam to its confluence with the Little Deschutes River and the Little Deschutes River from its confluence with Crescent Creek downstream to its confluence with the Deschutes River. These areas are all within designated critical habitat and represent approximately 22,688 acres.

This analysis builds upon and incorporates by reference the analyses conducted in the Service's 2017 and 2019 biological opinions for the Deschutes Project, the Final DBHCP, and the Final EIS for the DBHCP. The following analysis emphasizes effects that vary from those described in the Service's 2017 and 2019 Opinions and describes the anticipated improvement of the environmental baseline for spotted frogs over the 30 years of the permit term.

The effects analysis, herein, is organized by subbasin. The Upper Deschutes River subbasin is analyzed first and is followed by the analysis for the Little Deschutes River subbasin in each section below. Effects of interrelated and interdependent activities are also evaluated herein.

4.4.1.1 The DBHCP

For the reasons discussed below, implementation of the DBHCP is likely to have adverse effects to the spotted frog and its critical habitat that will lessen over time as habitat quality improves and as beneficial actions are increasingly implemented. These effects are likely to vary depending on geography. In some portions of the action area, implementation of the DBHCP is likely to have some beneficial effects to the spotted frog and its critical habitat compared to current, 2017 and 2019 Opinion operations, by improving its habitat during important life stages. However, in other portions of the action area, water management operations per the DBHCP are likely to maintain current, degraded habitat conditions caused by ongoing irrigation management operations in the short-term and improve conditions in the long-term.

The objective of the DBHCP conservation measures are to reduce impacts to the Oregon spotted frog and its habitat caused by ongoing operation and maintenance of Crane Prairie, Wickiup, and Crescent Lake reservoirs. The term of the section 10(a)(1)(B) permit for the DBHCP is 30 years. The primary components of the DBHCP conservation measures that are likely to affect the Oregon spotted frog and its critical habitat include changes in: storage at Crane Prairie Reservoir; minimum flow releases from Wickiup Reservoir; ramping rates at Wickiup Dam before and after the irrigation season; minimum flow releases from Crescent Lake Reservoir; and moderated flows released from Crescent Lake at the beginning and end of the irrigation season. Additionally, the Upper Deschutes River Conservation Fund will facilitate the enhancement of spotted frog habitat through the reduction of threats and stressors to Oregon spotted frog. In addition to DBHCP actions Reclamation's RO&M and SEED programs are likely to adversely affect spotted frogs and their habitat.

4.4.1.2 Methods used to Analyze Effects

The complexity of analyzing the effects of changes in water management over a broad geography representing approximately 22,688 acres of designated critical habitat, requires the use of multiple analytical tools. This analysis incorporates the Final HCP (Biota Pacific 2020) analysis and the Service's Final EIS for the HCP (USFWS 2020a) by reference and utilizes four primary tools to describe the effects likely to be caused by the DBHCP: (1) the hydrological monitoring methods described in the Environmental Baseline; (2) outputs of the RiverWare model (Reclamation 2020); (3) hydrograph data; and (4) ArcGIS outputs. In addition, for those components of the DBHCP that are the same as implemented under current operations, these effects are briefly discussed below with reference to the more detailed description in the Environmental Baseline section above.

Our analysis, below, also describes how the conservation fund per conservation measure UD-1 (i.e., Upper Deschutes Conservation Fund) may be implemented over time. The Service is currently in the process of developing a Recovery Plan for OSF and Recovery Implementation Strategy and anticipate final documents in 2022. The ongoing assessment of habitats identifies many of the threats and stressors to OSF that are in addition to the water management. Threats to Oregon spotted frogs within the HCP's covered lands identified by USFWS (2014, 2017 and 2019) include not only hydrological changes due to water management, but continued wetland habitat loss due to a lack of natural disturbance processes (e.g., floods, fire, beaver activity, etc.)

unrelated to the covered activities. Open water areas within wetlands are being encroached upon by lodgepole pine, cattails and shrubs. Reed canarygrass, an invasive species, is present within a number of occupied sites where it can spread and render habitats less suitable for Oregon spotted frogs. Introduced vertebrate predators such as bullfrogs and non-native fish also are present within a number of occupied sites on the covered lands, and active management is necessary to reduce the associated threats to Oregon spotted frogs. This Opinion describes the importance of utilizing DBHCP conservation measure UD-1 to complement the measures that address storage and release operations in the overall OSF conservation strategy.

Hydrological monitoring and thresholds for habitat inundation

Hydrological monitoring, described in the Environmental Baseline, provides the foundation for understanding how changes in reservoir volumes and flows at river gauges may impact spotted frogs and their critical habitat. Reservoir volumes and surface water elevations at Crane Prairie Reservoir have been assessed over a number of years to determine the quantity, quality and range of seasonal conditions for Oregon spotted frog. Correlations between river stage and wetland inundation (i.e., thresholds for habitat inundation) are well-established through years of monitoring on the Deschutes River and adjacent wetlands downstream of Wickiup Dam (USFWS 2017, USFWS 2019). Within the Crescent Creek and Little Deschutes River systems, the river stage and wetland inundation correlation is less precise due to the lack of river gauges within the expansive geography and the inherent natural hydrology that supplies water to habitat via groundwater.

RiverWare-modeled Hydrology

The RiverWare model (Reclamation 2020) was used in the FEIS for the DBHCP to assess how reservoir storage and flow regimes may change through implementation of the DBHCP over time (i.e., Years 1-7; 8-12; and 13-30). RiverWare-modeled outputs for current conditions (Environmental Baseline or No Action) were compared to outputs for the DBHCP to analyze potential effects to spotted frogs and spotted frog habitat anticipated over the term of the DBHCP (Chapter 8). These comparisons were assessed spatially and temporally by spotted frog life stage within the geographic area affected (FEIS, App 3.04).

The thresholds for inundation established in the Service's 2017 and 2019 biological opinions, were broadly applied to river reaches for the spotted frog analysis in the FEIS for the DBHCP (Table 29; modified from Table 3 in the FEIS App 3.04). We note that some of the flows presented in Table x below are based on take thresholds (USFWS 2017) and are not intended as flow targets for the rivers. The Service also recognizes that the thresholds established for take are likely to change over time on the Deschutes River, described below. We also note that there are specific areas that host spotted frogs within these river reaches that are inundated at flows that differ from those presented in Table 29 (e.g., Sunriver in Reach 3).

In general, the CRAO modeled flows were used to assess the effects of the proposed action on spotted frogs and critical habitat in and adjacent to the Deschutes River between Crane Prairie and Wickiup Reservoirs. The WICO and BENO modeled flows were used to assess the effects of the proposed action on spotted frogs and critical habitat between Wickiup Dam and Bend, OR.

The CREO and LAPO modeled flows were used to assess the effects of the proposed action on spotted frogs and critical habitat along Crescent Creek and the Little Deschutes downstream of the confluence with Crescent Creek. However, for the reasons stated above and in the Environmental Baseline, flow thresholds that result in adequate wetland inundation levels for the Deschutes River between the reservoirs, Crescent Creek and the Little Deschutes River measured at the CRAO, CREO and LAPO gauges, respectively, have not been determined.

Effects occurring in Crane Prairie and Wickiup Reservoirs are analyzed based on water levels or storage volumes for the duration of the HCP. The elevation of the water surface in the reservoirs determines the extent and quality of spotted frog habitat available along the shoreline and in adjacent wetlands, correlating largely to degree of inundation.

Table 29 (modified from Table 29 in FEIS App 3.04). Flow Thresholds for OSF analysis using RiverWare.

River	Reach in this Opinion	Reach in FEIS	Associated Gauge	Flow Threshold (cfs)
Deschutes River	Reach 1	Des-12a (Wickiup Dam to Fall River)	WICO	900 ^a
	Reach 2	Des-12 (Fall River to Little Deschutes)	WICO	900 ^a
	Reach 3	Des-11 (Little Deschutes to Benham Falls)	WICO	900 ^b
	Reach 4	Des-10a (Benham Falls to Dillon Falls)	BENO	1,200–1,600 ^a
	Reach 5	Des-10 (Dillon Falls to Lava Island Falls)	BENO	1,200–1,500 ^a
	Reach 6	Des-9 (Lava Island Falls to Central Oregon Diversion)	Modified from BENO <i>RiverWare Internode: Siphon2COIDInflow</i>	(none)
	Reach 7	Des-8a (Central Oregon Diversion to Colorado Street)	Modified from BENO <i>RiverWare Internode: Siphon2COIDOutflow</i>	1,200 ^b
Crescent Creek		CLD-3 through CLD-6 (Crescent Creek)	CREO	(none)
Little Deschutes River		CLD-1 and CLD-2 (Little Deschutes River)	LAPO	(none)

^a U.S. Fish Wildlife Service 2017 and 2019.

^b Developed by FWS for the FEIS for the DBHCP.

To connect the hydrological effects of the proposed action to the effects on Oregon spotted frogs, the FEIS analysis looked at the number of days during important time periods in the frog's life cycle that RiverWare-predicted flows are above “thresholds” for wetland inundation by river reach. The FEIS analysis looked at five periods during the year that are particularly important to certain life stages, including: the overwintering period (October 16 – March 1); the pre-breeding period (March 1 to March 31); the breeding period (April 1 – April 30); the period providing

tadpole rearing and habitat use by juveniles, sub-adults, and adults (April 15¹⁰ – August 31); and the period leading up to overwintering (September 1 – October 15).

The FEIS described the habitat characteristics, including water inundation, that support OSF during each of the life stage periods in order to complete a life cycle. For overwintering, spotted frogs need a body of water where at least a portion of the surface remains ice free with sufficient depth to not freeze solid. Frogs remain relatively inactive during the winter and are vulnerable to exposure and possible mortality via desiccation or freezing. During the pre-breeding period frogs emerge from overwintering sites and move to breeding locations if habitat conditions do not support breeding in the same location. For breeding, adults need a water depth of 12 inches or less with emergent vegetation. Frogs deposit egg masses in these shallow wetland areas which are sensitive to changes in water levels that can result in less favorable conditions for development (exposure to predation, risk of desiccation). During the rearing period, tadpoles, juveniles, sub-adults and adults OSF require access to emergent vegetation that is inundated with water at variable depths for cover and foraging. For the period leading up to overwintering, it is important that spotted frog summer habitat is adequately connected via water to suitable overwintering habitat for successful seasonal movement between habitats. Spotted frogs typically do not move from wetlands that are inundated throughout the seasons and life stages because all their life cycle needs are met in those wetted environments. Juveniles and adults are likely to move from breeding and rearing habitat to overwintering sites if habitat conditions do not support these life history periods in the same location, which can be a result of water management in the action area (USFWS FEIS 2020).

Although an analysis by life stage using the RiverWare modeled flows is helpful to compare changes in habitat that may occur as a result of the DBHCP, we emphasize the importance of habitat inundation throughout the entire life cycle, including movement periods, to facilitate survival and recovery of OSF. Due to inherent rule sets in the RiverWare model and natural variability between years, the modeled flows may not always represent the actual flow as the proposed action is implemented. In this analysis, we use the summary hydrographs generated by RiverWare to assess the variability of conditions to describe what we anticipate to occur in the future.

Arc GIS acres

ArcGIS was used to calculate acres of OSF habitat impacted by storage and release operations and the DBHCP. The seasonal variation in acres inundated are difficult to assess without sophisticated hydraulic modeling which is not available at this time over the broad geography affected by the proposed action. Therefore, our analysis below describes the changes in habitat function within these delineated acreages that we anticipate through implementation of the

¹⁰ The majority of tadpole rearing occurs after April 15. However, Oregon spotted frogs have been observed breeding as early as March 15, so for analysis purposes April 1 was considered as the start of the tadpole rearing stage.

DBHCP based on our hydrological observations and monitoring to date and RiverWare-generated hydrographs.

At the broad scale, we used the designated critical habitat GIS layer (shapefile) to account for habitat that is essential to the conservation of Oregon spotted frog. At the waterbody or river reach scale, we used National Wetland Inventory (NWI) GIS layers to delineate the estimated wetland acreages and open water habitats that are likely to be affected by the proposed action. At the site or population scale, we used breeding data to delineate polygons that represent areas that are used by spotted frogs for breeding and rearing within the Upper Deschutes and Little Deschutes River subbasins. Spotted frogs have been detected within the broader critical habitat, waterbody and reach spatial layers during summer monitoring efforts and in some cases winter telemetry studies. In the analysis herein, we use all of these spatial layers and scales to describe the anticipated effects to OSF habitat and populations through implementation of the DBHCP.

4.4.1.3 Effects in the Upper Deschutes River Subbasin

4.4.1.3.1 Effects Above Wickiup Dam

Crane Prairie Reservoir

Crane Prairie Reservoir, encompassing an area of approximately 4,982 acres, supports an important population of spotted frogs within the Upper Deschutes River subbasin. The reservoir, including adjacent habitat, provides breeding, rearing, and overwintering habitat for Oregon spotted frogs. It also provides connectivity between upstream populations unaffected by water management and populations downstream that are affected by the proposed action. For the reasons discussed below, the DBHCP will have significant beneficial effects on all life stages of Oregon spotted frogs within Crane Prairie Reservoir compared to the historical and current operations. Chapter 8 (pp. 8-136-146) of the DBHCP includes a detailed effects analysis for spotted frogs in Crane Prairie which we summarize below.

Implementation of early HCP conservation measures at Crane Prairie, described in the Service's 2017 and 2019 Opinions and in the Environmental Baseline above, have improved habitat conditions for Oregon spotted frog to a level that has resulted in a significant increase in breeding counts, an indicator of a positive population response to the measures. Crane Prairie currently hosts the largest population of spotted frogs in the Upper Deschutes River subbasin upstream of Wickiup Dam. In addition to supporting a large number of spotted frogs, Crane Prairie functions as a complex that allows for genetic exchange between populations that occur upstream of Crane Prairie within at least three tributaries: (1) the Deschutes River; (2) Deer Creek; and (3) Cultus Creek. The unique arrangement of habitat and distribution of adjacent populations underscore the importance of enhancing Crane Prairie to maintain the viability of the Oregon spotted frog in the Upper Deschutes River subbasin.

The DBHCP conservation measures for spotted frogs at Crane Prairie, identified in Chapter 6 of the DBHCP, intend to further enhance breeding, rearing and overwintering habitats for spotted frogs. The proposed action results in reservoir storage volumes ranging between 37,870 and 48,000 acre-feet (surface water elevation range between 4,443.23 feet and 4,443.48). Figure x (8-79 in Chapter 8 of HCP) depicts the surface water elevations at Crane Prairie under the DBHCP

compared to those under historical water management operations. Figure x (Figure 2 in FEIS Appendix 3.04) shows the daily water volume hydrographs generated for Crane Prairie Reservoir (CRA) using RiverWare for the no-action alternative and the proposed action relative to the seasonal habitats and life stages of Oregon spotted frog.

As stated in Chapter 6 of the DBHCP, Conservation Measure CP-1 establishes minimum and maximum water surface elevations for Crane Prairie Reservoir that will serve the dual purpose of minimizing overall reservoir fluctuations and maintaining desirable water depths in existing emergent wetlands that provide breeding and rearing habitat for Oregon spotted frog.

CM-CP-1 also articulates a drawdown rate for the reservoir that aims to prevent stranding frogs when irrigation releases begin on July 16. Furthermore, CM CP-1 increases the winter reservoir volume and surface water elevations to provide overwintering habitat for spotted frogs in excess of past operations. The specific details of the Conservation Measures for Crane Prairie Reservoir are described in Chapter 6 Section 6.2.2.

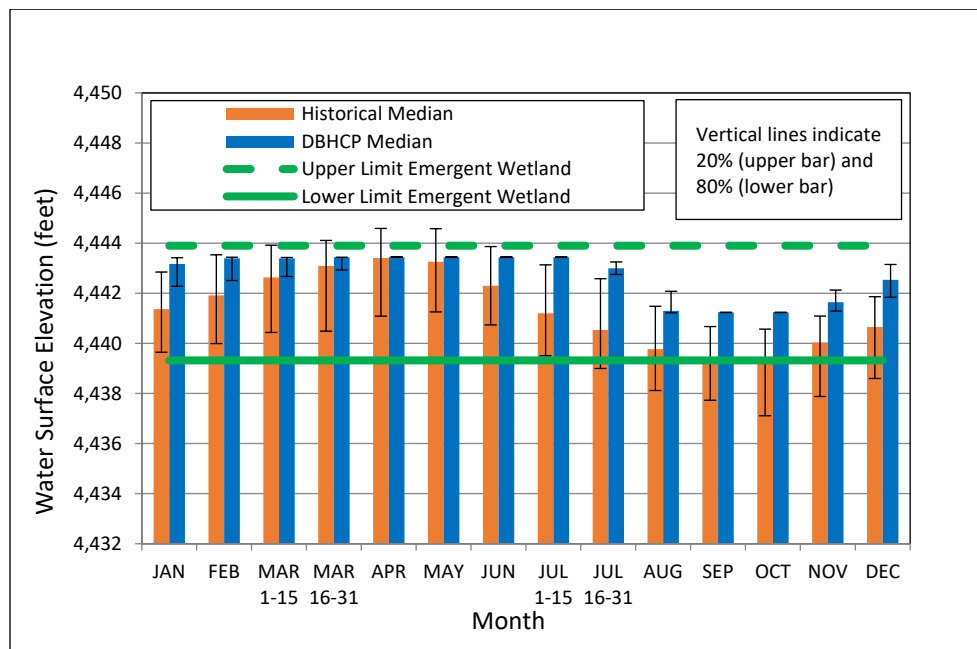


Figure 78. (Figure 8-79 in DBHCP). Comparison of monthly median water surface elevations and emergent wetland vegetation limits in Crane Prairie Reservoir. Sources: Reclamation 2020a, 2020b.

Under CM CP-1, water management of the reservoir aims to reach a reservoir storage volume of approximately 46,800 acre feet by mid-March to provide suitable spotted frog breeding habitat within the emergent vegetation (Figure 78). Reservoir volumes between 46,800 and 48,000 acre feet will be maintained during the spotted frog rearing period until July 15 when the reservoir is draw down to deliver irrigation water downstream.

There are an estimated 4,238 acres of open water within Crane Prairie Reservoir that extend into approximately 583 acres of freshwater emergent marsh along the shoreline. Breeding and rearing areas for spotted frogs occur within these shoreline marsh habitats which are inundated with water when reservoir volumes exceed approximately 30,000 acre feet as described in the HCP.

Maintaining reservoir volumes between 46,800 and 48,000 acre feet inundates emergent vegetation along the shoreline providing egg masses and recently hatched tadpoles with cover to elude predators and to protect embryos and larvae from extreme temperatures and strong winds that occur on the reservoir.

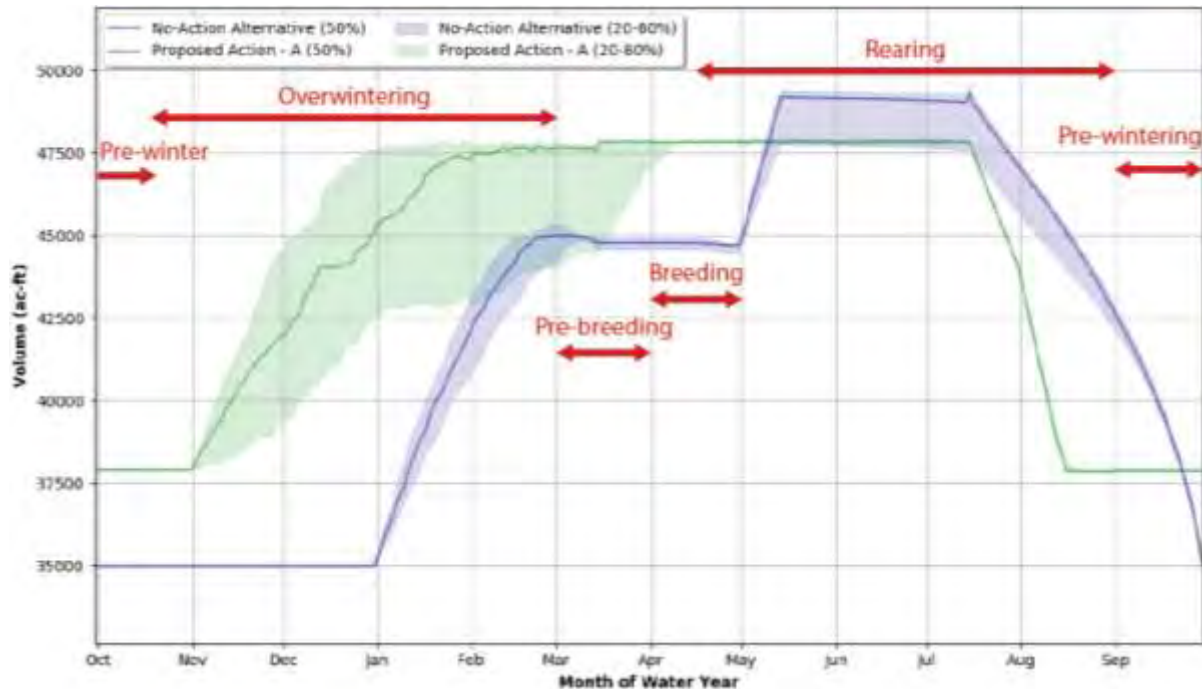


Figure 79. Water Volume (acre-feet) in Crane Prairie Reservoir Flow Modeled Using RiverWare under Proposed Action Compared to No-Action Alternative (Fig. 80 in FEIS Appendix 3.4-B).

Implementation of CM CP-1 increases the duration of inundation within the marsh habitats that provide important breeding and rearing habitat for spotted frogs compared to historical water management of the reservoir. Under the proposed action, from July 16th to July 31st, storage in excess of 37,870 acre-feet will be released at a rate that would result in a drop in reservoir elevation of no more than 0.05 feet per day. The slow rate of decrease is intended to provide spotted frogs the ability to move towards the residual pool of water without stranding. Since the metamorphosis period may not be complete when the reservoir draw down period begins, there is potential for some pre-metamorphic spotted frogs to strand as wetlands are voided of water within the approximate 583 acres of shoreline wetlands.

The proposed action requires that the residual reservoir pool remain at a minimum of 37,870 acre feet, which is above what is typically maintained under pre- proposed action conditions. The maintenance of higher water surface elevations through winter lessens the distance between the potential wintering sites and spring breeding habitats which reduces the energy expenditure of spotted frogs during this time in the life cycle and the potential for predation of spotted frogs by fish. Given that fish are abundant in Crane Prairie, spotted frogs that choose to overwinter within the reservoir at volumes of 37,870 acre feet remain at risk to predation.

The proposed action also allows for the filling of the reservoir to occur through the winter so that the desired volume and surface water elevation will be met by March 15, the onset of the

breeding season. The filling of the reservoir through winter make it likely that frogs will have a larger pool of water to evade predators as they migrate to the breeding areas.

Since the change in acreage of inundation between 37,870 and 48,000 acre feet is not discernable using ArcGIS, under the proposed action we estimate that there will be an improvement to approximately 583 acres of wetlands along the shoreline of Crane Prairie Reservoir, providing habitat and cover to support spotted frogs during the breeding and rearing periods of the Oregon spotted frog life cycle. Conservation measure CP-1 will minimize the impacts that occur to spotted frogs through stranding when the reservoir is drawn down for irrigation. The larger residual pool that will be maintained through winter and the filling of the reservoir through the winter will provide spotted frogs additional habitat to evade predatory fish compared to that which was available to OSF prior to the proposed action. Overall, implementation of the HCP is expected to improve survival of spotted frogs annually in Crane Prairie Reservoir by providing more adequate water levels at the right time to support spotted frog life history requirements. Increased OSF survival on an annual basis is likely to increase the OSF population at Crane Prairie Reservoir.

Despite the visible benefits that the early implementation of HCP conservation measures provide for spotted frogs within Crane Prairie, actions that reduce the spread of invasive plants and fish within the reservoir will be necessary over time. A consequence of maintaining higher water levels in Crane Prairie for spotted frogs may have had the unintended consequence of providing ideal conditions for brown bullheads, an invasive predatory catfish. HCP conservation measure CP-1 allows for an additional 5,000 acre feet of water to be released from Crane Prairie twice during the first seven years and 3 times during the later 8-30 years of the HCP to allow for aggressive invasive species management within the reservoir. We anticipate that this drawdown of an additional 5,000 acre feet of water within the reservoir will increase the likelihood of predation pressure for a short duration as the action is implemented since OSF will have less acres of overwintering habitat to evade predators. However, the invasive fish management will reduce the over-wintering predation pressure on Oregon spotted frog post implementation and in the long-term. This reduced predation is expected to result in more spotted frogs surviving to reproduce in subsequent years, bolstering the Crane Prairie population.

Conservation measure UD-1 provides funding to address threats to OSF at Crane Prairie in addition to water management that include but are not limited to the spread of invasive plants and fish. Currently, reed canarygrass, an invasive grass that reduces OSF breeding habitat quality, is abundant along the south shoreline of the reservoir and is present in small amounts in the emergent marshes along the northern shoreline. Treatment will be necessary to reduce its spread and maintain highly suitable emergent marshes for spotted frogs. Brown bullhead treatment will be coordinated with the Oregon Department of Fish and Wildlife. Habitat restoration of wetlands and ponds on Forest Service lands surrounding Crane Prairie Reservoir that support OSF also may be implemented using funds through UD-1.

Conservation measures CP-1 and UD-1, combined with monitoring and adaptive management elements in the DBHCP, will provide a significant conservation benefit to OSF in the Upper Deschutes River subbasin. Crane Prairie currently represents the largest OSF population in the

Upper Deschutes River subbasin upstream of Wickiup Dam. This OSF population may serve as a metapopulation since several drainages flowing into Crane Prairie are occupied by spotted frogs. From the spotted frog recovery perspective, the Crane Prairie OSF must be maintained to provide genetic exchange between populations and a source population for adjacent and downstream OSF populations. Furthermore, large source populations will be necessary if translocation to other areas within the Deschutes system is deemed necessary in the future. We believe the management of Crane Prairie reservoir under the DHCP will ensure a long-lasting and robust spotted frog population for the term of the DBHCP permit.

Deschutes River from Crane Prairie Dam to Wickiup Reservoir

Oregon spotted frog use of the Deschutes River from Crane Prairie Dam to Wickiup Reservoir is limited to one monitored location where the Deschutes River meets Wickiup Reservoir at full pool. The breeding site used by spotted frogs in this area typically does not remain inundated long enough for spotted frogs to metamorphose. The site is hydrologically influenced by Wickiup Reservoir storage volumes and less so by outflows from Crane Prairie reservoir. However, we include the RiverWare-modeled flows here to compare how flows in the river could change seasonally as water is now stored in Crane Prairie reservoir for OSF until July.

RiverWare modeling of the CRAO gauge shows that outflows from Crane Prairie will be highly variable in the Deschutes River between the reservoirs (Figure 80). However, we believe that the predicted flows that indicate a highly variable flow are an artifact of the model due to the model holding the water elevation at Crane Prairie reservoir in a stable state for OSF.

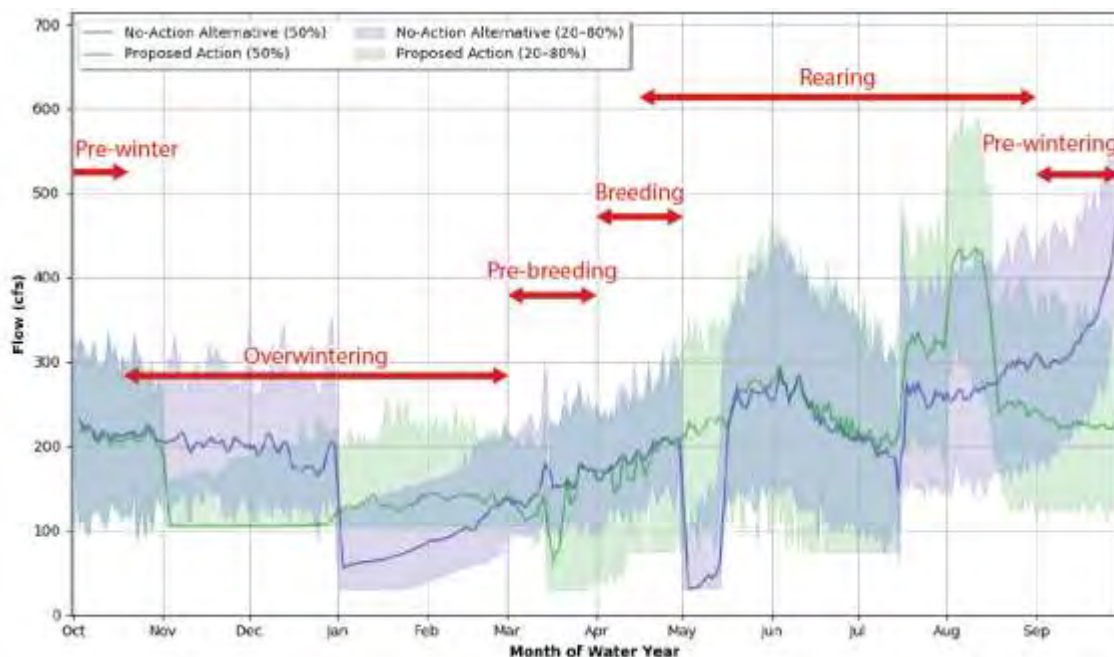


Figure 80. Deschutes River between Crane Prairie and Wickiup Reservoir Flow Modeled Using RiverWare at CRAO Gauge under Proposed Action Compared to No-Action Alternative.

The changes in Wickiup Reservoir storage that are anticipated to occur under the DBHCP are more likely to influence the way spotted frogs utilize wetland habitat adjacent to the Deschutes River between the reservoirs. We anticipate that the known OSF breeding location will become less suitable for frogs over time since Wickiup Reservoir storage volumes and water elevations are predicted to be lower in the later years of the DBHCP than under current operations and the first seven years of the DBHCP (Figure 80). However, the flow and storage changes will not necessarily eliminate habitat for spotted frogs along this reach of the river. Based on observations in 2019 when breeding was detected closer to the river channel, we anticipate that there may be a shift in habitat utilization depending on how suitable other wetland habitats along the river are during the implementation of the DBHCP.

Wickiup Reservoir

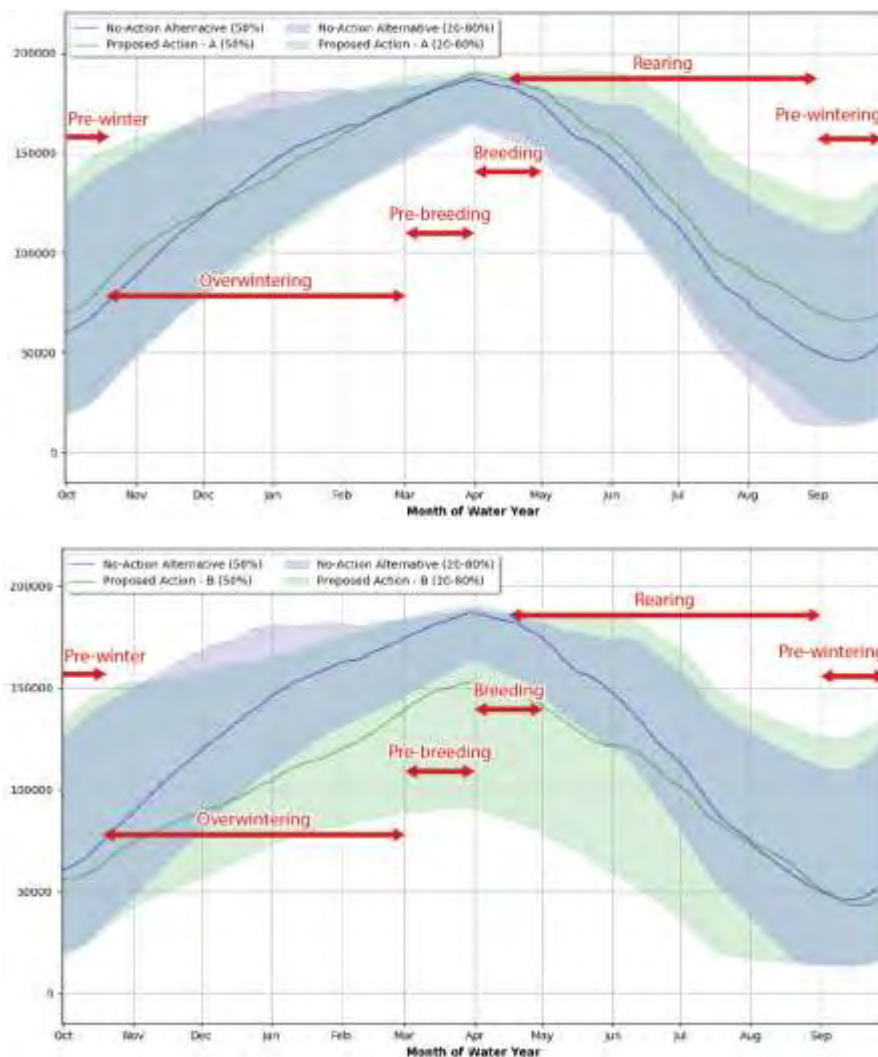
Wickiup Reservoir encompasses approximately 10,231 acres. There are an estimated 7,180 acres of open water within Wickiup Reservoir and approximately 2,961 acres of wetlands which includes the confluence of the Deschutes River where it flows into the reservoir. The small, two-acre spotted frog breeding site between the reservoirs (i.e., the Deschutes River arm of Wickiup Reservoir), described above, is included within the wetland acreage for Wickiup Reservoir. There have been observations of Oregon spotted frogs at various locations within the reservoir over a number of years in the wetland habitat along the edge of the reservoir. However, due to the expansive area of the reservoir, there have been few surveys for spotted frogs over the years. We assume that Wickiup Reservoir provides some function in terms of aquatic connectivity between spotted frog populations. However, survival of spotted frogs within Wickiup Reservoir is limited due to the large change in surface area inundation over a broad geography, which reduces the ability of spotted frogs to move between habitats that are suitable for breeding, rearing and overwintering over the annual life cycle.

As depicted in Figure 81 below, RiverWare-modeled storage volumes for Wickiup Reservoir indicate that the proposed action is likely to result in lower surface water elevations in Wickiup Reservoir beginning in year 8 of HCP implementation as higher winter flows are released to the Deschutes River. We do not know precisely the storage volume within the reservoir that creates the most suitable habitat conditions for spotted frogs within this geography. However, we know that a full reservoir at 200,000 acre feet is not ideal for spotted frogs during the breeding season because water is above the ideal depth for breeding in the emergent vegetation along the shore.

During past observations of wetland habitats within Wickiup Reservoir in the spring, we have observed unsuitable breeding conditions in the spring when reservoir storage volumes are close to maximum capacity. Therefore, if Wickiup is not as full in the spring as predicted in the modeled volumes for the proposed action in years 8 through 30, breeding conditions may be more suitable for spotted frogs. However, the rate of drawdown after April 1 when flows are released to support spotted frog breeding sites along the Deschutes River are likely to strand most eggs or tadpoles that occur in Wickiup Reservoir. Furthermore, the lower water volume through the wintering period in years 8 through 30 of the HCP are likely to limit survival of spotted frogs that in the reservoir.

In past Wickiup Reservoir monitoring efforts during the late summer/early Fall time frame, we have observed that the drawdown of Wickiup Reservoir results in very little overwintering habitat for spotted frogs. The remaining waterbody contains an abundance of non-native predatory fish, resulting in little refugia habitat for spotted frog overwintering.

Based on the current condition, we are reasonably certain that the implementation of the DBHCP will maintain the reservoir in this degraded condition. Under the DBHCP, there will be little suitable year-round habitat for spotted frogs due to the large change in surface water volumes of the reservoir as irrigation water is released for irrigation. It is likely the spotted frogs will use a portion of the 2,961 acres of wetlands within the reservoir and attempt to overwinter in residual pools over the course of the proposed action. In the long-term, we do not anticipate improved function of the habitat within Wickiup Reservoir to support spotted frogs.



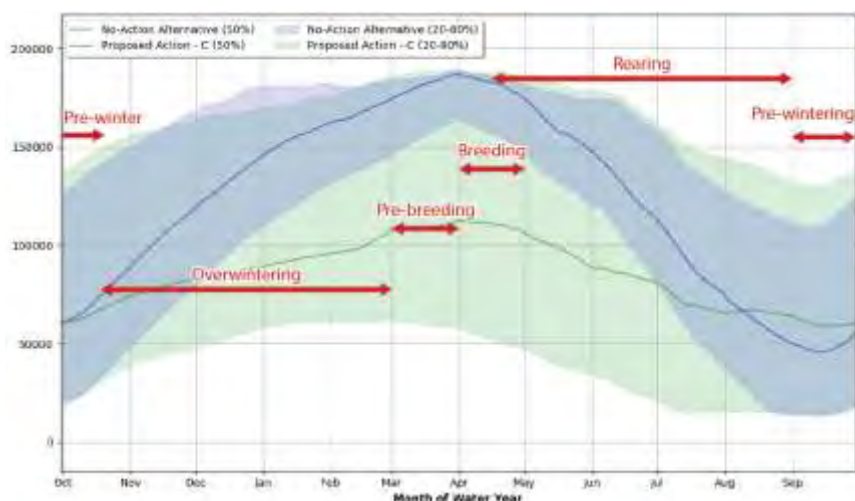


Figure 81. Water Volume (acre-feet) in Wickiup Reservoir Modeled Using RiverWare under Proposed Action Compared to No-Action Alternative for Year 1-7 (top), 8-12 (middle) and 13-30 (bottom). (Fig. 82 in FEIS Appendix 3.04).

4.4.1.3.2 Effects along the Deschutes River Below Wickiup Dam

As described in the Environmental Baseline, water management-related effects to the spotted frog and its habitat along the Deschutes River between Wickiup Dam and Bend, OR are strongly influenced by the timing and volume of water storage and release at Wickiup Dam. The current condition of the Deschutes River and ongoing storage and release operations have affected the survival of Oregon spotted frog and the conservation value of critical habitat downstream of Wickiup Dam.

There are approximately 1,960 acres of designated Oregon spotted frog critical habitat that are affected by storage and release operations along the Deschutes River between Wickiup Dam and Bend, OR. A total of 1,227 acres of wetlands and 988 acres of riverine channel are within critical habitat that are affected annually by water operations. Table 30 depicts the acres that have been and will continue to be affected by the proposed action within seven analysis reaches along the Deschutes River.

Table 30. Summary of spotted frog habitat acres below Wickiup Dam that are reasonably certain to be affected by the Proposed Action.

River Reach	Wetland acres affected	River location affected by River Mile	River channel acres affected	Spotted Frog Critical Habitat
1: Wickiup Dam to Fall River	325	RM 224 to RM 204.5	988	1,960
2: Fall River to Little Deschutes	308	RM 202 to RM 188		
3: Little Deschutes to Benham Falls	171	RM 188 to RM 181		
Sunriver	115*	RM 188 to RM 186		
4: Benham to Dillon Falls	198	RM 181 to RM 178		

5: Dillon Falls to Lava Island Falls	95	RM 178 to RM 174		
6: Lava Island Falls to COID diversion	7	RM 174 to RM 171		
7: COID Diversion to Colorado Street Bridge	8**	RM 171 to RM 167.5		
Total acreages and miles of river length affected	1,227	56.5 linear miles		

* Sunriver habitat managed with weirs and excluded from critical habitat; ** all wetlands are within the Old Mill District.

Our analysis below describes how we have determined that the implementation of the DBHCP conservation measures will lessen the impact to OSF along the Deschutes River that has been described in the past (USFWS 2017 and 2019) within the acreages of habitat delineated above in Table 30. This analysis also articulates how these conservation measures are reasonably certain to increase survival and promote recovery of the species into the future.

HCP Measures to minimize the impacts from water storage and release to OSF

The DBHCP includes two conservation measures that are designed to improve habitat conditions for Oregon spotted frog and critical habitat along the Deschutes River between Wickiup Dam and Bend, OR: (1) WR-1 Wickiup Reservoir Operation and (2) UD-1 Upper Deschutes River Conservation Fund (Table x).

Conservation measure WR-1 (Table WR-1. DBHCP) adjusts the timing and volume of flow releases to the Deschutes River to improve habitat conditions and support seasonal life stages of the Oregon spotted frog. These modifications to Wickiup Reservoir operations intended to improve survival of spotted frog life stages include:

1. Increasing spring flows by April 1 to support breeding in wetlands associated with the Deschutes river channel;
2. Reducing fluctuating flows in the spring to prevent flushing and stranding eggs and tadpoles during the breeding and rearing periods, respectively;
3. Conducting seasonal ramp ups and downs that allow for frog movement which reduces stranding during migration periods;
4. Increasing fall and winter minimum flows to improve overwintering conditions; and
5. Reducing high summer flows that may place frogs in wetland fringe habitats which may function as sinks (i.e., strand frogs when flows are reduced);

A detailed description of the conservation measure WR-1 and rationale for the measure are within Chapter 6 Section 6.2.5 of the DBHCP. Conservation measure WR-1, specifically Items F, G and H, outline the schedule for increasing winter flows in the Deschutes River at the WICO gauge over the 30-year permit term. Conservation measure WR-1 Items G and H also describe the summer flow caps at WICO beginning in year 8 and continuing through year 30. The time schedule for seasonal flows at the WICO gauge are as follows:

Implementation Years	Season	Flow at WICO
1 to 7	September 16 to March 31	Minimum of 100 cfs
8 to 12	September 16 to March 31	Minimum of 300 cfs
	April 1 to September 15	Flows will not exceed 1,400 cfs for more than 10 days
13 to 30	September 16 to March 31	Minimum of 400 cfs or up to 500 cfs
	April 1 to September 15	Flows will not exceed 1,200 cfs for more than 10 days

Conservation measure UD-1 will provide \$150,000 of funding annually to enhance OSF habitat and address threats to OSF that are outside of water operations. The application of these funds will be targeted by the Service to those areas where they can provide the most Oregon spotted frog conservation benefit during the three stages of the HCP. The rationale for conservation measure UD-1 is described in the DBHCP Chapter 6 (section 6.2.7).

Evaluating the effect of the Conservation Measures:

Beginning in year 1 of the DBHCP and continuing through the 30 year permit term, conservation measures WR-1 and UD-1 are likely to improve survival and support recovery of Oregon spotted frogs that occupy wetland slough and floodplain habitats along the Deschutes River. There is temporal variation (i.e., annual seasonal and over time) to the implementation of each of these conservation measures that will improve conditions for OSF in the short term and long-term. Temporal implementation of the measures is evaluated broadly by reach below and at the population scale.

Conservation measure WR-1 was designed to minimize seasonal impacts to OSF that significantly suppress population growth by reducing survival of key life stages of Oregon spotted frog, annually. Conservation measure WR-1 also includes the long-term conservation strategy for improving winter habitat for OSF, through the restoration of increasingly more natural river flows, which is currently very limited during the irrigation storage season. UD-1 provides a source of funding for improving the function and quality of habitat for OSF. Projects funded via UD-1 will be strategically implemented along the Deschutes River as directed by the Service to assist the known populations of spotted frogs in the short-term and long-term.

Effects analyses in the FEIS and DBHCP

The DBHCP and FEIS evaluated the proposed action and its anticipated effects to the Oregon spotted frog in the Deschutes River by life stage and by river reach. Both analyses utilized

Reclamation's RiverWare-modeled flows (1983- 2018) at WICO and BENO gauges to assess how flows may change and affect the Oregon spotted frog's life cycle and its habitat as the DBHCP is implemented over 30 years. Although RiverWare is a useful tool for comparing the proposed action to the current water management in the context of the Oregon spotted frog's life cycle, there are several reasons why we do not rely only on the RiverWare analyses presented in the FEIS and HCP to assess how we anticipate that implementation of the conservation measures will influence survival and recovery of OSF along the Deschutes River.

1. There are real-time operational changes in water storage and release that vary annually in response to weather conditions that are not accounted for using the RiverWare model.
2. There are site-specific characteristics that influence the quality of wetland habitats to support Oregon spotted frog populations the model does not account for.
3. Habitat quality is expected to improve via passive and active restoration over time, which the model also cannot predict and does not incorporate.

Furthermore, the broad scale analyses in the FEIS and DBHCP do not describe how individual populations may respond to the changes in flow that have been predicted using RiverWare. In this Opinion, we describe specific aspects of WR-1 that are aimed to minimize an impact to OSF at particular life stages. We refer to the summary hydrographs in the FEIS and DBHCP analyses to describe how Oregon spotted frog populations within wetland habitats adjacent to the Deschutes River are likely to be supported by the conservation measures outlined in the DBHCP over time. We further describe how the implementation of the Upper Deschutes River Conservation Fund may be used to address populations in the short and long-term implementation of the DBHCP.

Oregon spotted frog populations within the context of Deschutes River habitat acres

The storage and release operations over the past 70 years have significantly altered the physical and ecological function of the Deschutes River and its associated riverine and floodplain wetland habitats that support Oregon spotted frog downstream of Wickiup Dam. Currently, Oregon spotted frog populations along the Deschutes River are predominately small and separated by long distances (i.e., beyond a dispersal distance that would allow for connectivity and gene flow between them). We have asserted that the past and ongoing water management of Wickiup Reservoir are a factor contributing to the small and disjunct populations of Oregon spotted frog along the Deschutes River (USFWS 2017 and 2019).

The DBHCP conservation strategy for OSF along the Deschutes River includes modifying water storage and release operations to support key life stages as described above and funding to implement site specific projects that improve the function of wetland habitats to support OSF populations. In many cases, enhancing the function of habitat to support OSF involves reducing threats to the species presented by invasive plants and animals.

Oregon spotted frogs are a highly aquatic species that remain in water year-round for all life stages. Therefore, the demography of the species is strongly tied to the quantity and quality of aquatic habitats in terms of hydrological function. The quality of Oregon spotted frog habitat is also influenced by habitat features such as aquatic vegetation, springs and seeps, unconsolidated

flocculant substrate and beaver dams, lodges and channels (Pearl et al. 2018). Duarte et al. (2020) found that the probability of local OSF population persistence was strongly tied to the presence of beaver dams and flocculent detrital material at sites evaluated in Oregon. Ideally, the seasonal habitats used by OSF at the various life stages would be inundated with water, exhibit the habitat micro-features described above and would be in close proximity to one another to minimize travel distances during migration periods.

In areas along the Deschutes River that maintain the habitat features described above, Oregon spotted frog use the floodplain and riverine wetlands for breeding, rearing and overwintering. The Deschutes River and its connection to these wetlands facilitates OSF seasonal movements within and between wetland habitats. The juxtaposition of the river and adjacent wetland habitats combined with the timing and duration of water inundation within these habitats and the rate of change in water levels influence population persistence.

Approximately 1,227 acres of wetland habitat adjacent to the Deschutes River and 988 acres of river channel between Wickiup Dam and Bend, OR have been and will continue to be affected by storage and release operations (Table 31). Currently, Oregon spotted frogs utilize a much smaller portion of the overall wetland and riverine acreages affected by water operations (Table 31). Spotted frog breeding has been observed in approximately 229 wetland acres (19 percent) within the total wetland acres that are influenced by storage and release operations at Wickiup Dam. Approximately half of the spotted frog breeding habitat acres are in Sunriver (115 acres; 50%) in Reach 3 just below the confluence with the Little Deschutes River. The small acreage associated with the breeding and rearing areas compared to the large acreage of suitable habitat within the river reaches underscores the importance of maintaining these areas in a functioning condition to support local populations of spotted frog along the Deschutes River (Table 31).

Currently, Oregon spotted frog populations associated with the Deschutes River are restricted to areas along the river that exhibit the habitat features described above within reaches 1, 2, 3, 4, and 7. A recent evaluation of OSF population abundance along the Deschutes River indicates that few populations are large enough to be resilient to stochastic events. Abundance estimates are based on the number of breeding females, which are determined through egg mass counts. Our ranking of abundance for low, moderate and high abundance is as follows: Breeding females ≤ 50 = Low abundance; > 50 and ≤ 299 = moderate abundance; ≥ 300 = high abundance.

At this time there are only three populations where abundance estimates are in the moderate to high ranking category: Dead Slough located within Reach 1, Sunriver located within Reach 3 and Slough Camp located within Reach 4. Although the abundance within these populations indicate that they are likely to persist in the long-term, we note that there are stressors and threats to each of these populations that must be addressed through active management. Smaller spotted frog populations within Reaches 2 (i.e., Island Loop) and 7 (e.g., Old Mill) have a low number of adult breeding frogs and may not persist in the long-term without intervention that improves the habitat to facilitate population expansion (Table 31).

In other areas along the river, OSF breeding was detected in a single year in a location outside of these known populations (i.e., Bull Bend, S. Ryan Ranch, and private lands near river miles 202

and 172). These single breeding events lead us to believe that OSF are dispersing to new areas on occasion but are unable to survive and establish new populations because the year round habitat conditions are not suitable for all life stages. Long-term improvements to the function of the Deschutes River anticipated under WR-1 and UD-1, described below, are likely to support population establishment and persistence in other areas along the river.

In our recovery planning process now underway, the Service has ranked “resiliency” of spotted frogs within each of the subbasins where the species occurs in Washington and Oregon.

Resiliency is a term used to describe the species ability to withstand environmental stochasticity (normal, year-to-year variations in environmental conditions such as temperature and precipitation), periodic disturbances within the normal range of variation (drought, fire, floods), and demographic stochasticity (normal variation in demographic rates such as mortality and fecundity) (Redford et al. 2011, p. 40). As a measure of resiliency, Oregon spotted frog habitats and populations should be large enough and well distributed within each subbasin across the range to withstand small scale (site level) and large scale (basin or range level) stochastic events such as drought that could alter the timing and duration of water that would result in reduced survival. The following factors were used to rank OSF resiliency at the subbasin scale: (1) the number of populations; (2) the number of breeding individuals within each population; (3) the quantity and quality of habitat to support all life stages; and (4) connectivity between populations.

Based on the criteria above, Oregon spotted frogs within the Upper Deschutes River subbasin are ranked as having moderate resiliency. Despite have a large number of populations in the Upper Deschutes River subbasin, many populations have a low abundance (estimated by egg mass counts), habitat is limited, the quality of the habitat is poor and there is limited connectivity between populations. In our current approach to conservation and recovery of Oregon spotted frogs along the Deschutes River, we aim to improve the resiliency of existing populations and improve connectivity between them. Conservation measures WR-1 and UD-1 will be implemented strategically to support OSF populations and to restore the function of wetland habitats between populations to allow for population expansion. Re-establishing some level of connectivity between populations will facilitate genetic exchange between local populations. The DBHCP conservation measures aim to enhance the wetland habitats that currently support Oregon spotted frogs in the short-term (Years 1 through 7) and provide improved connectivity between seasonal habitats and populations along the Deschutes River over time (Years 8 through 30).

Temporal Implementation of WR-1 and UD-1

In the short-term, conservation measure WR-1 includes several items that result in adjustments to Wickiup Dam operations that are likely to increase survival of seasonal life stages and facilitate movement of OSF between seasonal habitats in and adjacent to the Deschutes River in the spring and fall, annually. These adjustments will occur each year for the life of the DBHCP permit and are expected to minimize impacts that result in death or injury to OSF. A reduction in mortality events at various life stages is expected to maintain populations. Monitoring and real-time

coordination between the Service and Applicants and OWRD will provide some flexibility to adjust the seasonal measures so that impacts to OSF will be minimized. Table 32 below summarizes the conservation objective for the items within conservation measure WR-1.

Table 31. Summary of spotted frog habitat acres below Wickiup Dam that are reasonably certain to be affected by the Proposed Action.

Deschutes River Reach	Wetland Acres	River acres	OSF Population	Breeding Habitat Acres	Breeding female abundance	Influenced by Wickiup Reservoir operation
Drains to Deschutes River via unnamed tributary			Dilman Meadow	14	Low	Partial
1: Wickiup Dam to Fall River	325	321	Bull Bend* ¹	1.22	none	Yes
			Dead Slough	17.4	Moderate	Yes
			Benchleg Pond Private Land (RM 206.5)	0.18	Low	No
			La Pine SP SW Slough	11.3	Low	Yes
2: Fall River to Little Deschutes	308	226	Private land (RM 202) ¹	~3	none	Yes
			Island Loop* (private)	~2	Low	Yes
3: Little Deschutes to Benham Falls	286	200	Sunriver	115	High	Yes
4: Benham to Dillon Falls	198	61	SW Slough Camp	10	Low	Yes
			East Slough Camp	52	Moderate	Yes
			S. Ryan Ranch ¹	~ 1	none	Yes
5: Dillon Falls to Lava Island Falls	95	67	None as of 2020	-	-	Yes
Reach 6: Lava Island Falls to COID diversion	7	49	Private Preserve (RM 172) ** ¹	7	none	Yes
Reach 7: COID Diversion to Colorado Street Bridge	8	64	Old Mill - LSA Marsh	8.4	Low	Yes
			Old Mill Pond	1.22	Low	No
Total Acres	1,227	988		228.5		

* Pre-metamorphic frogs

** Juvenile frogs

¹ Indicates a single observation

Population resiliency abundance ranking: Breeding females ≤ 50 = Low abundance; > 50 and ≤ 299 = moderate abundance; ≥ 300 = high abundance

Table 32. Annual, seasonal adjustments to Wickiup Reservoir operations to conserve Oregon spotted frog life stages associated with the Deschutes River under Conservation Measure WR-1.

Item	Time Period	Metric	Conservation objective
A.	Apr 1 – Sep 15	Flow at WICO ≥ 600 cfs (≥ 400 cfs if approved by USFWS)	Inundate wetlands early in the breeding period to a sufficient depth to support development of egg to larval stage.
B.	Apr 1 – Apr 30	Flow at WICO ≤ 800 cfs (unless higher flow approved by USFWS)	Increase survival of egg and tadpole life stages by maintaining relatively stable water elevations and to reduce the potential for flushing of early life stages out of habitat.
C.	Apr 1 – Apr 30	When flow at WICO is ≥ 600 cfs flow at WICO will not decrease ≤ 30 cfs.	Minimize stranding of eggs and tadpoles.
D.	May 1 – Jun 30	Flow at WICO over any 5-day period will not be reduced $\leq 20\%$ of total flow	Minimize stranding of tadpoles that move into emergent vegetation as flows rise.
E.	Through Sep 15	Flow at BENO $\geq 1,300$ cfs	Maintain inundation of wetland habitats to facilitate movement of juvenile and adult spotted frogs between summer and winter habitat.
J.	Jan 1 – Dec 31	When total flow at WICO is < 800 , Rate of increase in water surface elevation at WICO when total flow at WICO is 0.10 foot per 4-hour period and rate of decrease is 0.20 foot per 12-hour period	Ramping rates are intended to reduce stranding and flushing of life stages.
	Sep 15 – Oct 31	First 5-day pause in flow at BENO during ramp-down is 1,200 cfs	Reduce stranding of juvenile and adult spotted frogs as flows drop below 1,300 cfs at BENO (Item E above).
	Sep 15 – Oct 31	Second 5-day pause in flow at BENO during ramp-down is 1,100 cfs	

Deschutes River flows from Wickiup Reservoir rise and drop during OSF migration periods in the spring and fall, respectively, restricting movement of adults and juveniles and increasing the risk of predation due to stranding or moving through areas without cover. Conservation Measure WR-1 Items A through D are designed to increase Deschutes River flows at WICO to 600 cfs by

April 1 to facilitate movement between overwintering and breeding areas. Flows of 600 cfs do not fully inundate emergent vegetation in many areas along the river channel but are likely to provide sufficient water depths to support egg masses and tadpoles during the early rearing period. By maintaining both flows below 800 cfs in April and relative stability in water elevations as flows increase and decrease between April and June, this measure is likely to reduce or prevent stranding and flushing of eggs and tadpoles.

Current management results in a rapid dewatering of riparian and slough wetlands at the onset of the irrigation storage season in the fall that will continue for the duration of the 30 year DBHCP permit. This is a period of time when juvenile and adult spotted frogs are likely to be stranded in wetland habitats as they move to overwintering locations. A late-season movement and habitat use study of Oregon spotted frogs along the Deschutes River indicated that frogs move the greatest distance in late September into mid-October (Pearl et al. 2018). The movement study showed that travel distances between late summer season habitat and winter habitat were generally less than 820 ft (250 m). Frogs use vegetated shallows in late summer to early fall and move to a range of habitat types for winter (Pearl et al. 2018). Conservation Measure WR-1 items E and J maintain minimum flows at the BENO gauge at 1,300 cfs until at least September 15, and then hold flows at 1,200 and 1,100 cfs for five days, respectively, to keep wetlands inundated during the majority of the fall movement period.

As flows in the Deschutes River drop at the onset of the irrigation storage season, the area of inundation shrinks considerably and overwintering habitat for OSF is limited. The areas along the Deschutes River where OSF populations persist typically retain some degree of water through the winter via groundwater and exhibit unique habitat features. The Pearl et al. (2018) study of habitat utilization shows the importance of micro habitat features for OSF in the wintering period. Along the Deschutes River, three of 35 tracked frogs moved to the Deschutes River where they sought shelter in undercut banks and a beaver channel. At East Slough Camp, frogs were observed moving into the adjacent lava flow that likely retains a pool of water below the ground surface and provides thermal shelter during the winter. At SW Slough Camp, four out of six tracked frogs moved into a beaver channel in a willow thicket adjacent to the Deschutes River.

Movement to distinctive habitat features and concentrated use of those features by many frogs has been observed (Chelgren 2008). Therefore, a key aspect of improving winter habitat for OSF is to increase the availability of these micro habitat features close to breeding areas, shortening the distance between late summer and winter habitats. Restoring the function of the Deschutes River is an important part of OSF conservation and recovery.

In its current condition, the Deschutes River provides limited overwintering habitat for spotted frogs and connectivity between populations. In years one through seven, the outflows from Wickiup Dam will remain at 100 cfs as measured by the WICO gauge unless conserved water is available to release. Winter flows of 100 cfs are not sufficient to inundate slough habitats within the river nor adjacent floodplain wetlands. Therefore, wintering habitat will not expand within the acreages of habitat that currently support Oregon spotted frogs during the first seven years of the DBHCP.

The annual changes to the spring and fall timing of flows is intended to reduce the impact to OSF that occur from storage and release operations. Figure 83 shows the RiverWare generated hydrographs that compare the current operations (No Action) to the operations anticipated through implementation of WR-1 in years 1 through 7. The figure shows a subtle change in the timing in the drop in flow in the fall at the WICO and the BENO gauge under the proposed action. We anticipate that the ramp down in the fall as described in conservation measure WR-1 will facilitate successful movement of spotted frogs to winter habitats in all Deschutes River reaches.

Given that the storage and release of water has an annual frequency of occurrence, we believe the continual historic impact to particular life stages has not only affected the individual frogs and life stages, but translated to population level demographic suppression. By reducing the impact to key life stages on an annual basis through WR-1, we anticipate increased survival and potentially some positive population responses for spotted frogs along the Deschutes River below Wickiup Reservoir. Annual egg mass monitoring will continue through the early phase (Years 1 to 7) of the DBHCP to observe the effectiveness of items in conservation measure WR-1. Site-level habitat monitoring also will continue and will inform active management of OSF sites that is ongoing and anticipated in the early years of the DBHCP.

Passive and active habitat restoration of the Deschutes River and floodplain wetlands is not feasible in some areas until hydrological improvements are achieved in the later phases of the HCP (i.e., winter flow increases and summer flow decreases). Habitat maintenance work at OSF sites will be necessary to reduce existing threats and stressors to OSF in order to maintain and enhance population viability currently and into the future as flows are restored to the Deschutes River. HCP Conservation Measure UD-1 provides \$150,000 of annual funding to implement site specific actions to improve habitat conditions for OSF that complement enhanced flows in the Deschutes River (See Appendix D).

Conservation measure UD-1 will be used during the first seven years of the HCP to address ongoing threats and stressors to OSF populations along the Deschutes River and throughout other locations within the Upper Deschutes River basin. Conservation actions in the short-term will mainly address encroachment of vegetation within wetlands where frog movement in and between seasonal habitats may be obstructed, treatment of invasive reed canarygrass and bullfrog removal where extant OSF populations are affected. Each site that supports OSF was evaluated for threats at the time of the ESA listing in 2014 (https://www.fws.gov/wafwo/species/osf/OSF_Final%20Listing_Threats%20Synthesis.pdf), which has been updated as the Service develops the Recovery Plan. Actions that promote OSF recovery will be further identified in an Implementation Strategy for the Upper Deschutes River Basin, a component of the Recovery Plan.

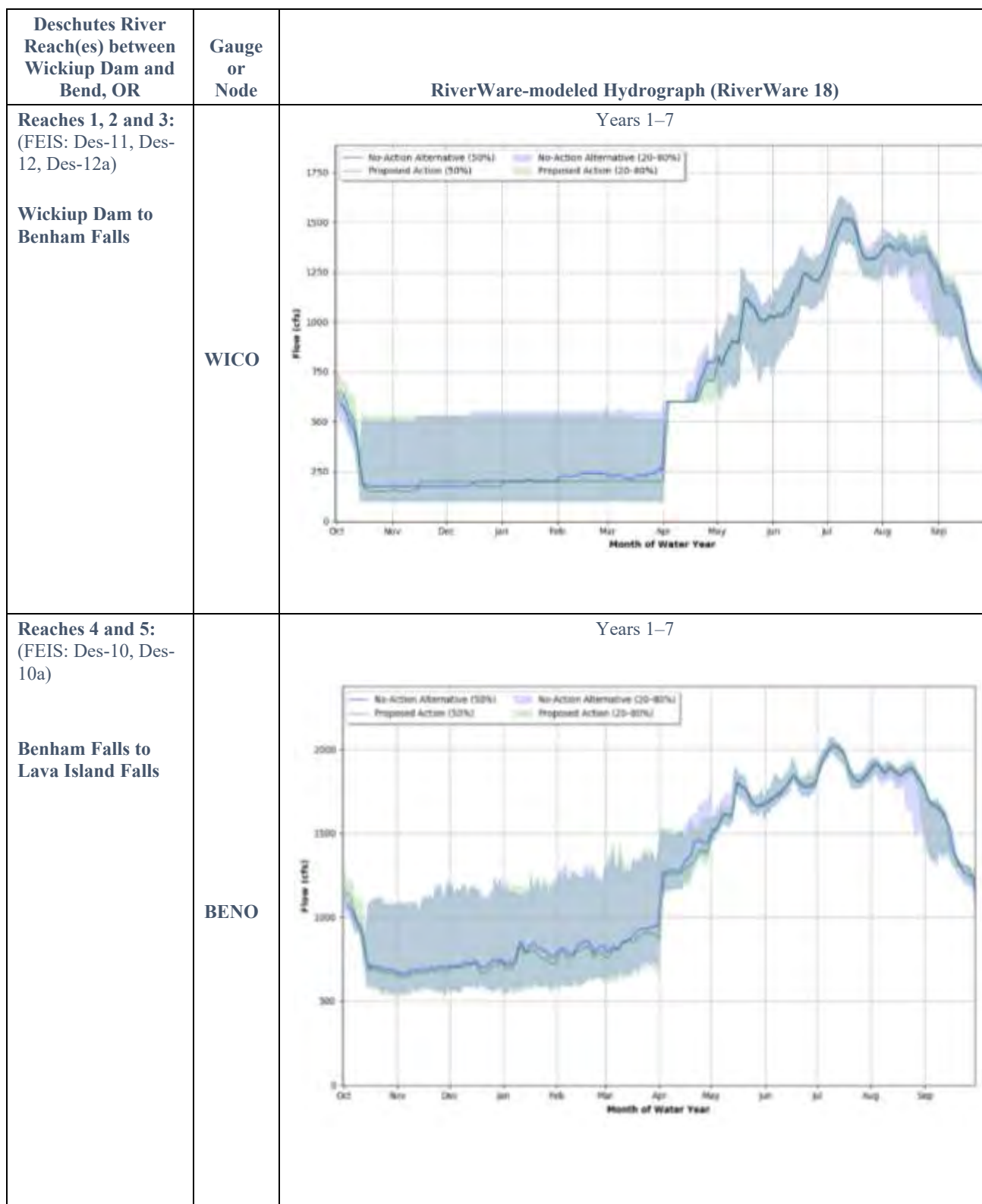


Figure 83. (Modified from FEIS Supplement): RiverWare modeled hydrographs at the WICO and BENO gauges in Years 1 to 7 of the DBHCP.

During Phase 2 of the DBHCP beginning in year eight, flows at the WICO gauge will increase to 300 cfs. During Phase 3 of the DBHCP beginning in year 13, flows will increase to 400 and up to 500 cfs in the winter. As the winter flows increase, summer flows are expected to decrease. Conservation measure WR-1 includes items G and H that describe the timing of increased winter flows and also include summer flow caps to 1,400 cfs and 1,200 cfs in the incremental stages of DBHCP implementation, respectively (Table 33).

Table 33. Timeframe for winter and summer flow adjustments to Wickiup Reservoir operations under Conservation Measure WR-1.

F.	Sep 16 – Mar 31	Flow at WICO in Years 1 – 7 - ≥ 100 cfs (higher if conserved water is available)
G.	Sep 16 – Mar 31	Flow at WICO in Years 8 – 12 - ≥ 300 cfs (higher if conserved water is available)
	Apr 1 – Sep 15	Flow at WICO in Years 8 – 12 - $> 1,400$ cfs for no more than 10 days
H.	Sep 16 – Mar 31	Flow at WICO in Years 13 – 30 - $\geq 400 – 500$ cfs, as determined by variable flow tool.
	Apr 1 – Sep 15	Flow at WICO in Years 13 – 30 - $> 1,200$ cfs for no more than 10 days

Increasing winter flows and decreasing summer flows are key aspects to restoring the functioning condition of the Deschutes River and associated slough and floodplain wetlands, and improving connectivity of habitats utilized by the Oregon spotted frog. Habitat restoration along the Deschutes River is primarily dependent upon improvement of flows (increased winter flows and reduced summer flows), coupled with some site-specific physical river channel habitat improvements that convey water into oxbows and wetland habitats where OSF occur.

As described in the Environmental Baseline and other Service documents (USFWS 2017, 2019 and FEIS 2020), there are two factors that influence the ecological function of the river and wetlands inhabited by OSF: (1) the physical configuration of the river and (2) the variation in the timing and duration of flow volumes within the river's channel (described in terms of cubic feet per second [cfs]). In its current condition, the Deschutes River channel is wider by approximately 20 percent than it was historically, as a result of storage and release operations from Wickiup Dam (USFS 1996). The widened river channel affects the way, and levels at which, water is distributed spatially onto the floodplain and into wetlands. Essentially, higher than historical flows are needed to reach and support the ecological function of floodplain wetland habitats where OSF occur.

Wetland habitats have shifted in distribution due to the high summer flows for irrigation, and the hydroperiod (i.e., seasonal timing and duration of water) within wetlands has also changed under

the regulated water management regime. The vegetative characteristics of wetland and riparian areas are influenced by the duration that water is present and the volume of water. High irrigation-season flows result in deep inundation of riverine slough habitats, inhibiting the growth of emergent wetland vegetation in many areas. During the irrigation storage season when flows in the Deschutes River are lowest, large unvegetated areas within the wetlands are without water which precludes the growth of vegetation in those areas. Although wetland habitat may extend further onto the Deschutes River floodplain than historically due to high summer flows, the existing condition and extent of vegetated wetlands is degraded due to water storage and release operations such that OSF may not successfully complete its lifecycle (USFWS 2017; USFWS 2019). As winter flows increase and summer flows decrease under the HCP beginning in year eight, there will be opportunities to strategically implement Conservation Fund restoration projects to improve function of habitats for OSF. We also expect a degree of passive restoration (e.g., sedge vegetation re-establishment within mudflats) to occur with normal change in the hydrograph, but this kind of response will take time. However, we mention the passive and active adjustments to the system as we believe that the lower summer flows coupled with higher winter flows are more likely to support OSF in the long-term for the reasons described below.

We anticipate that Oregon spotted frogs will respond to the adjustments in flow by shifting habitat utilization to align with patterns of inundation. At a broad scale, the lower summer flows will limit habitat use at the edge of inundation that is the greatest distance from the river. Currently, the fringes of wetland floodplains may function as “sinks” where OSF may be stranded as flows and water levels drop in the fall as the irrigation storage season begins. The higher winter flows will make more habitat accessible to OSF, not just in the winter but year round because higher winter flows will facilitate movement between seasonal habitats and create an opportunity for frogs to move into new areas along the river. A larger area of inundation within the Deschutes River channel and sloughs during the winter season will shorten the distance traveled by OSF during spring and fall movement periods, reducing the energy expenditure for OSF and the risk of predation. Winter flows anticipated in Phases 2 and 3 of the DBHCP also are likely to support river dwelling mammals such as beaver, mink and muskrat that create micro habitat features that support OSF through winter.

Long-term improvements to winter water conditions below Wickiup Dam will improve connectivity not only between seasonal habitats within the wetlands and river but between existing spotted frog populations that are dispersed along the river. Currently, connectivity is limited between existing spotted frog populations separated by large distances (>3.1 miles) as a result of the annual dewatering of habitats by irrigation water management operations. Improving winter flows within the Deschutes River is likely to create new habitat for dispersing juveniles that we have witnessed along the banks of the Deschutes River in the fall.

Studies have shown that amphibian population connectivity is predominantly achieved through juvenile dispersal (Madison, 1997; Preisser et al., 2001; Guerry and Hunter, 2002; Rothermel, 2004), and that post-metamorphic dispersal contributes more to regional persistence than adult dispersal (Sinsch, 1992, 1997; Sinsch and Seidel, 1995). The loss of inundated wetland habitats for juvenile spotted frogs to disperse into during the irrigation storage season has limited

population distribution and connectivity along the Deschutes River. We expect increasing winter flows in the river combined with a staged ramp down in the fall, to allow and facilitate juvenile and adult frog movements into a greater amount of winter habitat.

We also anticipate increased survival of OSF through winter as a results of higher winter water elevations and more habitat availability. A larger area to winter in that is not accessible to predatory fish in the river channel is the most desired future condition for Oregon spotted frogs that inhabit the Deschutes River.

Figures 84 and 85 represent summary hydrographs at the WICO and BENO gauges from the FEIS RiverWare modeling of the DBHCP years 8 to 12 and 13 to 30, respectively (USFWS 2020a). We have described in various analyses how the flows at these two gauges influence inundation of wetland habitats in Deschutes River reaches 1 through 5 (USFWS 2017, 2019). The FEIS RiverWare analysis also included additional points of reference (i.e., additional nodes within the model) for reaches 6 and 7 (USFWS 2020a). However, the reference points for reaches 6 and 7 were only relevant to the modeling and can not be evaluated through monitoring of gauges. Therefore, for this analysis, we refer to the hydrographs for the WICO and BENO gauges to show how we expect changes in flow to support passive and active habitat improvements of the Deschutes River and associated wetland habitats that support OSF. For the purposes of this analysis the Service only describes the changes expected at WICO and BENO gauges and contends that the downstream reaches will follow a similar pattern of improvement. Table 34 portrays the flows that influence inundation and habitat quality of wetland acreages within Deschutes River reaches.

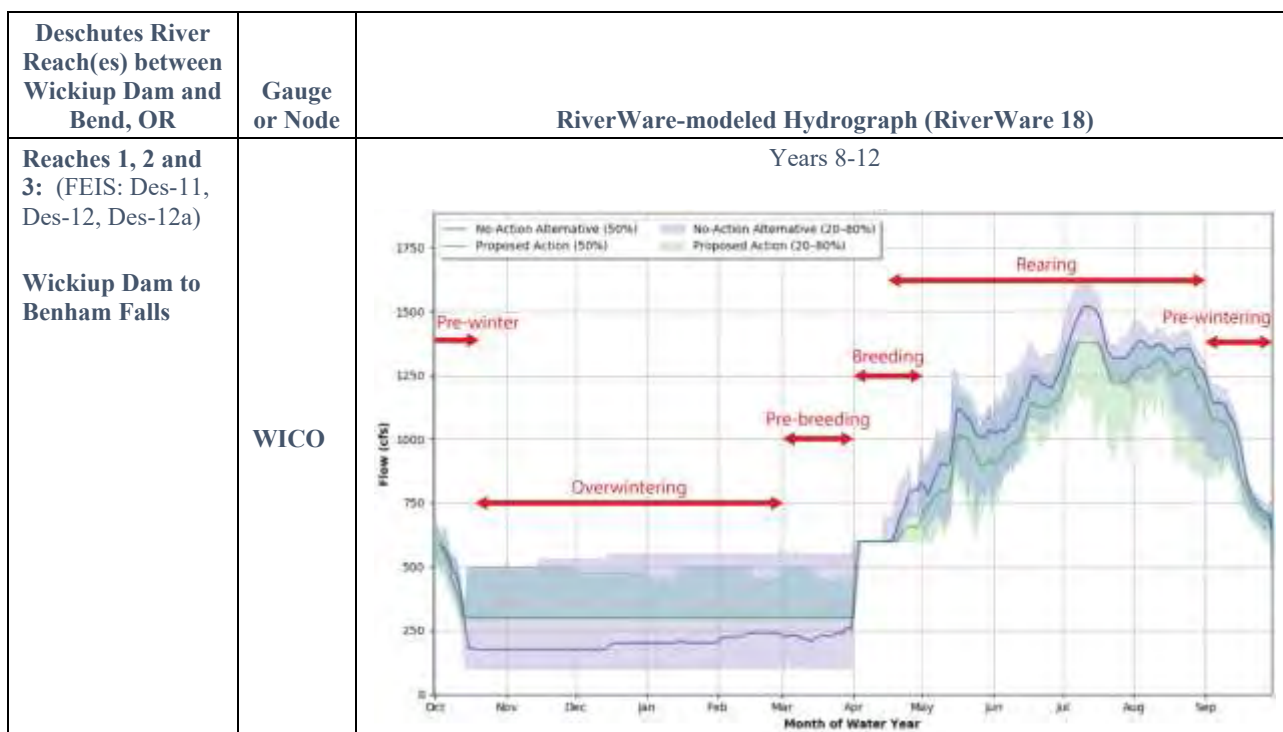
Table 34. Summary of spotted frog habitat acres below Wickiup Dam that are reasonably certain to be affected by the Proposed Action.

River Reach	Gauge flow thresholds below which de-watering of spotted frog habitat is likely to occur	Wetland acreages affected	River location affected by River Mile	River acres
1: Wickiup Dam to Fall River (includes monitored spotted frog sites at Bull Bend, Dead Slough and La Pine SP SW Slough)	900 cfs at WICO	325	RM 224 to RM 204.5	321
2: Fall River to Little Deschutes (includes monitored spotted frog sites on private land at RM 202 and 195)		308	RM 202 to RM 188	226
3: Little Deschutes to Benham Falls	900 cfs at WICO 1,200 at BENO	171	RM 188 to RM 181	200
Sunriver	1,580 cfs at WICO; 1,900 at BENO	115*	RM 188 to RM 186	
4: Benham to Dillon Falls (includes monitored spotted frog sites at East Slough Camp and S. Ryan Ranch)	1,600 to 1,200 at BENO	198	RM 181 to RM 178	61
5: Dillon Falls to Lava Island Falls	1,500 to 1,200 at BENO	95	RM 178 to RM 174	67

6: Lava Island Falls to COID diversion (includes monitored spotted frog site on private land at RM 172)	FEIS/HCP (2020)	7	RM 174 to RM 171	49
7: COID Diversion to Colorado Street Bridge (includes LSA Marsh in Old Mill)	FEIS/HCP (2020)	8**	RM 171 to RM 167.5	64
Total acreages and miles of river length affected		1,227	56.5 linear miles	988

* Sunriver habitat managed with weirs and excluded from critical habitat; ** all wetlands are within the Old Mill District.

Within a continued irrigation storage and supply system, hydrograph modification under the HCP with the purpose of restoring physical and ecological function to the Deschutes River and wetlands should trend toward a more natural flow regime. The RiverWare-modeled hydrographs (Figures 84 and 85) show that the flows in the Deschutes River will be less extreme in terms of highs and lows over time.



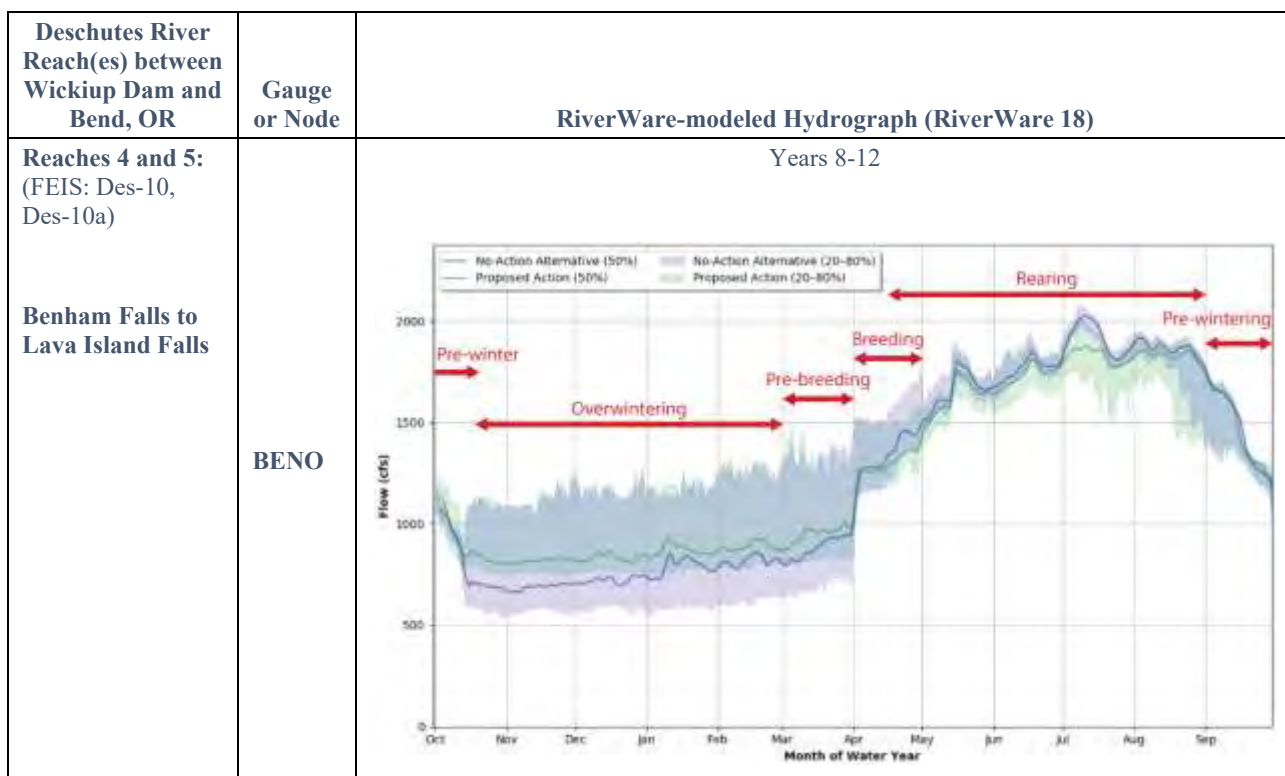


Figure 84. (Modified from FEIS Supplement): RiverWare modeled hydrographs at the WICO and BENO gauges in Years 8 to 12 of the DBHCP.

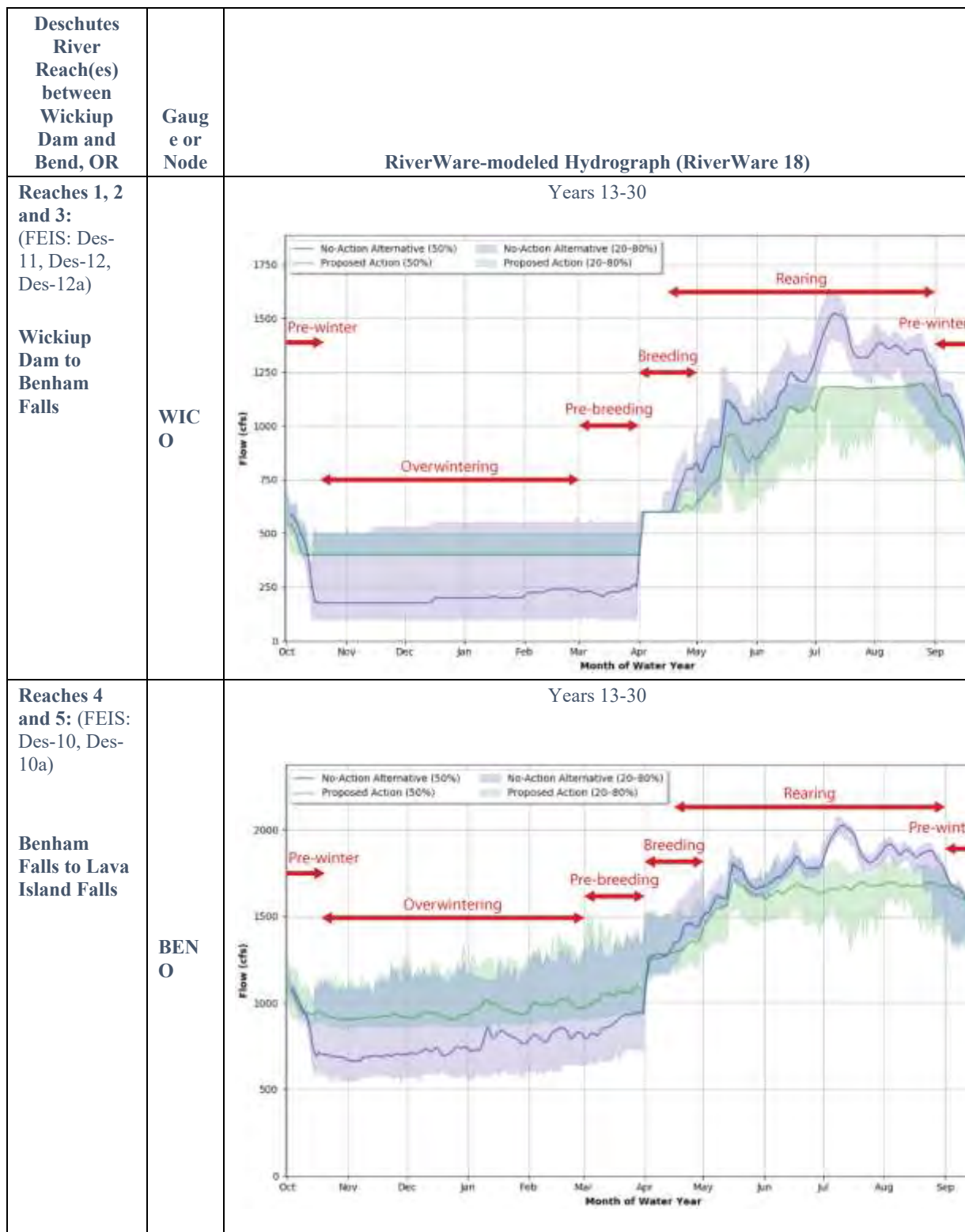


Figure 85. (Modified from FEIS Supplement): RiverWare modeled hydrographs at the WICO and BENO gauges in Years 13 to 30 of the DBHCP.

Influence of conservation measure WR-1 on implementation of UD-1

Increased winter flows under conservation measure WR-1 are likely to provide additional opportunities for spotted frog conservation at individual sites and throughout floodplain wetlands downstream of Wickiup Dam. However, even at full implementation (i.e., 400–500 cfs), restoration actions will be necessary to enhance the function and condition of the river and associated wetland sloughs that support OSF. A long term strategy to increase winter flows coupled with strategic habitat restoration within the Deschutes River and adjacent wetlands via the DBHCP will support survival and recovery of spotted frogs.

The effectiveness of conservation measure WR-1 is likely to vary by river reach due to geomorphological variation. Habitat and OSF population monitoring over time will determine how best to implement measure UD-1 to support survival and recovery of OSF. The application of measure UD-1 will be strategic in addressing site-specific habitat enhancements. Funding through UD-1 will also be used to address stressors and threats to OSF that directly suppress OSF demography and reduce the function of habitat in providing for the various life stages.

Below we provide some detail on how OSF populations and habitat within the river reaches of the Deschutes River are likely to be enhanced by the conservation measures.

Reaches 1 and 2

Approximately 633 acres of wetlands (53 percent) occur within Reaches 1 and 2 of the Deschutes River between Wickiup Dam and Bend (Table 34). The degraded condition of the river and the ongoing effect of storage and release operations render most of the wetlands unsuitable for spotted frogs to complete their life cycle. Within these acres, spotted frogs currently experience a restriction in movement, reduction in cover, and stranding, all of which increase the likelihood of predation and mortality during the spring and fall when flows do not fully inundate wetland habitats. These effects to OSF and habitat are expected to lessen over time as conservation measure WR-1 is implemented and the winter flows increase in the Deschutes River. Funds provided through conservation measure UD-1 will be used to enhance OSF sites and implement strategic channel restoration work that improves the function of OSF habitats in Phases 2 and 3 when winter flows increase over time.

The Dead Slough OSF population, located approximately 20 miles downstream of Wickiup Reservoir, is the only moderately abundant population (>100 breeding adults) within Reaches 1 and 2 (approximately 32 river miles)(Table x) and is therefore important to survival and recovery of OSF along the Deschutes River. The 17-acre Dead Slough is hydrologically supported by a spring which facilitates the persistence of spotted frogs within the slough during the low water period in winter. We expect that annual adjustments to WICO flows under CM WR-1 and increased winter flows will improve the function of habitat at the Dead Slough, resulting in a more robust population, creating the opportunity for more dispersing juveniles. These increased flows will improve wetlands within Reaches 1 and 2 that don't currently have breeding spotted frogs, creating opportunities for establishing new OSF populations in downstream and adjacent wetland habitats.

Winter flow increases to 400 cfs will have a direct influence on the quality of the Dead Slough. Surface elevation measurements conducted by the Forest Service (2014) and by River Design Group (2017) show that at approximately 400 cfs the surface elevation of the Dead Slough is at equilibrium with that of the Deschutes River. As a result, we expect that flows of approximately 400 cfs will reduce an ongoing headcut in the slough. A more stable connection to the river will also facilitate movement of OSF between the river and slough.

The presence of small-scale breeding efforts (e.g., at La Pine State Park SW Slough and Private Land RM 202) and summer spotted frog detections in riverine wetlands downstream of Dead Slough indicate that there is a potential for out-migrating frogs from Dead Slough to redistribute or disperse into downstream habitat that is well-within the spotted frog dispersal capability. As described above and in the Environmental Baseline section, spotted frog habitat is limited during the irrigation storage season and spotted frogs are likely to be concentrated into small areas in the river and adjacent habitat with predaceous fish such as the brown trout. As a result, it is likely that spotted frog survival is reduced during the winter period. Increases in winter flow to 300 cfs in years 8 to 12 will increase inundation of, and improve winter conditions in, the La Pine State Park SW Slough, downstream of Dead Slough. Increases of winter flow to 400 cfs will further enhance this riverine slough. Improving habitat within off-channel sloughs will provide refugia for OSF through winter and reduce the likelihood that OSF will be overwintering with brown trout. With the improvements to the established Dead Slough breeding and overwintering habitat, reduced predation and the resulting population improvements, the Service expects there to be increases in the number of dispersing Dead Slough juveniles. Sites such as La Pine State Park SW Slough and Private Land RM 202 are viable destinations for these dispersers given a) the distance from Dead Slough is within the spotted frog's dispersal range, b) the habitat quality will be improved at these sites with the improved hydrograph, and c) the current presence of small numbers of spotted frogs indicates these sites are already functioning as habitat, which we expect to only get better.

Within Reach 2 of the Deschutes River, spotted frog sites are associated directly with the river and sloughs and host small numbers of spotted frogs. Long term increases in winter flows are likely to improve the suitability of these river habitats for spotted frogs and create an opportunity to establish new OSF populations. Reach 2 is comprised primarily of private lands that have not been extensively surveyed for spotted frogs; while it is difficult to assess habitat suitability due to private land access issues, the current presence of spotted frogs makes us believe some new sites will be inhabited by spotted frogs in the future as winter flows increase.

The lower summer flows are also expected to improve the physical and biological features within wetlands sloughs in Deschutes River reaches 1 and 2. Low gradient areas within sloughs that have been deeply inundated with water at the highest flows during the summer growing season are currently void of the emergent vegetation spotted frogs need for cover from thermal elements and predators. As the depth of inundation during the growing season is reduced due to the lowered summer flows, we expect some passive revegetation to occur as vegetation colonizes these areas. We also will utilize funds provided through UD-1 to revegetate priority areas if it is deemed to support function for OSF.

In some cases lower summer flows may allow for encroachment of emergent vegetation into areas that are currently suitable for spotted frog breeding and rearing. For example, Island Loop hosts a small number of spotted frogs that appear to be groundwater dependent through the winter (i.e., spring supported). Habitat in this area could be enhanced for spotted frogs by removing encroaching vegetation such as cattails to maintain open water areas for spotted frogs surrounding the springs when river flows are not sufficient to inundate the wetland areas within the slough.

The key to understanding how these habitats will support OSF is through continued monitoring. The Upper Deschutes River Conservation fund (UD-1) will be used to actively manage and address the habitat function and other stressors that influence survival and recovery of OSF.

Reach 3

Within Reach 3 (Little Deschutes River to Benham Falls), there are approximately 286 acres of wetlands and 200 acres of river. Approximately 115 acres of these wetland acres are within the managed water bodies in Sunriver that support the largest population of spotted frogs downstream of Wickiup Dam.

As stated earlier, spotted frog habitat in Sunriver is buffered from some of the effects of irrigation storage in the reservoirs due to weirs that maintain water in the habitat through the winter season. Furthermore, spotted frog habitat in Sunriver is uniquely positioned below the confluence of the Little Deschutes and Deschutes rivers; the combined influence of the weirs and unregulated winter flows on the Little Deschutes River improve the hydrological function of the habitat in Sunriver. Oregon spotted frog habitat in Sunriver does not receive surface water from the Deschutes River until flows out of Wickiup Dam exceed 1,580 cfs at WICO and 1,900 at BENO gauges due to existing weir elevations. As summer flow caps are implemented via WR-1, Sunriver wetlands may experience lower water levels during the summer rearing period. Therefore, habitat monitoring of Sunriver wetlands will be important as the DBHCP is implemented.

Maintaining suitable spotted frog habitat within Sunriver is vital to the conservation and recovery of spotted frogs downstream of Wickiup Dam because it is the largest population in the Deschutes River downstream of Wickiup Dam. In recent years, the population of spotted frogs in Sunriver has declined, with increasing numbers of bullfrogs and the expansion of reed canarygrass within the Sunriver habitats the suspected contributors to this decline. The Service has been working with the Sunriver Resort and the Sunriver Owners Association to address the increasing threats to spotted frogs in Sunriver habitat and to develop appropriate ways to conduct hydrological measurements at the weirs. Efforts thus far have been successful but continued funding of threats management is needed in Sunriver. Conservation measure UD-1 will be used to address these site specific threats that result in demographic suppression. The Upper Deschutes Conservation Fund may also be used to support the hydrological function of Sunriver wetlands via the weirs if deemed necessary in the later years of the DBHCP.

Spotted frogs have also been observed adjacent to the Deschutes River in areas that are not managed by the weir system in the Sunriver area. In Reach 3, there are approximately 171 acres

of wetlands outside of the area that is maintained by the Sunriver weirs that provide important habitat for spotted frogs that disperse from the Sunriver spotted frog population. At the onset of the irrigation storage season the majority of these wetlands are dewatered and the aquatic connectivity of habitat is reduced. Although there are ponds within Reach 3 that maintain some water during the winter, the reduction in flow prevents spotted frogs from reaching these habitats. Spotted frogs are reasonably certain to be experiencing a restriction in movement, reduction in cover, and stranding, all of which increases the likelihood of predation and mortality. Long-term implementation of Conservation Measure WR-1, increasing winter flows, is expected to result in more suitable habitat for spotted frogs in Reach 3. In addition to this passive restoration associated with increased flows, opportunities for restoration of riverine wetlands are likely to arise as winter flows are increased and actions implemented under UD-1 will tie to the Service's Recovery Implementation Strategy for the OSF Recovery Plan, which is anticipated in August 2022.

Reach 4

Wetlands and riverine habitats along the approximate three miles of Reach 4 (178 to 181 RM) of the Deschutes River provide important habitat for Oregon spotted frogs. There are approximately 198 acres of wetlands and 61 acres of river within Reach 4 between Benham and Dillon falls. Located approximately 7.5 miles downstream from Sunriver, Slough Camp supports spotted frogs in wetlands on either side of the river. SW Slough Camp on the west side of the river is a nine acre site that is inundated by the high summer flows in the Deschutes River and maintains water throughout the winter. During periods of drought, the SW Slough Camp wetland can be reduced to having no water. In July of 2020, there was no water within SW Slough and river flows were not high enough to inundate this wetland. On the east side of the river, a 47-acre wetland complex of pond and marsh habitat (East Slough Camp) is impacted annually by storage and release operations at Wickiup Dam and the area is reduced to less than four acres of inundated habitat during the storage season. Immediately downstream (less than ¼-mile) from East Slough Camp, the US Forest Service has restored the Ryan Ranch wetland, a 65-acre historic spotted frog habitat that was drained and disconnected from the Deschutes River via a berm after the construction of Wickiup Dam. The Ryan Ranch wetland is now holding water year-round.

A recent USGS movement study using capture-mark-recapture methods, observed a spotted frog moving across the river from SW Slough to East Slough Camp between the summer of 2018 and the spring of 2019 (Rowe et. al. 2020). Such observations underscore the importance of enhancing aquatic connections between the Deschutes River and adjacent wetland habitats for OSF. Maintaining aquatic corridors for movement will allow spotted frogs to move between habitats within Reach 4 of the Deschutes River.

As described in the Environmental Baseline and above, juvenile spotted frogs have been observed along mudflats of the Deschutes River adjacent to East Slough Camp after the fall ramp down at the onset of irrigation storage season. We expect the slower fall ramp down under conservation measure WR-1 to facilitate successful movement of juvenile and adult spotted frogs to winter habitats. Higher winter flows beginning in year 8 of the DBHCP are likely to improve

connectivity of wetland habitats on either side of the Deschutes River. The Ryan Ranch wetland is expected to provide refuge to spotted frogs that are emigrating from the East Slough Camp wetland in the fall and we anticipate the re-establishment of an OSF population at Ryan Ranch wetland in the near future. Thanks to the Forest Service's restoration efforts, this 65-acre wetland now provides year-round habitat for OSF and the Service expects this restoration area could support a robust population of spotted frogs under the improved flow regime. In concert with East Slough Camp and SW Slough Camp, Ryan Ranch should improve both the robustness of the breeding population and the resiliency of spotted frogs within this short reach of the river, further contributing to the long-term viability of the species within the Deschutes River system.

Oregon spotted frogs within the East Slough Camp wetland appear to have a unique adaptation to surviving the storage season. Seasonal movement studies conducted by USGS found that many OSF within this large floodplain wetland move away from the river and into the adjacent large lava flow. It has not yet been determined if frogs are using a reservoir of water under ground for the winter or merely sheltering within the rocks. We suspect that higher winter flows through WR-1 beginning in year 8 of the DBHCP will further enhance this unique habitat feature within East Slough Camp, thereby improving survivability at that site.

As high flows in the summer are reduced there may be less wetland area inundated in Reach 4 which may reduce the quality of those habitats over time. For example, the SW Slough Camp breeding site may have been suitable for spotted frogs as a result of historical high flows that lengthened the duration that water remained within the wetland. In other areas within Reach 4, reducing the area of inundation with lower summer flows may eliminate the "sink" effect that occurs at the onset of the irrigation storage season when spotted frogs may be trapped in areas that are long distances from the Deschutes River and other small ponds that they migrate to for wintering. Continued monitoring of OSF and habitat in this reach will be necessary to determine how best to utilize conservation funds under UD-1.

Threats to OSF within the floodplain wetlands in Reach 4 in addition to water management include encroachment of vegetation such as cattails. Maintaining open water habitats for spotted frogs will be an important conservation tool for improving habitat suitability for spotted frogs as summer flows are reduced, which will be one focus of the conservation fund resources. Furthermore, as ground water elevations increase due to higher winter flows, there may be opportunities to excavate new open water areas within wetlands within this reach of the river and others which would increase the acreage of spotted frog habitat in this stretch of the river resulting in a boost to these localized spotted frog numbers.

Reaches 5 and 6

In Reach 5, there are approximately 95 acres of wetlands and 67 acres of river. Spotted frogs have not been observed within this reach, although there has been little emphasis on monitoring this part of the Deschutes River. Although passive improvements to habitat resulting from improved flows are expected within this reach, there are no currently known spotted frog populations that will benefit from the improved habitat conditions. Given the lack of monitoring within this reach, spotted frog breeding surveys and habitat monitoring will be conducted to

evaluate if the improved flow conditions result in a change from the current baseline, including the expansion of spotted frogs into these habitats.

In Reach 6, wetlands are limited to approximately 7 acres and the river accounts for an additional 49 acres. This reach of the Deschutes River was not included in the final critical habitat determination due to the lack of OSF breeding habitat and a greater than 6.2-mile distance from known spotted frog populations. However, in September of 2016, four juvenile spotted frogs were detected in a small pond on private land that was inundated during irrigation season and dewatered during the storage season which likely resulted in mortality of those individuals. Long-term improvements to winter flows are likely to create year-round suitability for OSF in the area where they had been detected in 2016, and potentially in the other seven acres along the river.

The detection of spotted frogs within Reach 6 underscores the importance of maintaining suitable wetland habitats along the river system for potential spotted frog dispersal between populations, or into newly restored areas resulting from hydrograph improvements. Ideally, there should be areas that maintain water throughout the irrigation water storage season so that spotted frogs may persist and recover. This OSF site on private land will be monitored to determine whether or not there is an opportunity to provide year-round habitat at this site that is suitable for spotted frogs. Conservation funds under UD-1 may be used to enhance the habitat in this area in the later phases of the DBHCP to support OSF as long as the landowner is willing.

Reach 7

In Reach 7 of the Deschutes River, spotted frogs occur within the Old Mill District in Bend, OR. Wetland habitats that are suitable for spotted frogs within Reach 7 are limited to approximately 8 acres, the majority of which are within the LSA marsh. The effects to LSA Marsh from storage and release operations is buffered by the Colorado Street dam and the marsh remains inundated through the winter storage season.

Increased winter flows under the DBHCP are likely to maintain suitable habitat for OSF within the LSA Marsh. However, the LSA marsh is being encroached with cattails and open water habitats and beaver channels that facilitate seasonal frog movements have been closing.

Spotted frog habitat management and monitoring within this reach occurs via the Old Mill CCAA (August 2014) on enrolled private lands. Habitat treatments that are outside of what was agreed to in the CCAA may be implemented using the conservation fund. Vegetation encroachment, described above, has been identified as a threat to spotted frog habitat within this reach of the river.

As described in the *Environmental Baseline*, egg mass counts indicate that the OSF population within the Old Mill District has declined since discovery on 2012. Continued population and habitat monitoring will be necessary to ensure that spotted frogs persist at this downstream most extent of the species' distribution in the Deschutes River Basin. Conservation measures WR-1 and UD-1 are likely to improve habitat conditions for OSF.

Overall benefits expected to the Deschutes River wetlands and OSF

The DBHCP is expected to greatly improve the function of habitats for OSF in the long-term for the reasons described above. We expect that annual changes to storage and release operations, particularly on the spring ramp up and fall ramp down, will increase survival of OSF by facilitating successful movement between seasonal habitats, which will decrease predation, stranding and desiccation. Increased winter flows and decreased summer flows beginning in year eight of the DBHCP, will shorten the distance that frogs will travel between seasonal habitats and create better conditions, including cover, for overwintering. Higher winter flows are expected to support mammals such as beaver, muskrat and mink that create microsite habitat features that OSF use during winter.

As winter flows increase and summer flows decrease, passive restoration of the river channel and sloughs is expected. Active restoration of the river channel is more feasible as the amplitude of the river hydrograph decreases. In addition, the Service will strategically implement the Upper Deschutes Conservation Fund expenditures (see Appendix D) throughout the life of the HCP where they can provide the most needed spotted frog benefits at varying times throughout the HCP.

Both conservation measures WR-1 and UD-1 are necessary to improve the function of habitat to support the life cycle of OSF. The FEIS and DBHCP summarized the effects to OSF life stages by Deschutes River reach at full implementation of WR-1 and UD-1 over 30 years (Table 35).

Table 35. (Modified from Table 4.4 6 in FEIS and Table 8-43 in DBHCP). Comparison of FEIS and DBHCP Effects of the Proposed Action on Oregon Spotted Frog by Key Life History Period Compared to the No-Action Alternative along the Deschutes River.

Reach	FEIS	FEIS	HCP	FEIS	HCP	FEIS	HCP	FEIS	HCP
Key Life History Period	Pre-breeding	Breeding		Rearing		Pre-winter		Overwintering	
Reach 1: Des-12a (Wickiup Dam to Fall River)	BE+	BE	↑	BE	?	BE	?	BE	↑
Reach 2: Des-12 (Fall River to Little Deschutes)	BE+	BE	↑	BE	?	BE	?	BE	↑
Reach 3: Des-11 (Little Deschutes to Benham Falls)	BE+	BE	↑	BE	↑	BE	?	BE	↑
Reach 4: Des-10a (Benham Falls to Dillon Falls)	BE	BE	↑	NE	≈	BE+	≈	BE	≈
Reach 5: Des-10 (Dillon Falls to Lava Island Falls)	BE	BE	↑	NE	≈	BE+	≈	BE	≈
Reach 6: Des-9 (Lava Island Falls to Central Oregon Diversion)	BE	BE	↑	NE	≈	BE+	↑	BE	↑

Reach 7: Des-8a (Central Oregon Diversion to Colorado Street)	BE	BE	↑	BE	≈	BE	≈	BE	↑

PB=Pre-breeding, B=Breeding, R=Rearing, P=Pre-winter, O=Overwintering

BE = beneficial effect, AE = adverse effect, NE = no effect; “+” indicates increased level of effect

↑ indicates increase in habitat quality ≈ indicates no substantive change in habitat quality

? indicates that the effects to habitat quality are uncertain

For the reasons described in our effects analysis above, we believe the DBHCP conservation measures will significantly improve survival and promote recovery of OSF that utilize the Deschutes River and wetlands habitats between Wickiup Dam and Bend, OR. Approximately 1,227 acres of wetlands and 988 acres of riverine channel will be improved by the DBHCP over the current condition. We anticipate that OSF breeding populations at Dead Slough, Sunriver, Slough Camp and the Old Mill will be more successful, thereby producing more frogs to disperse and overwinter. Those dispersing frogs are expected to, over time, colonize new areas where the increased flows have improved year round conditions.

4.4.1.3.3 Effects in the Little Deschutes River Subbasin

In the Little Deschutes River subbasin, the storage and release operations at Crescent Lake reservoir influence an area that includes approximately 5,204 acres of wetland habitat and 166 acres of open water, along Crescent Creek and the Little Deschutes River. Approximately 49 percent of designated critical habitat within the Little Deschutes River subbasin is affected by storage and release operations within this subbasin.

As described in the *Environmental Baseline* section, the storage and release of irrigation water from Crescent Lake Dam has an ongoing effect to spotted frogs in Crescent Creek and to a lesser extent within the Little Deschutes River. The magnitude of the effect is much less than that described for the Deschutes River downstream of Wickiup Dam for the reasons described below.

Crescent Lake dam is the only water storage structure within the Little Deschutes River subbasin; the remainder of the subbasin is unregulated. Runoff in the subbasin is driven by a snowmelt hydrology in which the highest flows occur in June and low flows occur at the end of summer (R2 and Biota Pacific 2016). Big Marsh Creek is the largest contributor of flow to Crescent Creek, doubling the flow in Crescent Creek at certain times (R2 and Biota Pacific 2016). Although storage and release of water from Crescent Lake dam influences Crescent Creek flows, this influence is moderated by the significant contribution of flow from Big Marsh Creek. The influence of water storage and release from Crescent Lake on flows in the Little Deschutes River is further moderated by unregulated flows contributed upstream of the river’s confluence with Crescent Creek. These unregulated flows account for the shape of the hydrograph at the LAPO gauge (Figure 67 in the Environmental Baseline (Figure 4-17 in DBHCP 2020). Most notable of the hydrograph for LAPO are the peaks that occur in the fall, winter and spring while flows at the CREO gauge at Crescent Dam are constant (Figure 67 in the Environmental Baseline (Figure 4-17 in DBHCP 2020). These peaks are natural hydrological events that have shaped the habitat for Oregon spotted frogs in the Little Deschutes River system. The natural hydrological inputs via these unregulated tributaries support and maintain spotted frog habitat at periods of time where flows may be low as a result of irrigation storage (i.e., winter into spring).

Crescent Lake Reservoir is operated to capture and store runoff from upper Crescent Creek in the fall, winter and spring (typically October through June) and release water during the irrigation season (May through September, with peak months being July, August and September). This operation results in flows downstream of Crescent Dam that are lower than unregulated conditions during the storage season and higher than unregulated conditions during the irrigation season (Figure 67 in the Environmental Baseline (Figure 4-17 in DBHCP 2020)). The summer increase in flow resulting from reservoir operation occurs at a time of year when unregulated flows in Crescent Creek and the Little Deschutes River would otherwise be at their lowest, thereby maintaining stream flows and wetland inundation levels that would not occur under natural conditions (Figure 67 in the Environmental Baseline (Figure 4-17 in DBHCP 2020)).

Implementation of Conservation Measure CC-1 and UD-1

The DBHCP Conservation Measure CC-1 will dedicate and manage a portion of the water storage in Crescent Lake Reservoir each year for Oregon spotted frog habitat management (hereinafter referred to as “OSF storage”). The OSF storage will be released after coordination with USFWS to increase flows in lower Crescent Creek and lower Little Deschutes River at times when flows would otherwise be insufficient to support Oregon spotted frog habitats. The amount of water available for this purpose will vary depending on the total storage available in the reservoir, and it will increase over the term of the DBHCP as TID completes water conservation projects reducing its need for Crescent Lake storage (Table 36; Table 6-4 in DBHCP). A certain amount of the OSF storage will be dedicated for use during the storage season (October 1 through June 30) to provide a minimum flow at Hydromet Station CREO below Crescent Dam of 10 cfs in Years one through 15 of DBHCP implementation, 11 cfs in Years 16 through 20, and 12 cfs in Years 21-30. The remaining OSF storage may be used to increase the storage season flow at CREO even further, or it may be used to increase flows in the spring and fall when TID is releasing little or no storage for irrigation use. These “shoulder seasons” before and after irrigation releases have been identified by USFWS as important periods in the life cycle of the Oregon spotted frog (USFWS 2017). The release of OSF storage during the shoulder seasons can offset naturally low flows in Crescent Creek and Little Deschutes River and support riparian wetlands used by the frogs for breeding, summer rearing/foraging and transitioning to overwintering (DBHCP 2020).

A tool was developed for the Service’s FEIS OSF analysis to help visualize how the OSF storage can be used to benefit Oregon spotted frogs. Figure 86(Figure 39 in FEIS App 3.04) uses the historical flow data for Crescent Creek from 2005, which was a dry year, to depict how the OSF storage releases could be applied under the proposed action to improve conditions for the species under a similar dry-year scenario. The black line tracks the historical Crescent Creek flow measured below the dam in 2005. During 2005, the irrigation season, depicted in gold, began on June 16 and continued through October 4. Note, there are some missing data during the middle of the irrigation season; the brief drop to zero flow is an artifact of those missing data. The figure also demonstrates the effect of irrigation water management in Crescent Creek on the Little Deschutes River during a dry year. Historical flow measurements from the LAPO gauge are noticeably influenced by the irrigation releases in a dry year. This pattern is less obvious during

Table 36. (Table 6-4 in DBHCP). Volumes of storage in Crescent Lake Reservoir to be made available for Oregon spotted frog conservation under the DBHCP.

DBHCP Years	Minimum Flow at CREO Oct 1 – Jun 30 (cfs)	Maximum Volume of OSF Storage Required to Provide Minimum Flow at CREO Oct 1 – Jun 30 (acre-feet)	OSF Storage Available for Uses Other than Providing Minimum Flow at CREO (acre-feet) ¹		
			When Total Storage Volume on July 1 is < 45,000 acre-feet	When Total Storage Volume on July 1 is 45,000 - 75,000 acre- feet	When Total Storage Volume on July 1 is > 75,000 acre-feet
1-10	10	2,174	3,090	5,090	6,590
11-15	10	2,174	4,290	6,290	7,790
16-20	11	2,717	4,947	6,947	8,447
21-30	12	3,261	5,603	7,603	9,103

- 1 Volumes of water available are calculated based on the maximum volume of water needed for storage season flows from October 1 through June 30. If TID begins releasing water for irrigation from Crescent Lake Reservoir prior to July 1 in a given year, the irrigation release will contribute toward meeting the minimum flow, and the volume of water required from this conservation measure to provide the minimum flow will decrease. When this happens there will be a corresponding increase in the volume of water available for other uses to benefit Oregon spotted frogs.

wetter years when Crescent Creek accounts for a much smaller percentage of the flow in the Little Deschutes.

In a hypothetical scenario under the proposed action, OSF storage could be allocated as follows. Its primary use would be to hold the winter minimum flows at between 10 and 12 cfs, depending on the phase of implementation. During the first 10 years, the initial phase of implementation for Conservation Measure CC-1 under the proposed action, in a dry year the winter minimum flow would require most of the available OSF storage. In the 2005 historical example the winter minimum flow accounts for 5,038 AF of the total 5,264 AF available during a dry year. In later years of implementation, or during wetter year scenarios, more water would be added to the OSF storage, ranging from the 5,264 AF available during the first 10 years and in a dry year, up to 12,364 AF in years 21 through 30 of the permit term during a wet year. This additional OSF storage could be used to step up the spring flow during the breeding or rearing season to inundate wetlands earlier than would otherwise occur (green-colored spring frog supplement in Figure 86). It could also be used to draw out the ramp-down that normally occurs at the end of the

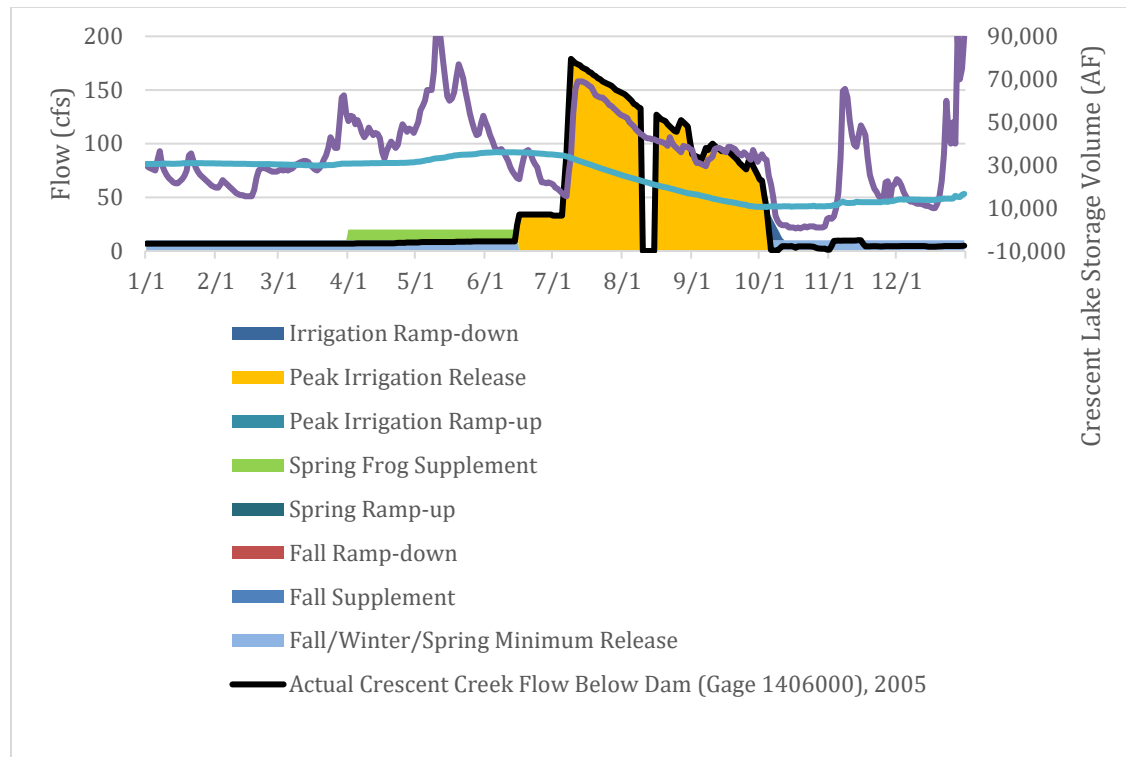


Figure 86. Performance of OSF Storage Flows in Crescent Creek during a Dry-Year Scenario (Fig. 87 in FEIS App. 3.04)

irrigation season, during the frog pre-winter period (dark blue fall supplement in Figure 86). This would improve conditions for frogs and facilitate movement to overwintering locations.

The potential effects of the proposed action's OSF storage water are summarized for each life history period in the FEIS for the DBHCP. However, this analysis was done for illustrative purposes using RiverWare and does not necessarily represent how the hydrograph will present in a given year. Monitoring and adaptive management for conservation measure CC-1, described in the DBHCP (Section 7.2.5), will determine how best to utilize the OSF storage to improve the survival of OSF life stages and populations over the duration of the DBHCP.

Oregon spotted frog habitat and populations within Crescent Creek and Little Deschutes River

As described in the *Environmental Baseline*, spotted frog surveys are limited in the Little Deschutes River subbasin because most of the habitat along Crescent Creek and the Little Deschutes River occurs on private land. Table 37 below provides approximate acreages of habitat the site scale within the Little Deschutes River subbasin. Due to expansive amount of wetlands and limited access of private lands, the acreages for breeding sites, calculated in ArcGIS, are likely an under-estimate of the habitat utilized by spotted frogs. There are approximately 11,033 acres of designated critical habitat within the Little Deschutes River subbasin within which the acres in Table x are nested.

The floodplains of these river systems provide an abundance of suitable wetlands habitat for Oregon spotted frog. Given the close proximity between known breeding sites, depicted by river

miles in Table 37 below, we expect that there is a broad distribution of spotted frogs within suitable wetland habitats along these two rivers and within critical habitat.

Based on the Service's resiliency ranking criteria described above, Oregon spotted frogs within the Little Deschutes River subbasin are ranked as having moderate resiliency. Despite most sites having a low abundance (Table 37) as determined through egg mass counts, the moderate resiliency ranking is based on the large number of spotted frog sites and the large acreage of connected habitat within the subbasin.

In order to improve resiliency of OSF populations within the Little Deschutes River subbasin, threats and stressors such as reed canarygrass and bullfrogs must be managed. The Upper Deschutes Conservation Fund (UD-1) will be used to improve survival of OSF by implementing actions that enhance the suitability of OSF habitat within approximately 1,182 acres of wetlands and 48 acres of open water on Crescent Creek, and 3,322 acres of wetlands and 118 acres of open water on the Little Deschutes River that are affected by storage and release operations. We also anticipate that UD-1 will be used to enhance the remainder of acres within the Little Deschutes River subbasin that provide habitat for OSF.

Implementation of UD-1 in the Little Deschutes River subbasin

The Upper Deschutes Conservation Fund provided through the DBHCP will support ongoing and future projects that enhance the function of OSF habitat. Active management of habitat and invasive plants and animals are essential to OSF recovery in the Little Deschutes River subbasin.

Within the Little Deschutes River and Crescent Creek there are opportunities to conduct conservation actions for OSF on Federal and private lands under the current and future flow regime. Approximately 5,362 acres of critical habitat for OSF are within the area influenced by storage and release operations at Crescent Dam. Approximately 70 percent of the lands adjacent to the Little Deschutes River and Crescent Creek are in private ownership. Therefore, private lands are important to conservation and recovery of OSF and efforts to establish relationships with landowners must continue.

Habitat restoration and management of invasive reed canarygrass and bullfrogs are key are to improving the function of critical habitat for OSF in the Little Deschutes River subbasin. Reed canarygrass has been documented throughout the Little Deschutes River and to a lesser degree along Crescent Creek in OSF breeding and rearing habitat. The invasive grass is likely to continue to spread and degrade the function of the wetland habitats that support OSF. The funds provided through UD-1 will be used to stop the spread of reed canarygrass within OSF habitat.

Bullfrogs occur throughout the Little Deschutes River between the confluence with Crescent Creek and the outlet near Sunriver. Current plans are underway to implement bullfrog control within OSF habitat on private lands in the lower reaches of the Little Deschutes River. A team of volunteers and consultants, with help from Federal and State agencies, are developing a strategy to control bullfrogs and reduce threats to OSF. The Upper Deschutes Conservation Fund will be used to support these efforts now and into the future.

Table 37. Oregon spotted frog population resiliency within and outside of the area affected by Crescent Dam operations.

Waterbody or River	River mile	Population/Sub-population/site Name	Breeding Habitat Acres	Population abundance	Affected by reservoir storage/release
Big Marsh Creek	7-12.5	Big Marsh	1,699	high	No
Crescent Creek	22 – 22.5	Crescent Creek above Highway 58	9.6	low	Yes
	21.5	Crescent Creek below Highway 58	4.44	low	Yes
	14	Black Rock lava pond	3	low	No
	9-9.5	Crescent Upper Oxbow	20	low	Yes
	3-7	Crescent Creek 62 RD	233	moderate	Yes
	0-2	Crescent Creek BLM oxbows	48	low	Yes
Little Deschutes River	95.5	LD Marsh S. Shore	1.14	low	No
	88-89	5830 Rd (LDR10) USGS Dogleg-Upstream HWY58	35	low	No
	87	Hwy 58 area sites (Upper oxbow, Mowich log pond)	21.1	low	No
	84-86	5830 Road dogleg3		low	No
	70-71	Odell Pasture; 100 road mill pond and oxbows	32.5	low	No
	60-61.5	LDR 62 road oxbow, floodplain pool, gravel pit, beaver	28	low	No
	56-57	Middle Little Deschutes complex 1 (RM 56-57)	40.3	low	Yes
	49-51	Middle Little Deschutes Complex 2 (RM 49-51)	146	low	Yes
	41-42	South Masten Road	2	low	Yes
	~35	Leona Park	7.54	low	Yes
	~30-31	Oxbows behind La Pine High School	12.21	low	Yes
	~27-28	Rosland Park	32.3	low	Yes
	~21	Riverside oxbow/ KC West (RM 21)	24.1	low	Yes
	~13-15	Casey Tract	91	low	Yes
	~4-6	Thousand Trails	70.5	low	Yes
	0-2	Crosswater (N. driving range pond, bullfrog pond, Fairway 2)	8.35	low	Yes
Long Prairie Creek	0-0.5	Long Prairie Beaver pond marsh (La Pine HS)	6.93	low	No
	1.5	Long Prairie Hwy 97 City Hall	1.44	low	No*
	2.5	Long Prairie Pond	25.5	moderate	No*
	6.5	Private site (RM 6.5)	11	low	No*
	6.5	Long Prairie upper BLM	4.47	low	No*

Addressing the ongoing threats to OSF from habitat loss and predation are essential for conservation and recovery. The Upper Deschutes Conservation Fund may be used to conduct the following types of habitat restoration activities and management within the Little Deschutes River subbasin to support OSF conservation:

- Installation of beaver dam analogs and wood structures within channel to increase duration and spatial extent of water on the floodplain and within oxbow habitats to support OSF life cycles and habitat connectivity.
- Riverbank restoration.
- Reed canarygrass treatment along the river and at OSF sites.
- Bullfrog removal to reduce predation on OSF.
- Excavation of oxbows on floodplain to intercept groundwater.

As stated in the *Environmental Baseline*, spotted frog populations outside of the area affected by water management are important to recovery of the species in that they can immigrate into areas where populations may be suppressed due to the disruption of the seasonal hydroperiod as a result of storage and release of water from Crescent Dam. Therefore, we anticipate that conservation funds will be applied to lands that are outside of the area affected by storage and release operations to enhance overall function of habitat and improve demography of OSF populations within the affected area. Overall, implementation of DBHCP conservation measures CC-1 and UD-1 are expected to improve function of OSF habitat to provide for OSF life stages and populations.

4.4.1.4 The RO&M and SEED Program effects to Oregon spotted frog

The implementation of Reclamation's Dam Safety Program of required Reviews of Dam Operations and Maintenance Activities (RO&M) and Safety Evaluations of Existing Dams (SEED) are described in Section 4.6 within the biological assessment (Reclamation 2020). Table 38 outlines specific actions that will occur during the implementation of the DBHCP that are likely to affect the Oregon spotted frog. Tables 38 and 39 (Tables 18 and 17 in the BA) identify Reclamation's examination activities for Wickiup and Crane Prairie Dams, respectively.

The RO&M and SEED programs will not be implemented in the Little Deschutes River subbasin, as Crescent Lake Dam is owned by the irrigation districts. Therefore, the following analysis addresses the implementation of these programs within the Upper Deschutes River subbasin only.

The primary mechanism for effects to the Oregon spotted frog and its habitat from implementation of the RO&M and SEED programs is a short-term reduction in flows downstream of the structure where the activity is being implemented. In order to minimize these effects, these activities are scheduled in close coordination with the Districts and the Service. The activities that require flows to be significantly reduced or completely shut down are implemented periodically at each of the dams (Table 38).

Table 38. Reclamation Actions that Affect Oregon spotted frog outside of those analyzed in for the DBHCP

Reclamation Action	Effects	Frequency	Crane Prairie	Wickiup	Crescent
Complete outstanding and future O&M recommendations	Possibly. Can only analyze existing/ outstanding O&M recommendations	As needed	Section 7	Section 7	Section 7
Periodic dive inspections	Short-term effects to flow	Every 6 Years	Section 7	Section 7	DBHCP
Periodic and Comprehensive Facility Reviews	Potential short-term effects to flow	Every 4 Years	Section 7	Section 7	DBHCP

Activities required at Crane Prairie Dam require flows to be reduced to as low as 0 cfs for up to four hours and 25 cfs for up to six hours in October on 8-year intervals. The Gate Full-Open/ Full-Close Test requires flows at 500 cfs for up to five minutes in early-August. Table 39 (Table 18 in the BA) provides details for inspection and operational testing activities planned for Crane Prairie Dam.

Table 39. (Table 18 in the BA). Crane Prairie Dam scheduled inspection and operational testing activities.

Activity	Details	Operation al Requirements	Months	Optimal Time for ESA Species	Frequency	Last Inspect ion/Op eration	Next Inspecti on/Ope ration
Dive Inspection of Stilling Basin	Requires no-to-low flows for visibility and safety. Can be completed in less than 2 hours.	4 hrs at 0 cfs	October	October	8 yrs	2019	2027
Dive Inspection of Intake Tower	Reclamation safety guidelines do not allow divers near an intake structure at flows >2 cfs. Velocities inside the trash screen and in front of the gate must be below this criteria.	4 hrs at 0 cfs	October	October	8 yrs	2019	2027
Concrete Conduit	Conduit inspections require turning off flows and	6 hrs at 25	Aug-Oct	August -	6 to 8	2019	Between 2025

Inspection	pumping upstream of the stilling basin flow spreading crest. Inspections are past due. The preferred method is to perform one side at a time by placing stoplogs in front of the conduits and pumping water out. Requires low flow conditions.	cfs		October	yrs		& 2027
Gate Full-Open Full-Close Test	Required by SOP. Test creates flow adjustments of 500 cfs for a few minutes downstream. An alternate test is attempted with the bulkhead in place to avoid these flow changes.	5 mins at 500 cfs	August	Early - August	Annual		

Crane Prairie Inspection and Operational Testing and Maintenance Activities

Inspection and operational testing activities and maintenance activities at Crane Prairie Dam that reduce flows will occur every 6 or 8 years. These activities are likely to affect Oregon spotted frogs and their designated critical habitat by reducing flows in the Deschutes River between Crane Prairie Dam and Wickiup Reservoir for seven to 10 hours (includes 2 hours to ramp up and 2 hours to ramp down) during the months of October, for 10 hours (includes ramping times) sometime during the August to October period, and for up to six days during October for the stilling basin maintenance/repair. In addition, the gate full-open, full-close test in August will result in an increase in flows for approximately five minutes.

There is only one known population of OSF within the Deschutes River between Crane Prairie Dam and Wickiup Reservoir. As described in the Environmental Baseline, the wetland where OSF breed that is adjacent to the Deschutes River typically goes dry in mid-July as Wickiup Reservoir is drawn down. Although we do not have movement and overwintering data for OSF at this location, we assume that individuals at this site overwinter either in off-channel aquatic habitat, or within the Deschutes River downstream of Crane Prairie Dam and are likely to be impacted by proposed action flow alterations.

Individual Oregon spotted frogs wintering in the Deschutes River when flows are reduced for four to 10 hours for up to 6 days are likely to be exposed to an increased risk of predation or forced to relocate to more suitable habitat. If the 6-hour (10 hours with ramping) concrete conduit inspection occurs during August or September, juveniles, sub-adults, and adults will likely be affected by following the waterline as flows recede and again as flows are restored. The change in flows is likely to increase the risk of predation as frogs are forced to move to locate cover.

The gate full-open, full-close test will occur in August when juvenile, sub-adult, and adult Oregon spotted frog individuals are likely using the Deschutes River. The gate will be steadily

opened and then steadily closed with no delay so the duration of the test will not exceed five minutes. There will be a noticeable increase in flow immediately below the dam, but the increase will be ameliorated as the pulse proceeds downstream. Individuals using the Deschutes River are likely to be along the margins of the river or within the oxbow habitats in this area. Therefore, the short-term increase in depth and velocity is not likely to result in flushing frogs to downstream areas.

Maintenance activities such as the stilling basin maintenance and repair require that flows be reduced to 0 cfs for up to six days. In the BA, Reclamation anticipated that frog mortality will result from this 6-day long period with low flow conditions below Crane Prairie Dam when this maintenance action occurs. Given the low flows and duration of 6 days, these maintenance activities are likely to cause harassment or direct mortality of Oregon spotted frog individuals that are present in the Deschutes River between Crane Prairie Dam and the upper end of Wickiup Reservoir. Given that these maintenance activities will be timed with irrigation storage in Crane Prairie Reservoir, flows within the Deschutes River will be already be low. As described in the BA, Reclamation will work with the DBBC Irrigation Districts and Reclamation maintenance and inspection crews to provide some flow within the Deschutes River for streamflow maintenance during this longer-term stilling basin repair activity.

Activities scheduled at Wickiup Dam require flows to be reduced to as low as 10 cfs for up to three days in October or November on 8-year intervals. Table x provides details for inspection and operational testing activities planned for Wickiup Dam.

Table 40. (Table 17 in the BA) Wickiup Dam scheduled inspection and operational testing activities.

Activity	Details	Operational Requirements	Months	Optimal Time for ESA Species	Frequency	Last Inspection/Operation	Next Inspection/Operation
Dive Inspection of Stilling Basin and Intake Tower	This dive requires no-to-low flows for visibility and safety. Toe drain flows of 25-40 cfs are not likely available during optimal inspection season due to low head in the reservoir. This requires inspection of stilling basin to be conducted one side at a time with alternating flow from outlet conduit pipes at 25 cfs maximum.	8 hrs at 25 cfs	Late October through November	November	8 yrs	Nov 2019	2027

Tube Valve Inspection	Getting into the tube valve requires flows to be about 10 cfs maximum. Above that, the water washes into the tube valve during inspection and is a safety concern. This will require at least 2 days for dewatering, inspection, and recharging the conduit. Toe drain flows may be negligible at these reservoir elevations during optimal inspection season and can't be consistently expected, therefore, 10 cfs from bypass pipe are used to meet river flow requirements.	3 days at 10 cfs	Late October through November	November	8 yrs	2013	2021
Unbalanced Gate Testing	Should be able to be performed during higher flow releases with no impacts to OSF	No noticeable change in flow volume. Can switch releases between gates.	October	November	6 to 8 yrs	2019	Between 2025 and 2027

Wickiup Dam Inspection and Operational Testing and Maintenance Activities

Inspection and operational activities and maintenance activities at Wickiup Dam are likely to adversely affect Oregon spotted frog and their designated critical habitat for a short duration by reducing flows in the Deschutes River downstream of Wickiup for variable periods of time. These activities that temporarily reduce flows in the Deschutes River below the dam are scheduled to occur every 6 to 8-years during the months of October and November. At this time, most frogs that choose to overwinter within the Deschutes River will be at or near their winter locations. Based on limited data gathered during USGS telemetry studies, we anticipate that a subset of spotted frogs from each population along the Deschutes River between Wickiup Dam and Bend, OR will be adversely affected by Reclamation's RO&M and SEED activities, described in the BA (Reclamation 2020). Approximately 988 acres of riverine channel occur between Wickiup Dam and Bend, OR where OSF may be overwintering during Reclamation's proposed action.

Reclamation determined in their BA that RO&M and SEED activities are likely to have a greater impact to OSF as winter flows in the Deschutes River increase in Phases 2 and 3 of the DBHCP. Therefore, Reclamation actions, described in the BA and analyzed below, will be limited to the first 7 years (Phase 1) of DBHCP implementation, when winter flows in the Deschutes River are a minimum of 100 cfs at the WICO gauge. Given the frequency of these actions at every 6 to 8 years, it is likely that each activity will occur one time within Phase 1 of the DBHCP. Of the

proposed activities, the tube valve inspection at Wickiup Dam requires that flows in the river be reduced to 10 cfs for three days in late-October or November.

The impacts to Oregon spotted frog downstream of Wickiup Dam related to any reduction in flow will be greater immediately below the dam than in reaches downstream. Reclamation examined the timing and duration of flows at the WICO and BENO gauges during a recent four to eight hour long dive inspection of Wickiup Dam, completed on November 3, 2018.

Reclamation determined that as distance from the dam increased, tributary and groundwater inputs to the Deschutes River lessened the magnitude of flow reductions in the river (Figure 76 in BA). Figure 77 in the BA shows that a reduction of 70 cfs at the WICO gauge resulted in a water elevation reduction of 6 inches at the WICO gauge. The 2018 dive inspection exercise manifested itself 24 hours later as a reduction of approximately 20 cfs at the BENO gauge that resulted in a water elevation reduction of 0.72 inches at the BENO gauge. Therefore, Reclamation determined that flow impacts to OSF and critical habitat will be most apparent in Reach 1, from the dam downstream to the confluence with the Fall River and become progressively less apparent as downstream distance increases through Reach 7 of the Deschutes River.

Short-duration dive inspections and other maintenance inspections that disrupt flow for up to 8 hour occur in late-October through November are anticipated to have low impacts to individual frogs. The timing of the inspections will occur when most frogs have settled into wintering locations. Given the short disruption of flows and the ability to bypass flows into the river as these activities are implemented, it is highly unlikely that frogs will be experience a change in flows that will disrupt their ability to maintain shelter.

The gate full-open, full-close test will occur in August when juvenile, sub-adult, and adult Oregon spotted frog individuals are likely using the Deschutes River adjacent to the wetlands immediately downstream of Wickiup Dam. For this operation, the gate will be steadily opened and then immediately closed with no delay so the duration of the test will not exceed five minutes. There will be a noticeable increase in flow immediately below the dam, but the increase will be ameliorated as the pulse proceeds downstream. Individuals using the Deschutes River are likely to be along the river margins or within slough habitats. Therefore, OSF are unlikely to be subject to flushing as these actions are implemented. The short pulse of water from the dam is expected to change water elevations within the river by no more than a few inches. As such, most individual frogs will not be affected by this rapid gate change exercise, especially for any frogs inhabiting the off-channel wetland areas which will not be affected by this operation.

Overall, the extent of Reclamation-caused flow fluctuations or alterations from RO&M and SEED activities are not expected to have significant negative impacts to Oregon spotted frog individuals or critical habitat if they occur over the first 7-year period of the 30-year long DBHCP term. The proposed activities are likely to cause short-term disruptions to OSF that are either moving to or are already within overwintering habitat when water levels drop within the 988 acre river Deschutes River channel between Wickiup Dam and Bend, OR.

4.4.2 Oregon Spotted Frog Critical Habitat

Within the Upper Deschutes River Basin, spotted frog critical habitat consists of Unit 8 in the Upper Deschutes River subbasin and Unit 9 within the Little Deschutes River subbasin. Unit 8 is divided into subunits: 8A is the area upstream of Wickiup Dam and 8B is the area downstream of Wickiup Dam. These subunits are affected differently by the Deschutes Project and implementation of the DBHCP. The description of each subunit and the impacts to critical habitat are described below by subunit. The effects analysis, above, that described the anticipated effects from implementation of the DBHCP, overlaps with the effects to critical habitat described below since nearly all of the habitat where spotted frogs occur are within designated critical habitat.

Approximately 98 percent of critical habitat within subunit 8A, 70 percent of critical habitat within subunit 8B, and 49 percent of critical habitat within Unit 9, is within the area affected by the DBHCP (Table 41).

Table 41. Critical habitat by unit and subunit within and outside of the area affected by the DBHCP and the Deschutes Project.

CH Unit	CH subunit	CH acres	Affected Acres	Percent (%) Affected
8. Upper Deschutes River	8A – Below Wickiup Dam	2,001	1,960	98
	8B – Above Wickiup Dam	22,031	15,365	70
Upper Deschutes River Total		24,032	17,325	72
9. Little Deschutes River		11,033	5,362	49

4.4.2.1 Effects of the DBHCP on Critical Habitat PCEs

As described in the *Environmental Baseline*, critical habitat within the action area, consists of freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, lake, and riverine habitat. Each of these habitat types will be affected differently by the DBHCP. The *Environmental Baseline* describes how the past and current operations have affected critical habitat and some of these effects will continue with the implementation of the DBHCP, while the magnitude or timing of others will change under the DBHCP.

4.4.2.1.1 Effects of the DBCHP on Spotted Frog Critical Habitat Subunit 8A

Subunit 8A includes 2,001 ac (810 ha) of the Deschutes River and associated wetlands downstream of Wickiup Dam to Bend, Oregon, beginning at the outlet of an unnamed tributary draining Dilman Meadow. Approximately 875 acres of critical habitat (44 percent of subunit 8A) are within the Deschutes River corridor between river mile 167.5 and 228. Operation of the Deschutes Project and implementation of the DBHCP affect 1,960 acres (98 percent) (793 ha) of critical habitat within subunit 8A (Table 41). These acres consist of 468 acres (189 ha) of

freshwater emergent wetland, 507 acres (205 ha) of freshwater forested/shrub wetland, 74 acres (30 ha) of freshwater pond, 37 acres (15 ha) of lake, and 875 acres (354 ha) of riverine habitat. Anticipated effects to the PCEs of spotted frog critical habitat are discussed below.

PCE 1 – Spotted Frog Nonbreeding, Breeding, Rearing, and Overwintering Habitat

For the reasons discussed below, the DBHCP is likely to improve the function of critical habitat in Subunit 8A over time. In years 1 through 7, the DBHCP is likely to maintain the functioning at risk rating for spotted frog nonbreeding, breeding, rearing, and overwintering habitat (PCE 1). However, conservation measures WR-1 and UD-1 are likely to enhance seasonal habitat conditions of PCE 1 within critical habitat in this subunit in the short-term for the following reasons:

1. Flow releases from Wickiup Dam in early April can improve spotted frog breeding and rearing habitat.
2. Reduced fluctuations of water levels in April and May enhance rearing habitat by creating more stable water levels that reduce the potential for stranding eggs and tadpoles.
3. Conservation funds will be used to implement restoration activities within OSF sites that directly improve the function of PCE 1.

Beginning in year 8 of the DBHCP, winter flows within the Deschutes River at the WICO gauge will increase to 300 cfs and summer flows will not increase above 1,400 cfs for more than 10 days. In years 13 through 30, winter flows in the Deschutes River will increase to 400 cfs and up to 500 cfs at the WICO gauge and summer flows will not exceed 1,200 cfs for more than 10 days. The increased winter flows and lower summer flows are expected to improve PCE 1 and the function of critical habitat in subunit 8A for the following reasons:

1. Overwintering habitat is likely to increase as a greater area is inundated with water.
2. Seasonal habitats will be in closer proximity (i.e., wetlands will be closer to the river).
3. Passive restoration of riparian and emergent vegetation is likely to occur.

PCE 2 – Spotted Frog Aquatic Movement Corridors

Conservation measure WR-1 is likely to enhance aquatic movement corridors (PCE 2) as early as year 1 of the DBHCP by changing the timing and extent to which certain habitats are wetted. Under conservation measure WR-1 Deschutes River flows at the WICO gauge increase to 600 cfs by April 1, which increases the wetted area and improves connectivity between wintering and breeding habitats. Conservation measure WR-1 maintains flows at the BENO gauge above 1,300 cfs until September 15 and then gradually drops to 1,200 and 1,100 cfs over 10 days. Maintaining the wetted area during the important movement period from fall to wintering habitats improves the function of critical habitat in supporting this portion of the OSF life cycle.

As winter flows increase and summer flows decrease, beginning in year 8 of the DBHCP, we anticipate that seasonal habitats will be in closer proximity. Therefore, the ramp up and down periods are likely to maintain wetted aquatic corridors that are shorter distances between seasonal habitats for OSF. For the reasons described above, it is likely that spotted frog aquatic movement corridors (PCE 2) will incrementally improve between years 8 and 30 of the DBHCP.

PCE 3 – Spotted Frog Refugia Habitat

Refugia habitat for OSF (PCE 3) is extensively reduced and limited during the winter irrigation storage season within sub-unit 8A. At winter flows of 100 cfs at WICO gauge, the area inundated by water is mainly within the Deschutes River channel and adjacent floodplain wetlands are void of water. Therefore, areas of refugia from predators, such as brown trout, that inhabit the river are scarce within critical habitat sub-unit 8A.

Implementation of the DBHCP will maintain the limited amount of PCE 3 within subunit 8A during the first seven years when flows at WICO are 100 cfs. As flows at WICO are increased to 300 cfs beginning in year 8, we anticipate an improvement to PCE 3 as more area within the river channel is inundated with water. In years 13 to 30 at winter flows of 400 cfs, we expect that there will be an increased area of inundation within the Deschutes River and slough habitats that will provide additional refugia for OSF.

4.4.2.1.2 Effects of the DBHCP on Spotted Frog Critical Habitat Subunit 8B

The area affected by the DBHCP encompasses Crane Prairie and Wickiup reservoirs and the Deschutes River and associated wetlands between the reservoirs, and includes approximately 15,365 acres (6,218 ha) of critical habitat (70 percent of subunit 8B). Wetland habitat types within these acres include approximately: 3,029 ac (1,226 ha) of freshwater emergent wetland, 809 ac (327 ha) of freshwater forested/shrub wetland, 3 ac (1 ha) of freshwater pond, 11,514 ac (4,660 ha) of lake, and 11 ac (4 ha) of riverine habitat. For the reason discussed below, implementation of the DBHCP improves the function of CHU 8B in a portion of the subunit while the remainder of the CHU is maintained in a degraded condition.

PCE 1 – Spotted Frog Nonbreeding, Breeding, Rearing, and Overwintering Habitat

The DBHCP is likely to provide significant benefits to spotted frog nonbreeding, breeding, rearing, and overwintering habitat (PCE 1) within Crane Prairie Reservoir which represents approximately 32 percent (4,982 acres) of CHU 8B. Within the large reservoir acreage, there are approximately 629 acres of emergent wetland habitat that are important physical and biological features of the critical habitat within the reservoir.

At Crane Prairie Reservoir, the implementation of early conservation of the DBHCP has resulted in improved function of OSF critical habitat (PCE 1) within the reservoir. Prior to these early conservation measures, reservoir operations resulted in breeding habitat that was functioning at risk. Storage volumes that exceeded 50,000 acre-feet resulted in water expanding into unsuitable, upland habitat outside of the sedge vegetation that protects egg masses and rearing tadpoles. Under CM CP-1, a reservoir storage volume of approximately 46,800 acre feet will be reached by mid-March to provide suitable spotted frog breeding habitat within the emergent vegetation. Reservoir volumes between 46,800 and 48,000 acre feet will be maintained during the spotted frog rearing period until July 15 when the reservoir is draw down to deliver irrigation water downstream.

Conservation measure CP-1 is likely to improve overwintering habitat within critical habitat. The DBHCP conservation measure for Crane Prairie reservoir requires that the residual reservoir pool

is at or above 37,870 acre feet, which is a larger storage volume than what was typically maintained under past operations of the reservoir. The storage volume of 37,870 acre feet provides a larger area of inundation for OSF overwintering. The maintenance of higher water surface elevations through winter also lessens the distance between the wintering sites and spring breeding habitats. For the reasons stated above, the DBHCP will improve the function of PCE 1 within critical habitat at Crane Prairie reservoir.

Although Conservation measures CP-1 and WR-1 improve hydrological function of critical habitat in sub-units 8B and 8A, respectively, there are consequences to the hydrological function within the portion of CHU 8B that includes the Deschutes River between the reservoirs. The hydrology of this portion of CHU 8B is predominately dependent on surface water elevations in Wickiup Reservoir. Based on the hydrological analysis in the FEIS (Figures x above), we anticipate lower reservoir water elevations in Wickiup Reservoir over time as WR-1 increases flows in the Deschutes River below Wickiup Dam beginning in Year 8. Lower reservoir water elevations will result in a smaller area of inundation within critical habitat. Although the wetted area of critical habitat is expected to shrink, it is possible that breeding and rearing habitat will shift in location and move closer in proximity to the Deschutes River. Therefore, it is plausible that there will be improved function of critical habitat that encompasses the Deschutes River and its floodplain between the reservoirs.

Under current conditions and implementation of the DBHCP, CHU 8B at Wickiup Reservoir will continue to have limited suitable year-round habitat for spotted frogs due to the large change in surface water depth and spatial extent of inundation that results from reservoir drawdown for irrigation water supply. RiverWare modeled storage volumes for Wickiup Reservoir indicate that the DBHCP is likely to result in lower surface water elevations in Wickiup Reservoir compared to current operations (Figure 81 above).

At lower storage volumes of water, breeding habitat will be shallower than the current condition described in the Environmental Baseline. As the irrigation season commences on April 1, the reservoir will be drawn down for irrigation and expansive areas of shallow water that provide breeding and rearing habitat will be drained of water over a large spatial area reducing the function of these PCEs. At the end of the irrigation season, the remaining storage volumes of water within the reservoir that provide overwintering habitat for spotted frog are likely to be further reduced under the DBHCP over time.

The minimum volumes of water that remain in the reservoir from October into the winter provide what may be marginal spotted frog overwintering habitat since these areas are predominately unvegetated with little refugia from the abundance of non-native fish that reside in the reservoir. On that basis, the function of PCE 1 is likely to remain degraded with implementation of the DBHCP.

PCE 2 – Spotted Frog Aquatic Movement Corridors

As described above for PCE 1, implementation of the DBHCP is likely to improve the function of PCE 2 at Crane Prairie Reservoir via a longer duration of inundation and higher residual pool

through the winter that will improve the connectivity of spotted frog breeding, rearing and overwintering habitats within the reservoir.

With implementation of the DBHCP, the function of PCE 2 may either be reduced or improved within the portion of CHU 8B that includes the Deschutes River between Crane Prairie and Wickiup reservoirs. This geographic area of CHU 8B provides important connectivity between upstream and downstream spotted frog populations. Storage of water in Crane Prairie for a longer duration and lower reservoir volumes in Wickiup Reservoir as a result of the proposed action, are likely to change the timing and duration of water levels and impact habitat connectivity within riverine habitat conditions in wetlands adjacent to the Deschutes River. For those reasons, the function of PCE 2 in Wickiup Reservoir is likely to be maintained in a degraded condition with implementation of the DBHCP.

PCE 3 – Spotted Frog Refugia Habitat

The DBHCP is likely to maintain the functioning at risk rating for refugia habitat in Subunit 8B. However, the condition of PCE 3 (refugia habitat) in Crane Prairie Reservoir is likely to be improved under the DBHCP by providing spotted frogs with increased access to cover throughout the year as a result of higher water levels being maintained in the reservoir for a longer period of time compared to past operations. The filling of the reservoir through winter makes it likely that frogs will have a larger pool of water to evade predators as they migrate to the breeding areas. Furthermore, conservation funds under UD-1 may be used to actively manage predatory fish such as brown bullheads within Crane Prairie, which will further enhance spotted frog refugia habitat within the portion of critical habitat within Crane Prairie Reservoir.

Under the DBHCP, spotted frog refugia habitat within the Deschutes River between the Crane Prairie and Wickiup reservoirs is likely to be maintained in its current degraded condition because water levels are unstable within wetland habitats during the breeding and rearing periods, leaving egg masses and rearing tadpoles at risk of desiccation and adult spotted frogs without leave without cover from predators such as cranes, herons, raccoons, minks, snakes and other natural predators. The DBHCP is likely to result in lower winter water levels and overwintering habitats coincide with predatory brown trout in the Deschutes River.

4.4.2.1.3 Effects of the DBHCP on the Recovery Support Function of Spotted Frog Critical Habitat Unit 9

In the Little Deschutes River subbasin, the storage and release operations at Crescent Lake reservoir influence an area that includes a total of 5,363 ac (2,171 ha) of critical habitat within CHU 9. The affected critical habitat consists of 2,306 ac (933 ha) of freshwater emergent wetland, 2,790 ac (1,129 ha) of freshwater forested/shrub wetland, 13 ac (5 ha) of freshwater pond, 88 ac (36 ha) of wetlands not overlapping with NWI-classified wetlands, and 166 ac (67 ha) of riverine habitat. These critical habitat acreages will continue to be affected by the DBHCP.

The critical habitat affected by the DBHCP largely consists of wetlands associated with low-gradient meandering reaches of the Little Deschutes River and Crescent Creek which interact

extensively with their floodplains. As described in the *Environmental Baseline*, the Crescent Creek and the Little Deschutes River receive unregulated (natural) hydrological inputs from Big Marsh Creek and the upper Little Deschutes basin above the confluence with Crescent Creek, respectively. For that reason, irrigation water storage and release from Crescent Dam has less of an effect on CHU 9 than CHU 8, as described above.

The most notable affect to critical habitat occurs at the onset of the irrigation storage season in the early fall when flows in Crescent Creek and the Little Deschutes River drop and the area of inundation within wetland habitat shrinks. The effect to OSF critical habitat as a result of irrigation storage will continue for the term of the DBHCP permit (30 years).

As described above, conservation measure CC-1 will dedicate a portion of the storage in Crescent Lake Reservoir each year for Oregon spotted frog habitat management (hereinafter referred to as “OSF storage”). The OSF storage will be released after coordination with USFWS to increase flows in Crescent Creek and the Little Deschutes River below the confluence with Crescent Creek at times when flows would otherwise be insufficient to support Oregon spotted frog habitats. We do not have baseline monitoring that calibrates surface water elevations that influence function of PCEs within critical habitat within this area. Monitoring and adaptive management for conservation measure CC-1, described in the DBHCP (Section 7.2.5), will determine how best to utilize the OSF storage to improve the function of critical habitat over the duration of the DBHCP permit.

The volume of OSF storage will increase incrementally over time (Table x). However, it is not possible to distinguish the incremental improvements to critical habitat that are expected within each time step of increases to the OSF storage. Monitoring and adaptive management will inform the effectiveness and implementation of conservation measure CC-1 over time.

The condition of critical habitat is degraded within CHU 9 by reed canarygrass and bullfrog infestations. Riverbanks are eroded from irrigation operations and grazing. Conservation measure UD-1 provides funding for habitat restoration work within critical habitat within CHU 9. Threat management (e.g., reed canarygrass treatment or bullfrog removal) also will be funded through conservation measure UD-1. These actions are likely to improve the function of OSF critical habitat within CHU 9.

PCE 1 – Spotted Frog Nonbreeding, Breeding, Rearing, and Overwintering Habitat

The DBHCP is likely to improve the condition of spotted frog nonbreeding, breeding, rearing, and overwintering habitat in CHU 9 for the following reasons. The DBHCP conservation measures CC-1 and UD-1 are intended to improve the hydrological function of critical habitat through water management adjustments and habitat restoration, respectively.

As described above, OSF storage may be used to increase flows in Crescent Creek and the Little Deschutes River at times when flows may not be sufficient to support breeding, rearing or overwintering. Habitat monitoring will determine how best to use the OSF storage to support the function of PCE 1.

Adverse effects to the function of critical habitat may vary seasonally from year to year due as weather and precipitation patterns determine the timing of irrigation releases from Crescent Lake dam. Therefore, the OSF storage may be used to inundate spring breeding, summer rearing and fall nonbreeding habitats when irrigation water does not sufficiently inundate critical habitat and there is reduced function to PCE1. In many years, winter flow releases of the OSF storage will be used to support overwintering habitat within critical habitat.

PCE 2 – Spotted Frog Aquatic Movement Corridors

The DBHCP is likely to maintain or improve the function aquatic movement corridors (PCE 2) in CHU 9, as a whole. The OSF storage may be used to temper the drops in flow that occur during the onset of the irrigation storage season. Implementation of the conservation measures that provide an increase in flows from Crescent Dam in the fall are likely to slightly improve wetland conditions that will facilitate spotted frog movement to overwintering habitat within a portion of CHU 9.

PCE 3 – Spotted Frog Refugia Habitat

Currently, spotted frog refugia habitat is reduced at the onset of the irrigation storage season and through winter when water levels within wetlands and the river are reduced. Predatory fish and bullfrogs may be concentrated into the remaining habitats where OSF choose to winter. The DBHCP is likely to improve the condition of refugia habitat in CHU 9 by increasing winter flows that increase the amount of overwintering habitat within critical habitat. Conservation measure UD-1 will provide funding for projects and actions that increase habitat and reduce predators within critical habitat.

4.4.2.2 Effects of the RO&M and SEED Programs for the Deschutes Project on Critical Habitat PCEs

4.4.2.2.1 Effects of the RO&M and SEED Programs on Spotted Frog Critical Habitat Subunit 8A

The effects analysis, above, that described the anticipated effects from implementation of the RO&M and SEED programs, overlaps with the effects to critical habitat described below since nearly all of the habitat where spotted frogs occur is within designated critical habitat. Approximately 98 percent of critical habitat within subunit 8A and 70 percent of critical habitat within subunit 8B is within the area affected by the Deschutes Project. None of the critical habitat within Unit 9 is affected by implementation of the RO&M and SEED programs, because Reclamation does not own Crescent Lake Dam and is not responsible for maintaining that facility.

At Wickiup Dam, these actions will occur during the first seven years of the DBHCP implementation when winter flows are at 100 cfs at the WICO gauge. These activities which disrupt flow from the dams in the fall are likely to temporarily result in an adverse effect to designated critical habitat for Oregon spotted frog. The majority of critical habitat within subunit 8A (approximately 1,960 acres) is periodically affected for a short duration by activities under

the RO&M and SEED programs. Anticipated effects to the PCEs of spotted frog critical habitat are discussed below.

PCE 1 – Spotted Frog Nonbreeding, Breeding, Rearing, and Overwintering Habitat

For the reasons discussed below, implementation of the RO&M and SEED programs is likely to temporarily affect overwintering habitat in Subunit 8A.

Activities implemented at Wickiup Dam will have a short-term effect on flows in the Deschutes River between Wickiup Dam and the Colorado Street Bridge. All of the activities that will occur at Wickiup Dam will be implemented between mid-October and November during the first seven years of the DBHCP when winter flows at the WICO gauge will be 100 cfs. Therefore, overwintering habitat is the only component of PCE 1 that will be affected. Each of the RO&M and SEED activities that occur once every 6 to 8 years will maintain releases between 25 and 40 cfs from Wickiup Dam and extend from 8 hours to 3 days.

The activities associated with the RO&M and SEED programs are likely to result in short-term reduced flows in the Deschutes River during their implementation. These activities that result in decreased releases from Wickiup for a period of 8 hours to 3 days every 6 to 8 years are likely to dewater the edge of the channel during that period. Overwintering habitat within adjacent wetlands will not be affected by the reduction of flows from 100 to 25 cfs, because the wetlands are already disconnected from the river at 100 cfs.

The Fall River, Spring River, and the Little Deschutes River contribute a significant amount of additional water, progressively lessening the magnitude of effect as you move downstream. Nonetheless, the activities associated with the RO&M and SEED programs are likely to dewater the edge of the Deschutes River channel to some degree during their implementation all the way to the Colorado Street Bridge.

PCE 2 – Spotted Frog Aquatic Movement Corridors

Implementation of the RO&M and SEED programs will have a slight effect on PCE 2 during the period frogs are moving into overwintering habitat by dewatering the edge of the channel for a period of 8 hours to 3 days every 6 to 8 years. The distance to access overwintering habitat within the Deschutes River is likely to increase up to several feet during these periods. The remainder of the year, the RO&M and SEED programs will have no effect on PCE 2 in subunit 8A.

PCE 3 – Spotted Frog Refugia Habitat

Implementation of the RO&M and SEED programs will have a slight effect on PCE 3 during the period frogs are moving into overwintering habitat by dewatering the edge of the channel for a period of 8 hours to 3 days every 6 to 8 years. The distance to access overwintering habitat that might also function as refugia habitat within the Deschutes River is likely to increase up to several feet. Also, the short-term decrease in flows is likely to result in a slight increase in the concentration of predacious fish within the Deschutes River. The remainder of the year, the RO&M and SEED programs will have no effect on PCE 3.

4.4.2.2.2 Effects of the RO&M and SEED Programs on Spotted Frog Critical Habitat Subunit 8B

The area affected by implementation of the RO&M and SEED programs encompasses Crane Prairie and the Deschutes River and associated wetlands between the reservoir nested within the 15,365 acres (6,218 ha) of critical habitat within subunit 8B. Anticipated effects to the PCEs of spotted frog critical habitat are discussed below.

PCE 1 – Spotted Frog Nonbreeding, Breeding, Rearing, and Overwintering Habitat

For the reasons discussed below, implementation of the RO&M and SEED programs is likely to result in a short-term adverse effects to rearing and overwintering habitat in Subunit 8B. The activities associated with the RO&M and SEED programs are likely to result in short-term adverse effects to the Deschutes River between Crane Prairie Dam and Wickiup Reservoir during their implementation. These activities are likely to affect designated critical habitat by reducing flows in the Deschutes River between Crane Prairie Dam and Wickiup Reservoir for seven to 10 hours (includes 2 hours to ramp up and 2 hours to ramp down) during the months of October, for 10 hours (includes ramping times) sometime during the August to October period, and for up to six days during October for the stilling basin maintenance/repair. In addition, the gate full-open, full-close test in August will result in an increase in flows for approximately five minutes.

Due to the short-term nature of the activities associated with the RO&M and SEED programs the effects within Crane Prairie Reservoir will be minor. The only effect to the habitat within Crane Prairie from completely shutting down releases from the reservoir for seven to ten hours is that the level of the reservoir will increase at a slightly greater rate during that period because inflows will continue, but releases will be shut down. In addition, the short duration of 5 minutes for the gate full-open/full-close examination is likely to have minimal effect on the water level within the reservoir. It is unlikely that the effect on the water level in the reservoir will even be observable given the volume of water in the reservoir and wave action along the shoreline of the lake.

Most of the activities associated with these programs will occur between August and October, so the effects will primarily be to rearing and overwintering habitat downstream from Crane Prairie Dam. Complete shutdown of releases from Crane Prairie for a period of 10 hours up to 6 days is likely to dewater significant portions of the Deschutes River channel between Crane Prairie Dam and Wickiup Reservoir during that period.

PCE 2 – Spotted Frog Aquatic Movement Corridors

Implementation of the RO&M and SEED programs, as described above, also will have short-term adverse effects to PCE 2 within subunit 8B by affecting the Deschutes River between Crane Prairie Dam and Wickiup Reservoir. During the period of time when actions are implemented, there will be a short-term affect to spotted frog aquatic movement corridors.

PCE 3 – Spotted Frog Refugia Habitat

Implementation of the RO&M and SEED programs also will effect PCE 3 within subunit 8B during the period frogs are moving into overwintering habitat by dewatering the edge of the channel of the Deschutes River between Crane Prairie Dam and Wickiup Reservoir. We anticipate Reclamation's action to temporarily reduce refugia habitat within critical habitat in the Deschutes River between the reservoirs.

4.4.2.2.3 Effects of RO&M and SEED Programs on Spotted Frog Critical Habitat Unit 9

Crescent Lake Dam is owned by the irrigation districts, so the RO&M and SEED programs will not be implemented in the Little Deschutes River subbasin. Therefore, these programs will have no effect on designated critical habitat in Unit 9.

4.5 CUMULATIVE EFFECTS

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they will require separate consultation pursuant to section 7 of the Act.

The portions of the action area that influence the subbasins where OSF occur are influenced by activities on State, county, Federal, and private lands, resulting in a wide variety of actions which may affect OSF, OSF critical habitat and/or OSF habitat. While the activities occurring on Federal lands (BLM and USFS) are tied to Federal land management plans that have already undergone Section 7 consultation, and therefore are not considered a Cumulative Effect by the definition above, there are rarely regulated divisions or boundaries between the activities throughout these river stretches that lend themselves to parsing out the Federal from the non-Federal actions. Except for activities that are only allowed on Federal lands, these Cumulative Effects may include the effects from activities that originate or cross over Federal lands, or otherwise involve an unknown Federal nexus. By being more inclusive we are taking a conservative approach and erring on the side of the covered species.

The activities we believe are reasonably certain to occur within the action area outside of those actions covered in the DBHCP largely include long-standing grazing, ditching, irrigation ponds that contain bullfrogs, and recreational activities, such as fishing, camping, hiking, biking and boating that may disturb OSF. While all of these actions have the potential to impact OSF, these effects are expected to be relatively minor to OSF in the action area given the localized nature of these activities, and the relatively large size of the rivers where OSF reside.

Effects from non-Federal grazing activities along Crescent Creek and the Little Deschutes River have been ongoing for many decades, and now constitute part of the basin's baseline. Grazing

cows generate significant amounts of solid and liquid wastes which seep into the ground, some proportion of which will enter the rivers and streams. These nutrient contributions can impact the water quality (which is largely a function of the proportion of the effluent to the flow within the channels) and may contribute to algal growth downstream. Nutrients and algae can effect OSF in a variety of ways, but we don't expect these effects to be any different than the baseline conditions that currently exist and where OSF are able to carry out their normal behavioral and life cycle functions. Grazing cows are effective at reducing reed canary grass and maintaining openings within emergent, which significantly improves many areas where OSF breed within the action area.

All of these reasonably foreseeable Cumulative Effects, however, are on-going activities that have contributed to the baseline condition for years or decades. We do not foresee any particular increase in these activities and are not aware of planned activities that would have impacts beyond what currently exists within the action area. Therefore, we do not anticipate a worsening of habitat conditions, a worsening of impacts to individual OSF, or a worsening of the effects to the PBFs of OSF critical habitat as a result of Cumulative Effects.

4.6 SUMMARY AND SYNTHESIS

The current baseline condition for the spotted frog and designated critical habitat in the Action Area is highly degraded. Implementation of the proposed action over the next 30 years is not likely to further degrade that condition and is likely to improve baseline conditions for several reasons: (1) improvements to spotted frog habitat at Crane Prairie Reservoir are likely to increase survival of all life stages of spotted frogs over the term of the proposed action within the Upper Deschutes River subbasin; (2) flows in the Deschutes River downstream of Wickiup Dam will be timed to inundate wetland habitats concurrent with breeding and early and late-season movement periods in the spring and fall; (3) increased winter flows in the Deschutes River over time are likely to support overwintering conditions for spotted frogs and facilitate movement between seasonal habitats; (4) adaptively managed flows from Crescent Lake in the Little Deschutes River subbasin are likely to increase spotted frog survival within critical habitat along Crescent Creek by extending the period of time in which spotted frog habitat is inundated; and (5) the Upper Deschutes Conservation Fund will be used to address site specific threats to spotted frog and implement restoration actions that improve survival throughout the Upper and Little Deschutes River subbasins.

The effects of the action on the spotted frog and its critical habitat vary geographically within the Action Area. Depending on where water is stored or delivered and the timing of these operations in the context of the Oregon spotted frog life cycle (i.e., breeding, rearing, pre-overwintering movement period, and overwintering), spotted frog habitat may be either improved or degraded. In some areas of the Action Area, the proposed action may improve habitat conditions in one area while degrading habitat in another area. For example, conservation measures that improve OSF habitat within Crane Prairie Reservoir and the Deschutes River downstream of Wickiup Dam are likely to render Wickiup Reservoir less suitable in the future. In the long-term implementation of the DBHCP, we anticipate improvements to all habitats for spotted frog as water is timed to coincide with the species life cycle and the Upper Deschutes Conservation

Fund is used strategically to provide support to key populations and improve the function of habitat on which the Oregon spotted frog depends.

Over the broad Action Area, Table 42, below, identifies the locations where the DBHCP is likely to improve or slightly improve habitat conditions for the spotted frog, or maintain degraded or further degrade habitat conditions as described in the *Environmental Baseline* section above. A summary of the anticipated effects to spotted frogs and designated critical habitat from implementation of the DBHCP are described below for each subbasin

Table 42. Effects of the DBHCP over time on the Oregon spotted frog and its habitat, by location, compared to baseline conditions.

Upper Deschutes River Subbasin				
	Years 1- 7	Years 8 - 12	Years 13 - 30	Acres
Above Wickiup Dam				
Crane Prairie Reservoir	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	583 acres of emergent wetlands and 4,238 acres of open water habitat
Crane Prairie Dam to Wickiup	Likely to Maintain Degraded Baseline Conditions	Likely to Maintain Degraded Baseline Conditions	Likely to Maintain Degraded Baseline Conditions	2,961 wetland acres
Wickiup Reservoir	Likely to Maintain Degraded Baseline Conditions	Likely to Maintain Degraded Baseline Conditions	Likely to Increase Degraded Baseline Conditions	
Deschutes River Reaches Below Wickiup Dam				
1: Wickiup Dam to Fall River 2: Fall River to Little Deschutes	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	633 acres of wetlands
3: Little Deschutes to Benham Falls	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	~286 wetland acres and 200 river acres
4: Benham to Dillon Falls	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	198 wetland acres and 61 river acres
5: Dillon Falls to Lava Island Falls	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	95 wetland acres and 67 river acres
Reach 6: Lava Island Falls to COID diversion	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	7 wetland acres and 49 river acres

Reach 7: COID Diversion to Colorado Street Bridge	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	8 wetland acres and 64 river acres	
Deschutes River channel	Likely to Maintain Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	988 acres of river channel along 59 river miles	
Little Deschutes River Subbasin					
	Years 1- 10	Years 11-15	Years 16-20	Years 21-30	Acres
Crescent Creek	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	Likely to Improve Baseline Conditions	1,182 acres of wetlands and 48 acres of open water
Little Deschutes River below confluence with Crescent Creek	Likely to Maintain Degraded Baseline Conditions	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	Likely to Maintain or Slightly Improve Degraded Baseline Conditions	3,322 acres of wetlands and 118 acres of open water

4.6.1 Upper Deschutes River Subbasin

Crane Prairie Reservoir

Baseline Condition

Irrigation water operations at Crane Prairie reservoir prior to 2017 adversely impacted Oregon spotted frog associated with 583 acres of emergent wetlands and 4,238 acres of open water habitat. The timing and volume of storage and release operations resulted in water elevation levels within the reservoir and perimeter wetlands that did not support life stages of the Oregon spotted frog, resulting in population suppression.

Prior to 2017, reservoir storage exceeded 50k acre feet resulting in OSF egg mass deposition within upland habitats outside of suitable emergent wetland vegetation. Irrigation releases from the reservoir often occurred during the OSF rearing period (late April through July) and prior to OSF metamorphosis, which dewatered OSF breeding and rearing habitat within the 583 acres of wetlands surrounding the reservoir. As the reservoir draw down occurred tadpole, juvenile, sub-adult and adult life stages of OSF were stranded and without cover, resulting in losses to the population by desiccation or predation. The large change in storage volume and water elevation within the reservoir resulted in longer OSF travel distances between seasonal habitats (winter to breeding and late summer to winter), increasing exposure to predation and energy expenditure for frogs.

At the onset of the storage season in early October, reservoir volumes could be drawn down completely, leaving little habitat for OSF overwintering. The lower the winter water levels concentrated invasive fish predators such as the brown bullhead, resulting in a reduced breeding population at the beginning of each spring.

Under water management prior to the 2017, the population numbers in the reservoir were low and showed fluctuations that could result in local site extirpations; the sort of concerns that lead to a species being listed.

Effects of the minimization and mitigation Measures at Crane Prairie Reservoir

As a result of the agreements in the HCP, water management at Crane Prairie has been and will continue to be modified to provide for Oregon spotted frog reproductive needs for the entirety of the breeding season, and the drawdown during the irrigation season will occur in July after the majority of tadpoles have metamorphosed into juvenile frogs. The reservoir will be drawn down at a rate of 0.05 feet/day which will be slow enough that young frogs will be able to move with the water towards wintering areas in the reservoir pool. The adjustment in the timing and rate of drawdown is expected to prevent stranding and reduce predation of spotted frogs. Furthermore, the reservoir pool at the onset of the storage season will be higher than under past operations, providing an increased area for overwintering spotted frogs and more habitat to evade predatory fish that reside in the reservoir.

DBHCP conservation measures for OSF have been implemented at Crane Prairie Reservoir since 2017. Oregon spotted frog monitoring results indicate that the conservation measures have been successful thus far in boosting the population.

In addition to conservation measure CP-1, the DBHCP makes available funding for habitat management through the Upper Deschutes Conservation Fund (UD-1). This fund will be used to treat invasive reed canarygrass and reduce invasive and predatory fish within the reservoir.

The Service anticipates a substantial increase in the following Oregon spotted frog parameters as a result of these changes in management:

- Increased Oregon spotted frog reproduction within the 583 acres of wetlands.
- Increased reproductive success within the 583 acres of wetlands.
- Decreased predation of adult frogs, tadpoles and juvenile frogs within the 583 acres of wetlands.
- Increased survival of tadpoles and juvenile frogs within the 583 acres of wetlands as they transition to wintering areas.
- Increased survival during the overwintering period with an increase in the residual reservoir pool.
- Increased survival of all life stages as invasive predatory fish are reduced through active management.
- Enhanced breeding and rearing habitats as reed canarygrass is treated and in some areas eliminated before it spreads.

These improvements are expected to be realized within the first season of implementation of the HCP, which is expected to result in a robust increase in the Oregon spotted frog population within the Crane Prairie reservoir footprint. This increased population will result in numerous beneficial effects to the species.

First, more Oregon spotted frog are expected to survive overwintering in the reservoir where predation by non-native fishes is an existing threat, thereby bolstering the number of reproducing Oregon spotted frog each subsequent year. Increased population parameters within the reservoir provide resiliency for when maintenance drawdowns are conducted in the reservoir which we expect to result in more Oregon spotted frogs surviving into each subsequent breeding season.

Secondly, these improved population metrics provide a source population for other sub-populations downstream of Crane Prairie Reservoir, such as the Deschutes River. Having a robust source population provides a backstop for unforeseen events in those other populations, and redundancy for populations throughout the system.

The benefits to OSF and critical habitat anticipated through implementation of DBHCP conservation measures at Crane Prairie Reservoir (CP-1 and UD-1) are expected to be realized in the first year of the DBHCP and will continue through the 30-year DBHCP permit term.

Deschutes River and Wetlands between the Reservoirs

Baseline Condition

Oregon spotted frog use of the Deschutes River from Crane Prairie Dam to Wickiup Reservoir is limited to one monitored location where the Deschutes River meets Wickiup Reservoir at full pool. The breeding site used by spotted frogs in this area typically does not remain inundated long enough for spotted frogs to metamorphose. The site is hydrologically influenced by Wickiup Reservoir storage volumes and less so by outflows from Crane Prairie reservoir. As Wickiup Reservoir is drawn down in the spring to release irrigation water to the Deschutes River downstream of Wickiup Dam, the inundated floodplain where spotted frogs breed is dewatered. Hydrological monitoring has determined that the dewatering of the breeding site occurs when Wickiup Reservoir storage drops below 142,000 acre feet. In 2019, Wickiup storage volumes were between 134,000 and 135,000 acre feet and the known breeding was void of water. Surveys during that time detected breeding in an area near to the known breeding site but closer to the Deschutes River channel.

Effects of the minimization and mitigation Measures within the DBHCP

There are no minimization measures within the DBHCP for OSF within the 1-mile reach of the Deschutes River between Crane Prairie and Wickiup Reservoirs. Within the DBHCP, conservation measures that maintain water levels within Crane Prairie reservoir and increase winter flows in the Deschutes River downstream of Wickiup Dam may have adverse downstream consequences to spotted frogs in the Deschutes River between the reservoirs. We anticipate that the known OSF breeding location will become less suitable for frogs over time since Wickiup Reservoir storage volumes and water elevations are predicted to be lower in the later years of the DBHCP than under current operations and the first seven years of the DBHCP.

However, the flow and storage changes will not necessarily eliminate habitat for spotted frogs along this reach of the river. Based on observations in 2019 when breeding was detected closer to the river channel, we anticipate that there may be a shift in habitat utilization depending on how suitable other wetland habitats along the river are during the implementation of the DBHCP.

Wickiup Reservoir

Baseline Condition

There are approximately 2,961 acres of wetlands where Oregon spotted frog reproduction could potentially occur within the 10,231 acres of Wickiup Reservoir that extend into the floodplain of the Deschutes River between Crane Prairie and Wickiup reservoirs, as described above. These wetlands are dewatered as the reservoir is drawn down from maximum storage volumes of 200,000 acre-feet during the irrigation season, and do not provide year-round suitable habitat for spotted frogs. As the water recedes from these wetlands, spotted frogs are without cover from terrestrial and avian predators and are at an increased risk of predation. Spotted frogs that overwinter within the reservoirs are concentrated into the residual pool of the reservoir with an abundance of predatory fish and no refugia habitat to escape predatory fish.

Given the expansive size of Wickiup Reservoir, OSF surveys have been less robust than in other wetland and riverine habitats within the area affected by the HCP. Recent efforts to survey the reservoir have not detected OSF since 2012. As noted in the *Environmental Baseline* and *Effects* sections, the Service recognizes there is some level of spotted frog reproduction in Wickiup Reservoir and the reservoir functions for connectivity between OSF populations that may occur within the margins of the reservoir or for populations migrating downstream from Crane Prairie reservoir. It is possible Wickiup Reservoir acts as a population sink from upstream frogs, but that is an unknown at this point. Based on the limited survey data showing spotted frogs in the reservoir, the Service assumes there is some successful reproduction, rearing and overwintering supported in this area.

The operation of Wickiup Reservoir for downstream irrigation results in hydrologic regime that may only infrequently sustain OSF through the entire life cycle, resulting in an Oregon spotted frog population that is likely small compared to its potential. The extent to which Wickiup Reservoir spotted frogs contribute to adjacent reaches is unknown, but is expected to be low and inconsequential from a demographic standpoint. We have no reason to believe this part of the population has been more of a contributor to the overall Oregon spotted frog demography in the past.

Effects of the minimization and mitigation Measures within the HCP

Implementation of the DBHCP will maintain the degraded spotted frog habitat condition in Wickiup Reservoir during Phase 1 (Years 1-7) and will further degrade habitat function for OSF in Phases 2 (Years 8-12) and 3 (Years 13-30) of the permit. Conservation measure WR-1, designed to improve the suitability and function of OSF habitat along the Deschutes River downstream from Wickiup Dam results in a decline in reservoir storage volumes during the later

phases of the DBHCP. Therefore, it is anticipated that the DBHCP will further degrade existing habitat conditions for spotted frog and designated critical habitat within Wickiup Reservoir.

While the proposed action will alter the Wickiup Reservoir storage volumes and water surface elevations over time, no significant change is expected in Phase 1, as shown in Figure x in the effect analysis above. The effect of the take that will occur during the first 7 years of DBHCP implementation is the same as the effects of the existing Wickiup Reservoir water management regime. We expect there to continue to be a small but persistent Oregon spotted frog population in Wickiup Reservoir, with numbers kept low by water management, predatory invasive species, and the interaction of those two.

In Phases 2 (years 8-12) and 3 (years 13-30), RiverWare modeling predicted that reservoir storage volumes are likely to drop considerably due to the increased winter flows in the Deschutes River downstream of Wickiup Dam. The lower winter storage volumes within the reservoir result in less OSF overwintering habitat. Spotted frogs that overwinter within the reservoirs will continue to be preyed upon as they are concentrated into progressively smaller residual pools of the reservoir with an abundance of predatory fish and no refugia habitat for protection against predatory fish.

Deschutes River below Wickiup Dam

Baseline Condition

There are approximately 1,227 acres of wetlands and 988 acres of riverine channel habitat along 59 miles of the Deschutes River that are adversely affected by irrigation storage and release operations at Wickiup Reservoir. Within these affected acres, there are approximately 1,960 acres of designated OSF critical habitat. Of these acres, OSF utilize only 19 percent (~229 acres) of the wetland acreage between Wickiup Dam and Bend, OR to fulfill life cycle requirements (i.e., breed, rear, overwinter). OSF populations are sparsely distributed along the Deschutes River as a result of ongoing water operations and connectivity between populations is limited between Wickiup Dam and Bend, OR.

Irrigation water management of Wickiup Reservoir effects the Deschutes River flows that influence hydrology within riverine sloughs and floodplain wetlands inhabited by OSF. The timing and volume of water released and stored at the dam for irrigation has disrupted the OSF life cycle in the following ways: (1) the irrigation seasonal delivery of water often occurs in mid to late April, resulting in little water within floodplain and slough wetland habitats where OSF breed, limiting the amount of available breeding habitat and restricting movement via aquatic corridors from winter to spring breeding locations; (2) rapid rise and drop in flow and water levels in wetlands during the breeding and rearing period have caused flushing and stranding of eggs and tadpoles; (3) high irrigation flows during the summer inundate a vast area within floodplain wetlands that can function as a sink for OSF as these areas are left void of water as the irrigation storage season commences in the fall; 4) at the onset of the irrigation season in the fall, rapid drops in flow and water elevations within wetlands result in stranding of juvenile, sub-adult and adults OSF during the movement period to winter areas. At this time frogs are left exposed without the cover of water and vegetation and fall prey to raccoons, herons and other

opportunistic predators; (5) the irrigation storage season vastly reduces the acreage of inundated wetland and riverine habitat available to OSF for wintering; and (6) the annual reduction of habitat in the fall and through winter prevents juvenile OSF from dispersing to sites that would facilitate OSF population expansion and limits connectivity between populations along the Deschutes River.

Winter flows in the Deschutes River of 100 cfs at the WICO gauge are confined to the river channel. OSF that choose to winter in the wetted river channel are subject to predation by non-native fish such as brown trout. These winter flows leave the footprint of the river channel and associated sloughs void of water, resulting in exposed mudflats that freeze and thaw and scour when spring flows are increased for irrigation. The annual storage and release of water from Wickiup Dam over the past 70 years has resulted in an oversized river channel and continued degradation of the riverine channel and sloughs. In the river's current condition, larger than historical volumes of water are needed to inundate the floodplain wetlands inhabited by OSF. High summer irrigation flows inundate the floodplain wetlands with larger volumes than necessary to maintain hydrological function to support the OSF life cycle and sustain habitat elements such as emergent vegetation.

Effects of the minimization and mitigation measures WR-1 and UD-1

Conservation measure WR-1 (Table WR-1. DBHCP) adjusts the timing and volume of flow releases to the Deschutes River to improve habitat conditions and support seasonal life stages of the Oregon spotted frog. This conservation measure will be implemented in phases over time that will gradually and substantially improve OSF habitat function. Conservation measure WR-1 requires the following annual adjustments to water operation that will minimize ongoing impacts to OSF life stages each year for the life of the DBHCP permit.

1. Increased spring flows by April 1 to support breeding in wetlands associated with the Deschutes river channel;
2. Reduced fluctuation of flows in the spring to prevent flushing and stranding eggs and tadpoles during the breeding and rearing periods, respectively; and
3. Adjustments in the timing and duration of seasonal ramp ups and downs that allow for frog movement in order to reduce stranding during migration periods.

Conservation Measure WR-1 results in increased winter flows of 300 cfs at the WICO gauge by year 8 (Phase 2) and increased winter flows of 400-500 cfs by year 13 (Phase 3) of the DBHCP implementation. During Phases 2 and 3 of implementation, summer flows in the Deschutes River will be reduced to approximately 1,400 cfs and 1,200 cfs at the WICO gauge, respectively.

The Upper Deschutes Conservation Fund (UD-1) provides a funding source for active management of OSF habitat (vegetation encroachment) and threats (e.g., bullfrogs and reed canarygrass) that influence the survival and recovery of OSF (see Appendix D). The timing and location of project implementation to improve conditions for OSF will be determined by the Service and tier to the OSF Recovery Plan (expected in 2022) and specifically the Recovery Implementation Strategy for the Upper Deschutes River subbasin.

Phase 1 (Years 1- 7) – Deschutes River winter flows of 100 cfs at the WICO gauge

During the first phase of the DBHCP, Deschutes River winter flows will remain at 100 cfs. Therefore, we do not anticipate an increase in the amount of habitat that is available year-round to OSF. Winter habitat for OSF along the Deschutes River will remain limited through the first seven years of DBHCP implementation. During phase 1, we anticipate benefits to OSF mainly through the annual spring and fall seasonal changes to water operations, described above, and through conservation projects that are funded by conservation measure UD-1 of the DBHCP.

Site-specific management of OSF habitat and threats is essential to OSF conservation as the few OSF populations that occur along the Deschutes River are suppressed not only by water management but by habitat succession and encroachment of vegetation and non-native predators such as bullfrogs.

Phases 2 (Years 8 – 12) Deschutes River winter flows of 300 cfs at the WICO gauge

During Phase 2 (years 8-12) of DBHCP implementation, winter flow in the Deschutes River at the WICO gauge will be increased to 300 cfs and the summer maximum flow will be 1,400 cfs.

Increasing winter flows to 300 cfs in the Deschutes River will inundate some of the wetland sloughs within the river channel where OSF occur in small numbers. Increased winter flows are likely to facilitate OSF survival through the winter period. Increasing the wetted area of the riverine channel will provide more areas for OSF to overwinter and escape predatory fish such as brown trout that reside in the river. The continuous wetting of the channel through the winter period is likely to encourage use by riverine mammals such as beaver and muskrats that provide denning habitat and overwintering microsite features for OSF. Higher winter water levels within the Deschutes River will shorten the distance that OSF must travel to spring breeding sites, thereby lessening the energy expenditure for OSF and minimizing the predation risk to OSF.

Given that much of the impact to OSF occurs at the onset of the storage season and through winter, the combined effect of a gradual fall ramp down and more wetted area due to increased winter flows is likely to improve the survival of juvenile, sub-adult and adult spotted frogs during the fall migration period to winter habitat. During this period of time, frogs will have wetted corridors and shorter distances to travel to overwintering areas, thereby reducing exposure to predators.

The loss of inundated wetland habitats for juvenile spotted frogs to disperse into during the irrigation storage season has limited population distribution and connectivity along the Deschutes River. We expect increasing winter flows in the river combined with a staged ramp down in the fall, to allow and facilitate juvenile and adult frog movements into a greater amount of winter habitat.

Winter flows of 300 cfs in the Deschutes River are mostly confined to the riverine channel and do not inundate the roots systems of sedge vegetation that are exposed to freeze and thaw through winter, leaving the banks of the river vulnerable to scouring at the onset of the irrigation season when flows in the river rise. However, the lower maximum summer flow of 1,400 cfs is likely to lessen the scouring of riverbanks and reduce water elevations within wetland sloughs

which has inhibited the growth of emergent wetland vegetation, a key feature of quality OSF habitat. In the long-term, we anticipate that lower summer flows will result in emergent vegetation moving outward into unvegetated areas of slough habitats, providing cover for all life stages of OSF.

Reducing high summer flows also is likely to reduce the risk of stranding OSF that utilize wetland fringe habitats that are long distances from the Deschutes River and other floodplain areas that retain water through the irrigation storage season. Lower summer flows and higher winter flows are likely to result in less area inundated over time and shorter distances for frogs to travel seasonal migrations in the spring and fall.

Overall, increased winter flows during Phase 2 are likely to provide better habitat connectivity between summer and over-wintering habitats, ensuring more OSF will survive the movement period and migrate successfully into their overwintering habitats. Increasing survival for OSF entering the overwintering period increases the likelihood that more OSF adults will successfully overwinter and be part of the breeding population each spring.

Increased numbers of adults entering the breeding period is likely to yield a higher number of egg masses each year, thus enhancing the population. Another benefit of increasing winter flows is that more habitat will be available to adult, sub-adult, and juvenile frogs year round, thereby reducing predation pressures and increasing winter survival. Inclusion of the summer cap on maximum flows (with flexibility for some exceedances) will prevent further degradation of the river channel due to sustained erosive forces and also allow wetland vegetation to grow, thus providing suitable OSF habitats closer to the river channel.

Expenditures from the Upper Deschutes Conservation Fund during Phase 2 will (1) continue invasive species removal; (2) initiate habitat improvement projects, including wetland riparian vegetation planting; (3) initiate treatment of encroaching vegetation (cattails, lodgepole, etc.) to maintain suitable open-water OSF habitats; and (4) implement site-specific habitat projects that improve the hydrological function within riverine sloughs and floodplain wetlands. Site-specific installation of habitat features (such as beaver dam analogs) retain water and increase the duration of habitat inundation, which allows OSF to complete their life cycle in water, move between seasonal habits, and evade predators. As maximum summer flow levels in the Deschutes River decrease, water depths in wetland sloughs will decrease, providing an opportunity to strategically enhance OSF breeding habitat with wetland vegetation plantings. Additional wetland vegetation provides cover for young tadpoles, reducing predation.

Increased winter flows in Phase 2 reduces the area within the river channel and associated slough habitat that is dewatered each year, thus improving OSF survival through the critical overwintering period. In Phase 2, we anticipate increased survival of all life stages of Oregon spotted frog through (1) improved connectivity between seasonal habitats; (2) enhanced function of wetland habitats through restoration projects; (3) reduction of invasive predators, such as bullfrogs; and (4) reduction of the impact of invasive fish, such as brown trout.

Phase 3 (Years 13-30) – Deschutes River winter flows at 400 – 500 cfs

During Phase 3 (years 13 -30) of the DBHCP implementation, winter flow in the Deschutes River at the WICO gauge will be increased to 400 cfs and up to 500 cfs at times and summer flows will be capped at 1,200 cfs. Phase 3 of the DBHCP beginning in year 13, is the longest phase of the DBHCP and is likely to maximize the benefits to OSF and critical habitat along the Deschutes River between Wickiup Dam and Bend, OR for the reasons described above for Phase 2 and below.

At winter flows of 400 to 500 cfs, we anticipate increased OSF survival through the winter period as more wetted area of the riverine channel and associated sloughs allows OSF to escape predatory fish such as brown trout that reside in the river. We also anticipate the establishment of new OSF populations within sloughs along the river as more OSF survive through winter. The continuous wetting of the channel through the winter period is likely to increase beaver and muskrat activity within the river and sloughs, enhancing the overwintering microsite features such as dens for OSF to winter in. Higher winter water levels within the Deschutes River at flows of 400 to 500 cfs will inundate greater areas within riverine sloughs that are connected to the river, further shortening the distance that OSF must travel to spring breeding sites from their overwintering habitats, thereby lessening the energy expenditure for OSF and minimizing the predation risk to OSF.

In many areas along the Deschutes River, studies have shown that winter flows of 500 cfs are necessary to inundate the riparian sedge roots systems, described above. Winter flows of 500 cfs are “near natural” or what may have occurred through winter prior to Wickiup Dam construction. As winter flows increase to 400 and 500 cfs in Phase 3 of DBHCP implementation, we anticipate some improvement riparian vegetation along the river and within the sloughs. However, due to the enlarged river channel that has resulted from 70 years of storage and release operations, active channel restoration will be necessary and winter flows in the 400 to 500 cfs range are most likely to support restoration efforts.

The Phase 3 summer flow cap of 1,200 cfs at the WICO gauge is likely to enhance wetland habitat quality for OSF by creating suitable conditions for emergent vegetation to recolonize areas within sloughs that had been overly inundated during the growing season, which inhibits the natural growth of emergent vegetation that provides cover and food resources for OSF during all seasons. Although the change in flows under Phase 3 will result on some passive restoration of riparian vegetation along the river and within the sloughs, active restoration will be necessary to repair the river and sloughs to a more functioning condition that supports OSF year round.

At Phase 3 flow levels, we anticipate the Upper Deschutes Conservation Fund expenditures to support larger habitat projects, including but not limited to river bank restoration, installation of beaver dam analogs and large in-channel wood complexes, and excavation of existing wetlands and oxbows. Restoration efforts during Phase 3 will improve the riparian wetlands that constitute the bulk of OSF breeding habitat, thereby improving the quality of breeding habitat. These larger habitat projects will (1) improve depositional aggradation (sediment accumulation increasing riverbed elevation), which will reduce the cross-sectional area of the channel and thus improve

hydrological connectivity between the floodplain/wetland and the river channel; (2) moderate the effects of flow fluctuations that can strand young tadpoles; and (3) intercept base flow and groundwater to provide new habitats for OSF.

4.6.2 Little Deschutes River Subbasin

Baseline Condition

Tumalo Irrigation District (TID) operates Crescent Dam to store and release water in Crescent Lake for irrigation purposes. These water management operations affect a portion of the Little Deschutes River subbasin where spotted frogs occur: Crescent Creek from the Crescent Lake Dam to the confluence with the Little Deschutes River and from the Little Deschutes River at the confluence with Crescent Creek to the outlet at the mainstem Deschutes River. Unregulated portions of the Little Deschutes River subbasin, such as Big Marsh Creek and the Upper Little Deschutes River above the confluence with Crescent Creek, contribute natural flow to areas that are affected by the storage and release operations at Crescent Dam. Therefore, precipitation that occurs in the spring and late fall into winter contribute to the hydrological function of OSF habitat, dampening the adverse impacts to OSF that occur during the irrigation storage season when water is retained behind Crescent Dam. Through our analyses, we have determined that the adverse effect to OSF and habitat occur primarily during the fall at the onset of the storage season and water levels in wetlands recede.

Water operations at Crescent Lake reservoir influence an area that includes approximately 5,204 acres of wetland habitat and 166 acres of riverine open water, in Crescent Creek and the Little Deschutes River. Although these habitat acres are affected by storage and release operations at Crescent Dam, the magnitude of the effect is much less than the effect to OSF and habitat that occurs along the Deschutes River below Wickiup Dam, as described above. The natural hydrological inputs to wetland habitats and the abundance of oxbow habitat adjacent to the Little Deschutes River that provides quality breeding, rearing and overwintering habitat provide significant benefits to OSF in the current condition. However, unmanaged threats such as bullfrogs, which inhabit the majority of this habitat, pose a significant threat to OSF into the future. Reed canarygrass, another threat identified in the ESA listing of OSF, is prevalent within breeding and rearing habitats.

Storage and release of irrigation water from Crescent Lake affects 1,182 acres of wetland habitats adjacent to Crescent Creek that support Oregon spotted frog and to a lesser degree 3,322 acres of wetlands along the Little Deschutes River. Adverse effect to these wetland acres are most noticeable in the fall at the onset of the irrigation storage season when flows drop and water levels within oxbows along Crescent Creek and the Little Deschutes River drop. Along the Little Deschutes River, where bullfrogs are abundant, breeding female OSF have been observed attempting to overwinter in oxbows with residual water where predatory bullfrogs occur. We suspect that the overlap of these two species through winter is to the detriment of OSF. It is highly likely that adult breeding OSF and juveniles are eaten by bullfrogs during this period, resulting in OSF population suppression.

4.6.3 Effects of the minimization and mitigation measures CC-1, CC-2, CC-3 and UD-1

Conservation Measures CC-1 provides winter minimum flows out of Crescent Reservoir; and additional volumes of water (OSF storage) to be released by TID in coordination with the Service to optimize habitat conditions downstream of Crescent Reservoir for the spotted frog. We anticipate winter flows and supplemental OSF flows to improve habitat conditions and support seasonal life stages of the spotted frog. This conservation measure will be implemented in phases over time that will gradually and substantially improve OSF habitat function. Spotted frog surveys and habitat assessments over the life of the DBHCP will further inform releases from the OSF storage account. Crescent Creek conservation measures require the following adjustments to water operation that will minimize ongoing impacts to the spotted frog life stages each year for the life of the DBHCP permit.

1. Minimum winter flows of 10 cfs (years 1-15); 11 cfs (years 16-20) and 12 cfs (years 21-30) to provide year-round flow below Crescent Dam;
2. Additional annual spotted frog conservation flows from the OSF storage account: 5,264 AF – 8,764 AF (years 1-10); 6,464 AF – 9,964 AF (years 11-15); 7,664 AF – 11,164 AF (years 16-20); 8,864 AF – 12,364 AF (years 21-30) for release based on the water year (e.g., natural flow in Crescent Creek and the Little Deschutes) to wet up seasonal habitats making them more suitable; and to assist with late season migration;
3. Minimum irrigation season flows of 50 cfs to provide certainty of timing and volume of flows between July 1 and October 31;
4. Modified ramping rates from Crescent Reservoir to reduce stranding during migration periods.

The Upper Deschutes Conservation Fund (UD-1) provides a funding source for active management of OSF habitat (vegetation encroachment) and threats (e.g., bullfrogs and reed canarygrass) that influence the survival and recovery of OSF. The timing and location of project implementation to improve conditions for OSF will be determined by the Service and tier to the OSF Recovery Plan (expected in 2022) and specifically the Recovery Implementation Strategy for the Upper Deschutes River subbasin.

Under the HCP conservation measures CC-1 and CC-3, TID will provide year-round minimum flows in Crescent Creek; and will also provide additional OSF conservation releases from the “OSF storage” account. Winter minimum flows over the life of the DBHCP will provide water outside of the irrigation season, which will combine with inputs from other natural sources, such as Big Marsh Creek. In addition, TID and Service will collaborate to strategically release additional flows from Crescent Lake to provide for a variety of habitat enhancements which will vary annually depending on the needs of the spotted frog, as well as the conditions that year and that season. As noted in the effects section, these supplementary flows could be used to provide for additional river channel flows during the storage season, to provide for aquatic connectivity of breeding habitat, easing the incline of the ramp up or drawn down curves, or a variety of other opportunities. Since the allocation and application of the OSF Storage is dependent on the localized conditions in each year it is difficult to precisely predict what benefits will be bestowed on the spotted frog sites in Crescent Creek. However, it is safe to say that providing additional

flows will better align the water management operations below Crescent Creek with the life history needs of the species.

In addition, conservation measure CC-2 modifies operation of the reservoir to maintain and enhance spotted frog habitat downstream of Crescent Lake Dam in Crescent Creek and the Little Deschutes River by restricting the magnitude of flow increases and decreases (ramping rates) below the dam to more natural fluctuation rates. This is designed to avoid sudden changes in water levels in downstream wetlands that would result in stranding when flows are ramped down (frogs left exposed and vulnerable to predation and desiccation), or to be swept downstream when ramp up levels are too quick. Moderating these ramping rates will provide benefits to all life stages by reducing stranding events and assisting with movement to overwintering habitats.

Over the life of the DBHCP increasing volumes will be added to the OSF storage account that can be strategically released downstream depending on the environmental conditions and the needs of the spotted frog. The benefits of the increasing OSF Storage account releases include: (1) increased breeding opportunities; (2) improved breeding success; (3) reduced stranding and desiccation; and (4) reduced predation for both young-of-the-year and overwintering spotted frogs). This has the potential to provide strategic benefits to spotted frogs at numerous times of the year and with more volume making those benefits even more helpful to the frog. Spotted frog survey and habitat assessment data will further inform releases to benefit the spotted frog over the life of the DBHCP.

4.6.4 Summary of Effects to Critical Habitat Units 8 and 9

Overall, the implementation of the DBHCP is likely to improve the degraded condition of designated critical habitat in Units 8 and 9. Changes in storage and release operations at Crane Prairie, Wickiup and Crescent Lake Dams will influence the river flow volumes, and the timing and duration of inundation within OSF critical habitat. Projects that enhance the function of critical habitat by reducing threats and stressors to OSF will be implemented with expenditures from the Upper Deschutes Conservation Fund. For the reasons described in the *Effects* section above, we anticipate improvements to PCEs within portions of each unit (Table 43).

In Subunit 8A, implementation of the DBHCP is likely to improve the degraded function of critical habitat over time through implementation of WR-1 and UD-1. The function of critical habitat within this subunit is disrupted annually by the seasonal storage and release of water for irrigation. The majority of critical habitat within subunit 8A is adversely affected (i.e., 1,960 acres) during the irrigation storage season that dewateres most of the wetlands adjacent to the Deschutes River in the fall and winter. All PCEs are adversely affected during this time period. Implementation of Phases 2 and 3 of the DBHCP will increase the winter flows in the Deschutes River and improve the function of designated critical habitat.

In subunit 8B, the DBHCP will improve the condition of PCEs and the function of critical habitat at Crane Prairie Reservoir, which represents approximately 32 percent (4,982 acres) of CHU 8B. In the remainder of CHU 8B, the DBHCP will maintain critical habitat in a degraded condition whereby the duration of function is limited due to the seasonal changes in water levels within Wickiup Reservoir that reduce PCE conditions within critical habitat.

In Unit 9, storage and release operations at Crescent Lake affect total of 5,363 ac (2,171 ha) of critical habitat within this CHU. Through our analyses, we have determined that the portion of critical habitat that is within the Crescent Creek system (i.e., 1,182 acres) is more affected by storage operations than the portion of critical habitat that is within the Little Deschutes River and adjacent wetlands downstream of the confluence with Crescent Creek, primarily due to the Little Deschutes River receiving natural hydrological inputs from the upper Little Deschutes River watershed and Big Marsh Creek.

Implementation of the DBHCP is likely to improve the function of the portion of critical habitat within Crescent Creek as additional flows are released into Crescent Creek during the winter. Furthermore, the OSF storage account will be used to manage flows to enhance PCEs such as breeding and rearing habitat to best support the OSF life cycle.

Throughout all critical habitat in Unit 9, the Upper Deschutes Conservation fund expenditures will be used to remove reed canarygrass and bullfrogs, thereby improving breeding, rearing, overwintering and refugia (PCE 1 and PCE 3) elements of critical habitat.

Table 43. Summary of effects to PCEs of designated critical habitat within CHUs 8 and 9

CH Unit	CH subunit	PCE 1 – Breeding, rearing, overwintering, nonbreeding	PCE 2 – Aquatic movement corridor	PCE 3 – Refugia habitat
8. Upper Deschutes River	8A – Below Wickiup Dam	Improvement to entire sub-unit	Improvement to entire sub-unit	Improvement to entire sub-unit
	8B – Above Wickiup Dam	Improvement within 32%	Improvement within 32%	Improvement within 32%
9. Little Deschutes River		Partial Improvement	Partial improvement	Improvement

4.7 CONCLUSION

4.7.1 Oregon Spotted Frog

This no jeopardy finding for the Oregon spotted frog is supported by the following:

Over the life of the DBHCP, we expect OSF reproduction and survival to increase substantially and measurably due to demographic improvements resulting from DBHCP implementation. These improvements will result from improved breeding habitat, reduced predation, improved survival, and increased OSF access to new breeding areas.

4.7.2 Oregon Spotted Frog Critical Habitat

After reviewing the status of the Oregon spotted frog, the environmental baseline for the action area, and the effects of the proposed action, including all measures proposed to avoid and minimize adverse effects, and the cumulative effects, it is the Service's Biological Opinion that issuance of an ITP pursuant to section 10(a)(1)(B) of the Act, the implementation of the DBHCP,

and Reclamation's actions to authorize and maintain the Deschutes Basin Projects, as proposed, is not likely to result in the destruction or adverse modification of designated critical habitat for Oregon spotted frog.

This finding of no destruction or adverse modification of critical habitat is supported by the following:

- Overall, the implementation of the DBHCP is likely to improve the degraded condition of designated critical habitat in Units 8 and 9.
- In critical habitat sub-unit 8A, we anticipate improvement to all designated critical habitat (i.e., 1,960 acres) as Phases 2 and 3 of the DBHCP are implemented and winter flows are increased within the Deschutes River between Wickiup Dam and Bend, OR.
- In critical habitat sub-unit 8B, we anticipate improvement to the functioning condition within 32 percent of the sub-unit (encompassing Crane Prairie Reservoir) beginning in the first year of DBHCP implementation and continuing for the 30 year permit term.
- In critical habitat Unit 9, the DBHCP will enhance a portion of critical habitat through increased winter flows and specific management of the OSF storage account for the purpose of enhancing the functioning condition of critical habitat for OSF.
- The Upper Deschutes River Conservation Fund will be applied to enhancing the functioning condition of all critical habitat within Units 8 and 9.
- Reclamation's actions will only temporarily impact critical habitat for a very short duration.

The DBHCP covered lands within the Upper and Little Deschutes River subbasins are within the core of the OSF range, and encompass 35 percent of designated OSF critical habitat range-wide. Overall, the effects of DBHCP-covered activities on the OSF, taken together with cumulative effects, when added to the environmental baseline, are expected to improve the resiliency of OSF populations and increase the function of designated OSF critical habitat. Given the large extent of designated critical habitat within the DBHCP covered lands, implementation of the DBHCP is expected to play a significant role in the conservation/recovery of the OSF. Improving the conservation function of critical habitat on these covered lands is essential to meeting the recovery needs of the OSF.

5 BULL TROUT

5.1 STATUS OF THE SPECIES

For a detailed account of the status of the bull trout, refer to Appendix E: Bull Trout Status of the Species.

5.2 STATUS OF CRITICAL HABITAT

For a detailed account of the status of critical habitat for the bull trout, refer to Appendix F: Bull Trout Status of Critical Habitat.

5.3 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the

consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

5.3.1 Current Condition of the Species in the Basin

Project facilities and operations are located within the Coastal Recovery Unit (RU) for bull trout, which is comprised of 21 core areas (refer to *Bull Trout Status of the Species*, Appendix E). Of the 21 core areas of the Coastal RU, five are described as population strongholds in the 2015 recovery plan for the species (USFWS 2015b). The Lower Deschutes River Core Area is the southernmost of these strongholds and overlaps with a majority of the action area, from the confluence of the Deschutes River with the Columbia River upstream to Big Falls at RM 132 northwest of Redmond. The core area is comprised of five local bull trout populations: Shitike Creek, Warm Springs River, Whitewater River, Jefferson/Candle Creek complex, and Jack/Canyon/Heising Spring complex, with the latter three collectively referred to as the Metolius complex (USFWS 2015b). In the recovery unit implementation plan, which describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the RU, the Service determined that the Lower Deschutes River Core Area has no primary habitat, demographic, or non-native threats at the metapopulation level (USFWS 2015c). Conservation recommendations for the core area include continued demographic monitoring efforts of bull trout populations within the Basin, angling impacts in the spring fishery of Lake Billy Chinook, and spawner and juvenile densities in the Warm Springs River.

Historically, bull trout were distributed throughout the Basin from its headwaters to the Columbia River (Buchanan et al. 1997). The southwestern-most extent of the action area (upstream of Big Falls) lies within the historically occupied Upper Deschutes River watershed where bull trout have been extirpated for several decades but habitat is such that populations could re-establish. Present day distribution includes the Deschutes River from Lake Billy Chinook Reservoir to Big Falls, Lake Billy Chinook, the Metolius River subbasin, the Crooked River subbasin to Bowman Dam (following recent fish passage at the Opal Springs Diversion Dam), and lower Whychus Creek. Bull trout also reside in limited numbers in the lower mainstem Deschutes River from the Pelton Reregulating Dam to the confluence with the Columbia River, as well as in Shitike Creek and the Warm Springs River (USFWS 2002; CTWSRO 2011).

Populations in the Basin Unaffected by the Proposed Action

The five local populations of the robust Lower Deschutes River Core Area exhibit both resident and migratory (fluvial and adfluvial) life history forms, and spawn in river subbasins to the west

of the action area that lie upstream of effects of the proposed action (USFWS 2010a). Three of these populations are found in the nearby Metolius River watershed, with primary spawning areas found in Jefferson, Candle, Canyon, Roaring, Spring, and Jack creeks and the Whitewater River. Spawning can also occur in the mainstem Metolius River (ODFW 2003). These spawning and rearing habitats are considered to be in good to excellent condition and support the largest bull trout populations in Oregon (USFWS 2010). Overall productivity of bull trout in the Metolius River subbasin is stable.

Many young bull trout migrate from natal streams in the Metolius watershed during their second or third year of life and disperse into other accessible waters, including those within the action area. Migratory fish from these Metolius populations become piscivorous, grow rapidly, and after reaching maturity, return to the Metolius to spawn from August through October (Ratliff 1992). Migratory bull trout like those that forage in reaches within the action area usually return to spawn in the Metolius watershed as 5-year-olds.

Bull trout in the Metolius population complex declined significantly in the early 1900s, and 1986 surveys found only 26 redds in the Metolius River subbasin. This decline was attributed to overharvest, habitat loss and degradation, dam construction, introduction of non-native species such as brook trout, and targeted removal of bull trout as an undesirable species that preyed upon more desirable species such as rainbow trout. Local efforts to recover bull trout began in the 1990s and included changes in Oregon's angling regulations in 1997 that restricted anglers to keeping one bull trout per day, from the previous five fish limit. After these regulation changes and the listing of the species as Federally threatened in 1999, redd counts began to increase markedly.

Redd count surveys have been conducted annually in all reaches of bull trout spawning habitat in the Metolius River subbasin since 1986. These long-term redd counts indicate that the three local populations are healthy and that the numbers of spawning adults and redds have generally increased. Between 1987 and 2004, the number of redds steadily increased from 26 to 1,045 (Ratliff et al. 1996; Wise 2003). In 2008, redd counts declined to a low of about 382 then began to rebound in 2010 with a total of 634 redds counted. Based on redd counts, spawning numbers can be estimated at 2.3 adult fish per redd. A peak observation of 2,400 bull trout spawned in the Metolius subbasin in 2004, and the 5-year average from 2005-2009 was 1,554. In the last 5 years, the Metolius River populations have averaged about 430 redds per year, which represents about 1,000 spawning adults (E. Moberly, pers. comm. 2020).

The stability and abundance of the Metolius population complex has allowed them to be used as donor stock for reintroduction efforts into historical habitats from which bull trout have been extirpated, such as the Clackamas River Basin (Shively et al. 2007). In the Lower Deschutes Basin, the Warm Springs River and Shitike Creek bull trout populations are generally much smaller than seen in the Metolius watershed, but they both support spawning and rearing (Brun and Dodson 2002). Spawning distribution within each tributary can be extensive, with as many as 32.3 redds per mile (20.1 redds per kilometer) in the Whitewater River and 61.3 redds per mile (38.1 redds per kilometer) in Shitike Creek (Goodman et al. 2005). A remnant of the

species' historical upper Basin range, Odell Lake also supports a population of resident bull trout that is now isolated from the rest of the Basin and is located upstream of the action area.

Although bull trout can be found in all three major tributaries upstream of Round Butte Dam (i.e., the Metolius, Crooked, and Middle Deschutes rivers), all Middle Deschutes River Basin bull trout appear to originate from the Metolius River subbasin, since this is the only area where there is evidence of reproduction (Ratliff et al. 1996; Thiesfield et al. 1996). Extensive surveys of the Deschutes River arm of Lake Billy Chinook have not captured significant numbers of juveniles, nor have researchers observed the stratified age structure indicative of a reproductive population of bull trout as is seen in surveys near the mouth of the Metolius River (Thiesfield et al. 1996). Until recently, Metolius-origin bull trout populations were isolated from those found in the Lower Deschutes River reach due to construction of Round Butte Dam in 1964, and the subsequent abandonment of passage facilities in 1968. Fish passage above the PRB complex was re-established by PGE and the Tribe in 2012 with a trap and haul program, but still restricts connectivity between the five local populations to an extent. Bull trout less than 10 inches are able to pass downstream of the PRB complex from Lake Billy Chinook to the Lower Deschutes River, and subsequently get passed back upstream when they return. However, fish originating in the Lower Deschutes (i.e., from the Shitike or Warm Springs populations) are not permitted to pass upstream¹¹.

Populations in the Basin Affected by the Proposed Action

Bull trout from the three Metolius populations are interconnected by the mainstem Metolius River, and have migratory corridors between spawning and rearing areas in the Metolius and foraging, migration, and overwintering (FMO) habitat in the Metolius River, Lake Billy Chinook, the Middle Deschutes River, Whychus Creek, and the Crooked River subbasin. The connectivity between these three local populations diminishes the risk of extirpation of the bull trout in the Lower Deschutes River Core Area that could result from habitat isolation and fragmentation.

The proposed action affects bull trout in several occupied reaches of the Basin (Figure 88):

- 1) The Middle Deschutes River – the mainstem Deschutes River from Big Falls at RM 132 to and including Lake Billy Chinook at RM 117
- 2) The Lower Deschutes River – the mainstem Deschutes River from its confluence with the Columbia River upstream to the base of the Pelton Regulating Dam at RM 100.5
- 3) The Crooked River subbasin – the Crooked River from its confluence with Lake Billy Chinook upstream to the base of Bowman Dam at RM 70, and its tributaries including Ochoco, McKay, and Lytle creeks

¹¹ During the planning process for anadromous reintroduction in the Basin, pathologists from ODFW and USFWS expressed concern that passing fish upstream from the Lower Deschutes River would bring new diseases into the Deschutes, Metolius, and Crooked rivers. In order to minimize the likelihood of disease transmission, fish managers agreed to limit the fish passed upstream to only those individuals that could be clearly identified (in the form of fin clips and PIT tags) as having originated from populations upstream of the dams. This restriction applies to bull trout, as well as spring Chinook, steelhead, and sockeye.

- 4) Whychus Creek – from its confluence with the Deschutes River to the currently known upstream limit of fish dispersal at about RM 8.5 Rimrock Ranch.

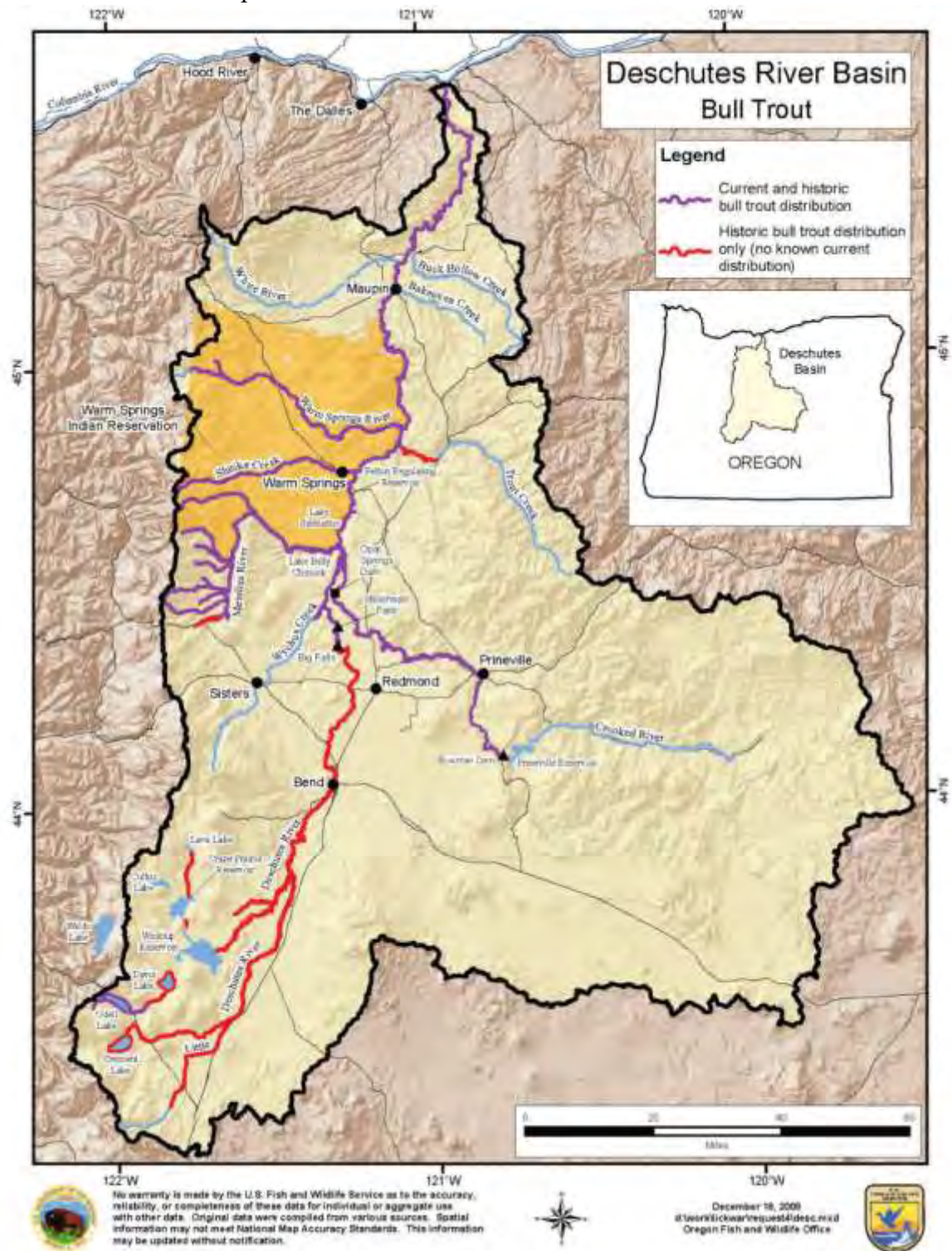


Figure 88. Current and historic distributions of bull trout in the Deschutes Basin.

Spawning and rearing activity is not known to occur within the action area; adult and sub-adult bull trout occupy reaches in the action area for foraging, migration, and overwintering.

Foraging habitats in the Middle Deschutes River, Whychus Creek, and the Crooked River subbasin are important for adult bull trout from the three Metolius spawning populations, which must recover their physical condition after fall spawning in order to spawn again next season. These foraging habitats are also important for sub-adult bull trout which may have greater foraging success and less predation risk in riverine habitats as compared to Lake Billy Chinook. Riverine tributaries to Lake Billy Chinook increase overwintering and foraging opportunities for bull trout, which also may reduce cannibalism on younger age classes of bull trout in the reservoir. Dispersal out of the reservoir, even temporarily, decreases the potential for population loss from cannibalism. Cannibalism can have significant effects on populations, particularly when other forage species are not available (Beauchamp and Shepard 2008, p. 6).

The current condition of the species in each of the four occupied reaches within the action area indicated above is further described below.

5.3.1.1 Current Condition of the Species in the Middle Deschutes River

As described above, the Metolius subbasin supports a migratory bull trout population that uses Lake Billy Chinook and the Middle Deschutes River (as well Crooked River and Whychus Creek) upstream of the PRB dam complex as seasonal foraging habitat and as a migratory corridor (Buchanan et al. 1997). Most bull trout, even those not ready to spawn, begin migrating upstream in May or June and return to mainstem rivers or lakes in November or December. In addition to spawning, this migration may be necessary to avoid high summertime water temperatures or insufficient lake water levels. Adult adfluvial bull trout generally spend about half of every year, generally November through June, in a natural or manmade lake such as Lake Billy Chinook. These fish most likely forage in shallow areas in the reservoir where most of their prey exists. Depending on water conditions, bull trout will occupy deep areas of the reservoir where water temperatures are cool (7 to 12 °C; 45-54 °F) and move to the surface when surface water temperatures drop to or below 12 °C (54 °F). At other times of the year, these fish may move upstream to forage in the lowermost portions of the Middle Deschutes River, Crooked River, or Whychus Creek. The Metolius population complex is large and stable enough to permit anglers in Lake Billy Chinook to retain one bull trout per day over 610 millimeters (24 inches) long.

5.3.1.2 Current Condition of the Species in the Lower Deschutes River

Bull trout currently reside in limited number in the lower mainstem Deschutes River from the Reregulating Dam to the confluence with the Columbia River, as well as in Shitike Creek and the Warm Springs River (USFWS 2002; CTWSRO 2011). Migratory life history forms from these local populations are known to forage in the mainstem Deschutes River between the confluence with the White River and the Pelton Regulating Dam (Reclamation 2003a). Recent studies by the Tribe also suggest fluvial populations of bull trout may inhabit the lower Deschutes River to its confluence with the Columbia River (Graham et al. 2011). There are tributaries to the Lower Deschutes River where bull trout have never been detected. Bull trout are not known to use the

lower 2 miles of the White River downstream of Reclamation's Wapinitia Project. Beyond that, Celestial Falls at RM 2 of the White River is impassible to bull trout.

Bull trout in the Lower Deschutes River are generally from the Warm Springs and Shitike populations. Exceptions to this include infrequent dispersing bull trout from the Columbia River and smaller bull trout that are allowed to pass downstream from the PRB complex from Lake Billy Chinook into the Lower Deschutes River.

5.3.1.3 Current Condition of the Species in the Crooked River

Historically, sub-adult and adult bull trout from the Metolius watershed were occasionally caught in the Crooked River as far upstream as the City of Prineville (RM 48) through the early 1980s (Buchanan et al., 1997). However, the 1982 enlargement of the Deschutes Valley Water District's Opal Springs Diversion Dam (Opal Dam) on the lower Crooked River 0.6 miles upstream of Lake Billy Chinook created a complete upstream barrier to bull trout and other migratory fish (NPCC 2005). In November of 2019, a fish ladder was constructed at Opal Dam and re-establishes bull trout volitional access to the Crooked River up to Bowman Dam for foraging, migrating, and overwintering. This passage opens access to 109 miles of the Crooked River, as well tributaries including Ochoco, McKay, and Lytle creeks.

Since fish passage facilities began operating in November 2019, by August of 2020 the Opal Dam fish ladder had passed over 200 bull trout traveling upstream into the Crooked River (Mike Barry, pers. comm. 2020). Data on all fish moving upstream through the fish ladder is collected using a Vaki Riverwatcher, an infrared fish counter that uses an underwater camera and lights to provide a record of each fish's passage. The Riverwatcher collects video data that the Opal Dam operator uses to identify the species and estimate approximate length of each fish. Data on fish species and length is provided to the Service, NMFS, and other interested parties approximately every 1 to 2 months.

Only sub-adult and adult bull trout are expected to use FMO habitat in the Crooked River, as evidenced by the size of fish recorded passing through and historically trapped at Opal Dam. These individuals can remain upstream of Opal Dam for an unknown period time, but will eventually return to the Metolius subbasin because there is no bull trout spawning habitat in the Crooked River or its tributaries.

5.3.1.4 Current Condition of the Species in Whychus Creek

Whychus Creek (previously known as Squaw Creek) is a tributary to the Middle Deschutes River that enters at RM 120. As described in the *Current Condition of the Species in the Middle Deschutes River* above, migratory bull trout from the Metolius population complex disperse into Lake Billy Chinook and use upstream reaches including Whychus Creek as seasonal foraging habitat and as a migratory corridor (Buchanan et al. 1997). Bull trout have historically been found in Whychus Creek, though their distribution has been reduced due to historical irrigation activities that have heavily modified the stream channel and degraded habitat, as detailed below. Whychus Creek and its tributaries (Snow, Pole, and Indian Ford creeks) are severely degraded and do not provide high quality habitat for bull trout, though recent efforts are being made to restore this reach as detailed in the *Current Condition of Critical Habitat* in the next section.

In recent years, instream flows and habitat conditions in the creek have improved, and it appears that bull trout are present up to about RM 8.5 at Rimrock Ranch. Between 2003 and 2005, PGE detected several bull trout during fish density surveys between USFS road 6360 at RM 6 and just downstream of Alder Springs at RM 1. These fish were 407 mm long (2003), 315 mm (2004), and 340 mm (2005). A 90 mm bull trout was captured by PGE just downstream of Alder Springs at RM 1 on September 20, 2014. In November of 2014, USFS biologists captured a 368 mm bull trout in the Rimrock Ranch area (RM 8.5). It appears that bull trout may be moving further upstream in the creek as irrigation season instream flow past the TSID diversion increases and water temperatures decrease (USFWS pers. comm. 2014).

5.3.2 Current Condition of Critical Habitat in the Action Area

Designated critical habitat within the action area lies within the Lower Deschutes River CHU: Unit 6 (refer to *Bull Trout Status of Critical Habitat*, Appendix F) and, as described in the *Current Condition of the Species*, is occupied by bull trout. Critical habitat within the action area is suitable for foraging and migrating adults and sub-adults year round. There is no spawning and rearing habitat within the action area. Bull trout critical habitat was designated on October 18, 2010 (70 FR 63898) and, within the action area, includes roughly 68 miles of the Lower Deschutes River between its confluence with the Columbia River and the Pelton Reregulating Dam (excludes portions of the river under jurisdiction of the Tribe and inaccessible portions between the dams of the PRB complex), Lake Billy Chinook, approximately 15 miles of the mainstem Deschutes River upstream from the head of Lake Billy Chinook to Big Falls, about 14 miles of the Crooked River from the head of Lake Billy Chinook to Highway 97, and the lower 5.5 miles of Whychus Creek upstream to the USFS 6360 road crossing.

Bull trout habitats within the Basin include high Cascade headwater streams, glacially fed streams, spring systems, lakes, and mainstem rivers. The storage, release, and diversion of irrigation water in the upper Basin can have a significant impact on downstream water quality including dissolved oxygen (DO), pH, nutrients, algae, and temperature. Water temperature is typically the primary limiting habitat characteristic for bull trout, and is discussed in more detail in the subsections below. The Service (2014a) has interpreted the upper threshold of suitable temperatures for bull trout in the Basin to be a 7-day maximum of the daily average temperature (7-DADM) of less than or equal to 16 °C. Bull trout are increasingly vulnerable to sublethal effects from stress and disease at temperatures above 16 °C, and are susceptible to lethal effects when the 7-DADM reaches 23 °C or higher (R2 and Biota Pacific 2013, Table 1.1). In juvenile and adult bull trout, warm water has sublethal effects such as reducing feeding rate and growth rate (USFWS 2010). During the summer in the Basin, temperatures in this narrow range are only found in the uppermost reaches of headwater streams, in spring-fed systems like the Metolius River, or downstream of significant sources of groundwater discharge such as Opal Springs (Crooked River) and Alder Springs (Whychus Creek).

As described in the *Current Condition of the Species*, the Service outlined that no primary habitat threats (or demographic or non-native threats) exist for the Lower Deschutes River Core Area in the recovery plan for the species. Baseline conditions for bull trout critical habitat in the Lower Deschutes River CHU are described by reach in the subsections that follow. The primary

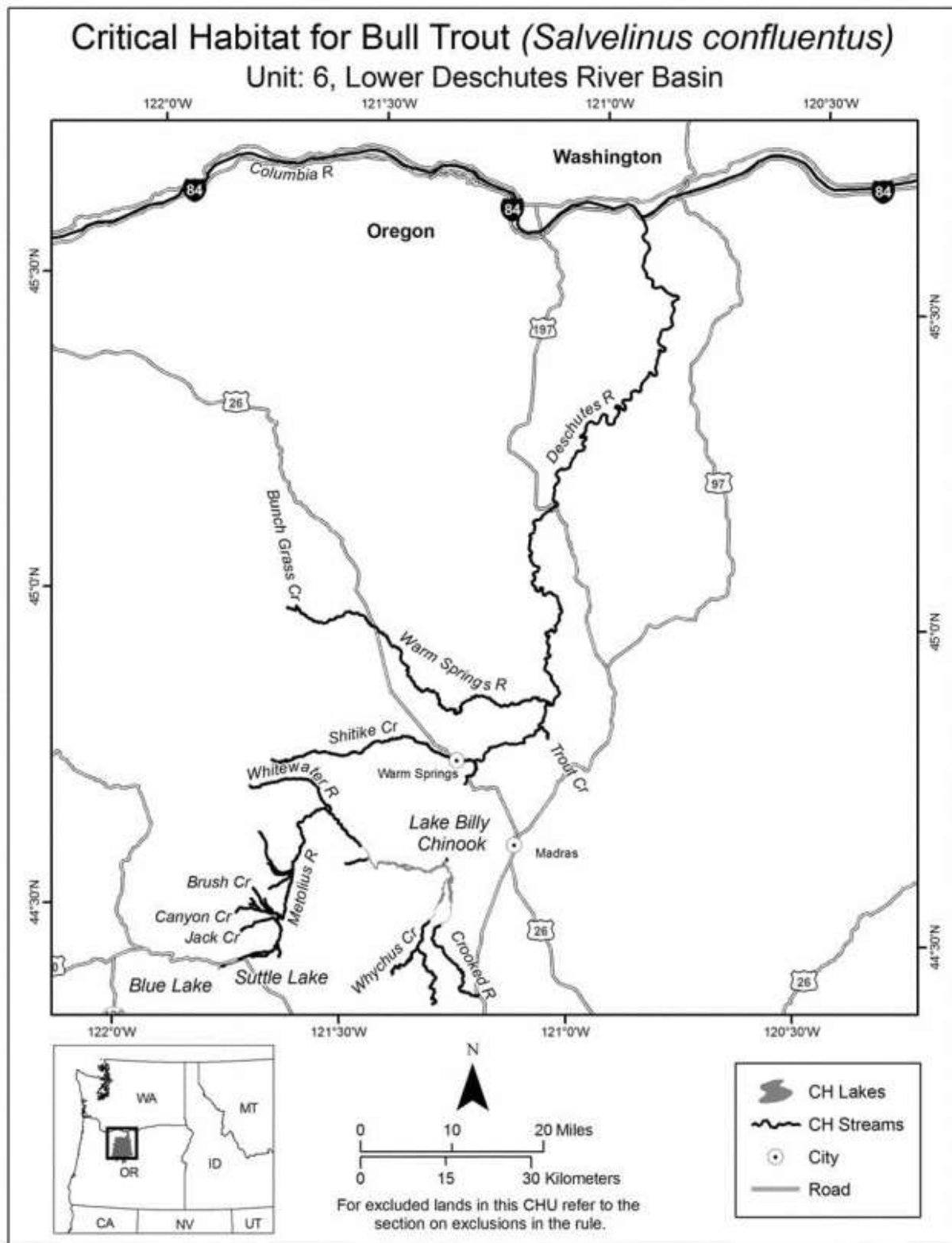


Figure 89. Unit 6, Lower Deschutes River Basin Critical Habitat Unit.

biological features (PBFs) essential for the conservation of bull trout are listed below for reference; for a full description of the PBFs of bull trout critical habitat, refer to the Appendix F, *Bull Trout Status of Critical Habitat*.

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

PBF 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.

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

PBF 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.

PBF 5: Water temperatures ranging from 2 °C to 15 °C (36 °F 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.

PBF 6 pertains to spawning and rearing habitat and is not applicable to the action area because critical habitat conditions are not suitable for bull trout spawning; it is thus not included in further descriptions of baseline conditions below, or in the analysis of *Effects of the Action* in section 5.4.

PBF 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.

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

PBF 9: Sufficiently low levels of occurrence of non-native 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.

5.3.2.1 Current Condition of Critical Habitat in the Middle Deschutes River

Designated critical habitat within the Middle Deschutes River reach, extending from the Round Butte Dam at the base of Lake Billy Chinook to the upstream limit of fish access at Big Falls (RM 132), is FMO habitat for fluvial bull trout (Buchanan et al. 1997, p. 57). Critical habitat in Lake Billy Chinook includes the reservoir to the ordinary high water elevations and normal

operating pool elevations, respectively (USFWS 2010). Tributaries to the Middle Deschutes River include Whychus Creek.

Upstream of Bend, land use along the Middle Deschutes River is predominantly forestry, recreation, agriculture, and rural residential. Within the Bend urban growth boundary, the river corridor is highly developed for residential, commercial, and recreational use. Downstream, the predominant land uses are cultivated agriculture, grazing, recreation, hydropower, and rural residential. The Middle Deschutes River is designated as *Scenic* under the Federal Wild and Scenic Rivers Act of 1968 from above Big Falls at Odin Falls (RM 140) to Lake Billy Chinook (RM 120). ODFW permits angling and harvest of bull trout in Lake Billy Chinook.

Two of the five irrigation reservoirs covered by the DBHCP impound water within the mainstem of the Upper Deschutes River: Crane Prairie Reservoir at RM 238.5 and Wickiup Reservoir RM 226.8. Crescent Lake Dam (RM 29 of Crescent Creek) also lies upstream of the Middle Deschutes River reach. Five of the eight covered irrigation districts (AID, COID, LPID, NUID and SID) divert all or most of their irrigation water from the mainstem Deschutes River within or immediately upstream of Bend. TID also diverts a significant portion of its irrigation water within this reach. Waters released from Prineville and Ochoco reservoirs of the Crooked River subbasin also drain into Lake Billy Chinook.

PBF 1: Direct surface runoff makes up a relatively small percentage of the flow in the Upper Deschutes River; most precipitation that falls in the upper Basin becomes groundwater before re-emerging at multiple springs and seeps further downstream. Stream flows in the Middle Deschutes River are heavily influenced by irrigation activities upstream (e.g., storage and release of irrigation water at Crane Prairie, Wickiup, and Crescent Lake dams), and show considerable seasonal variation. Effects of irrigation activities are most apparent in the Upper Deschutes and decrease in relative magnitude with downstream distance due to the counteracting influences of tributary and groundwater inflows, such the infusions of cool water from Tumalo Creek (RM 160) and a number of springs downstream of Big Falls (see further discussion below in *PBF 5* and *PBF 7*).

PBF 2: The Deschutes River provides connectivity between all five of the Lower Deschutes River Core Area populations, though the PRB dam complex creates a distinct separation point of exchange between the upper and lower sections of the Basin (USFWS 2010). As described previously, trap and haul passage at the facility was established in 2012; however, currently passage is only permitted for small bull trout originating upstream of the Round Butte Dam. Bull trout from Shitike and Warm Springs populations are restricted in distribution to the Lower Deschutes River below the dam, and fish originating from the Metolius population complex above the dam are largely geographically separated from those in the lower Deschutes River.

Lake Billy Chinook provides important foraging and overwintering habitat for the Metolius population complex and connectivity between spawning and rearing habitat in the Metolius subbasin to FMO habitat in the Deschutes, Metolius, and Crooked rivers. Big Falls at RM 132 is a natural impassable barrier to upstream fish passage (USFWS 2010).

PBF 3: Bull trout prey species, including juvenile salmonids, are abundant in the action area. Habitat in the Middle Deschutes and Lake Billy Chinook is of good quality and supports native populations of mountain whitefish, redband trout, sculpin, suckers, dace, and northern pikeminnow (ODFW 2006). Non-native game species introduced above Round Butte such as kokanee, Atlantic salmon, and cutthroat, rainbow, brown, and brook trout are abundant in the Upper and Middle Basin and contribute to the forage base for bull trout (ODFW 2006). Reintroduced anadromous species such as steelhead and spring Chinook salmon also contribute to forage base.

In justifying the designation of critical habitat, the Service explained (USFWS 2010, p. 258) that Whychus Creek and the Crooked River are important habitats because they allow bull trout in Lake Billy Chinook to disperse out of the reservoir. Dispersal out of the reservoir, even temporarily, decreases the potential for population loss from cannibalism. Cannibalism can have significant effects on populations, particularly when other forage species are not available (Beauchamp and Shepard 2008, p. 6).

PBF 4: Downstream of Benham Falls (RM 181), the bed and banks of the Middle Deschutes River become increasingly dominated by exposed lava flow and boulders, riparian slopes become steeper, and the channel becomes more confined. Riparian vegetation also becomes sparser and lower in stature, transitioning from trees to shrubs and grasses, as annual precipitation decreases along the Middle Deschutes River.

PBF 5: The 112.5 miles of Deschutes River from Wickiup Dam to Lake Billy Chinook are identified as water temperature limited under Section 303(d) of the Clean Water Act for exceeding the year-round maximum 7-DADM of 18 °C for salmon and trout rearing and migration (ODEQ 2017). As stated previously, bull trout are present only up to Big Falls at RM 132.

Water temperatures in the Middle Deschutes River show a strong seasonal trend reflective of local weather patterns, with additional influences from upstream storage, release, and diversion of irrigation water. Downstream of Wickiup Reservoir, winter water temperatures generally decrease with downstream distance while summer water temperatures increase. However, infusions of cool water from Tumalo Creek (RM 160) and a number of springs downstream of Big Falls (RM 132) counteract the general trend of increasing summer temperature with downstream movement. Water temperature data collected from multiple points between RM 133 and RM 120 in 2013 (Figures 90 and 91) illustrate the significant cooling effect of spring discharge to the river in this reach. About 1 mile upstream of Big Falls at Lower Bridge (RM 133), the 7-DADM was above 18 °C for 102 days and above 20 °C for 65 days (Figure 90). About 5 miles downstream of Big Falls at Foley (RM 128) the river was cooler; the 7-DADM was above 18 °C for 41 days and above 20 °C for 4 days. Another 8 miles downstream at the Culver Gage (RM 120), the reported 7-DADM only exceeded 16 °C briefly during 2013.

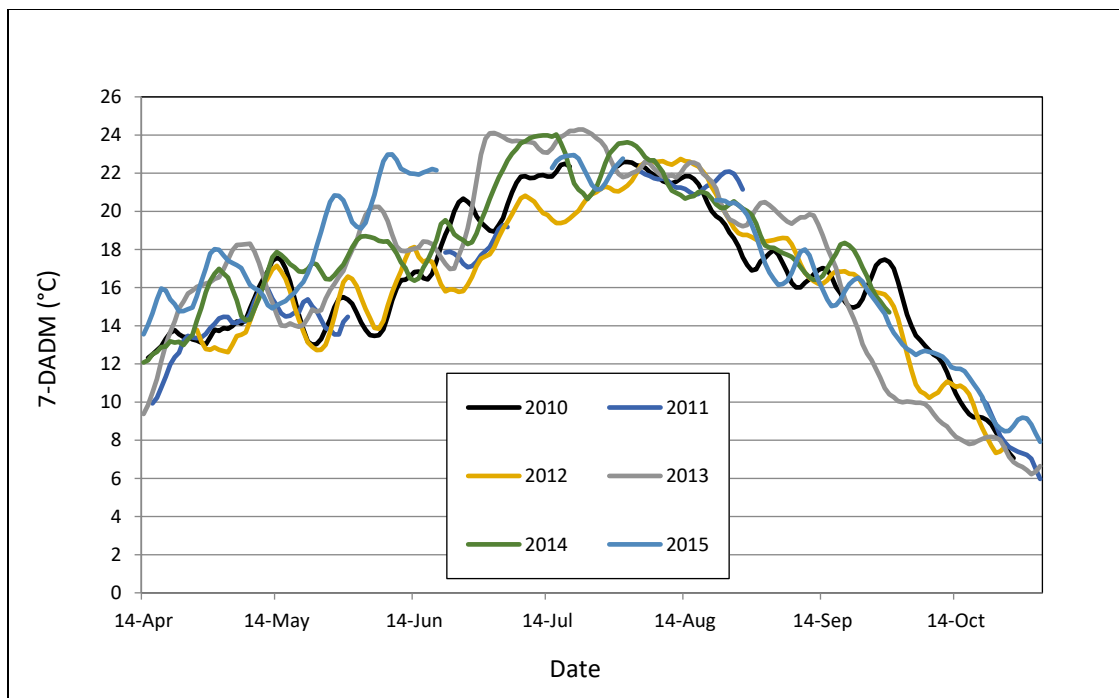


Figure 90. Seven-day averages of daily maximum water temperatures (7-DADM) in the Deschutes River at Lower Bridge (RM 133) from mid-April through October.
Source: UDWC 2016.

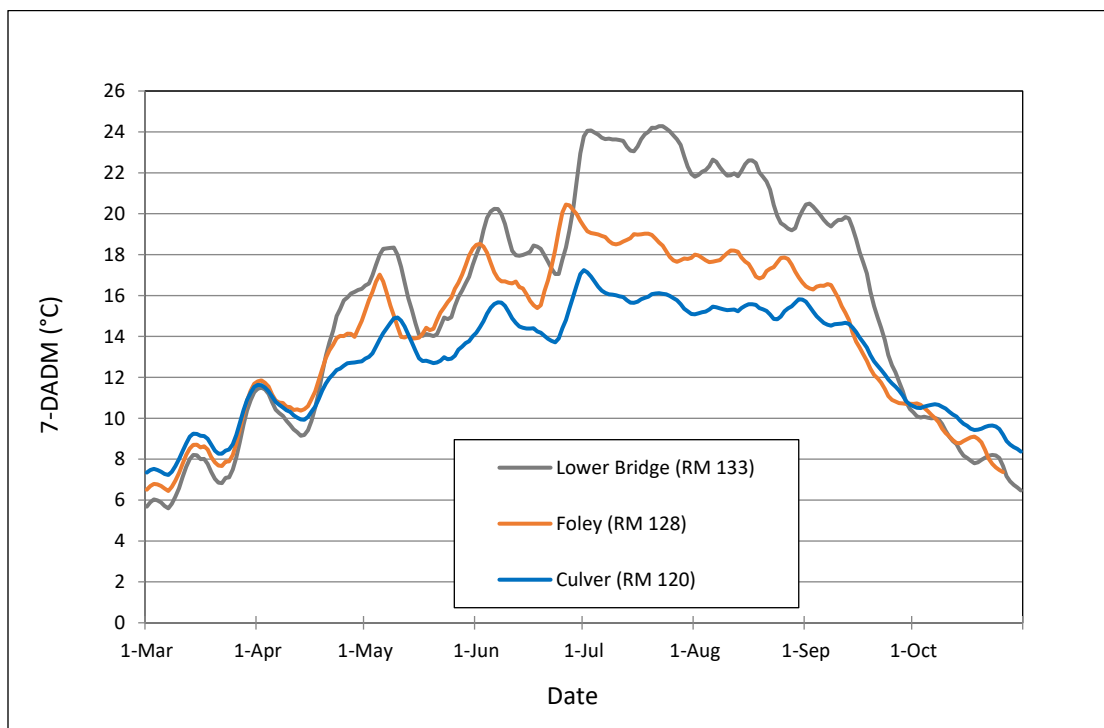


Figure 91. Seven-day averages of daily maximum water temperatures (7-DADM) at three locations in the Middle Deschutes River from March through October 2013.
Source: UDWC 2016.

PBF 7: The diversion of irrigation water in the upper Basin result in flows downstream of Bend that are generally low during the late spring and summer irrigation season. Most flow, both natural and released storage, is diverted into six canals and multiple small diversions on the Deschutes River. As stated previously, five irrigation districts (AID, COID, LPID, NUID, and SID) divert all or most of their irrigation water from the mainstem Deschutes River within or immediately upstream of Bend. The rates of diversion at each of these facilities vary during the irrigation season in accordance with the respective water rights, but peak diversions typically occur between May 16 and September 15.

Flows in the Middle Deschutes are also reduced from natural conditions by irrigation storage in the fall, winter, and early spring. However, natural inflow from tributaries and springs downstream of the reservoirs moderates the influence of storage somewhat and winter flows are not nearly as low at Bend as they are in the upper Basin between Wickiup Dam and Fall River. Middle Deschutes River flows fluctuate periodically during the winter when water is diverted into four of the canals (Central Oregon, Pilot Butte, Swalley, and Tumalo) for periods of 1 week or less each month to supply water for livestock.

As mentioned above (*PBF 1*), tributary and groundwater inflows diminish the influence of upstream water storage and release on flow volume by the time the river reaches designated critical habitat nearly 100 miles downstream. Winter flows in the Deschutes River below Bend are not appreciably different from those at Benham Falls (RM 181) because there is limited inflow and diversion between these two points, but summer flows are much lower below Bend due to irrigation diversions. This pattern persists to the gauge at Culver at RM 120 (Figure 92), which is 40 miles downstream of Bend and within bull trout designated critical habitat, but the total flow at Culver is higher due to inflow from Tumalo Creek, Whychus Creek, and groundwater discharge. The current hydrology of the Middle Deschutes River measured at the Bend and Culver gauges is illustrated by flow data for the past 38 years in Figures 91, 92.

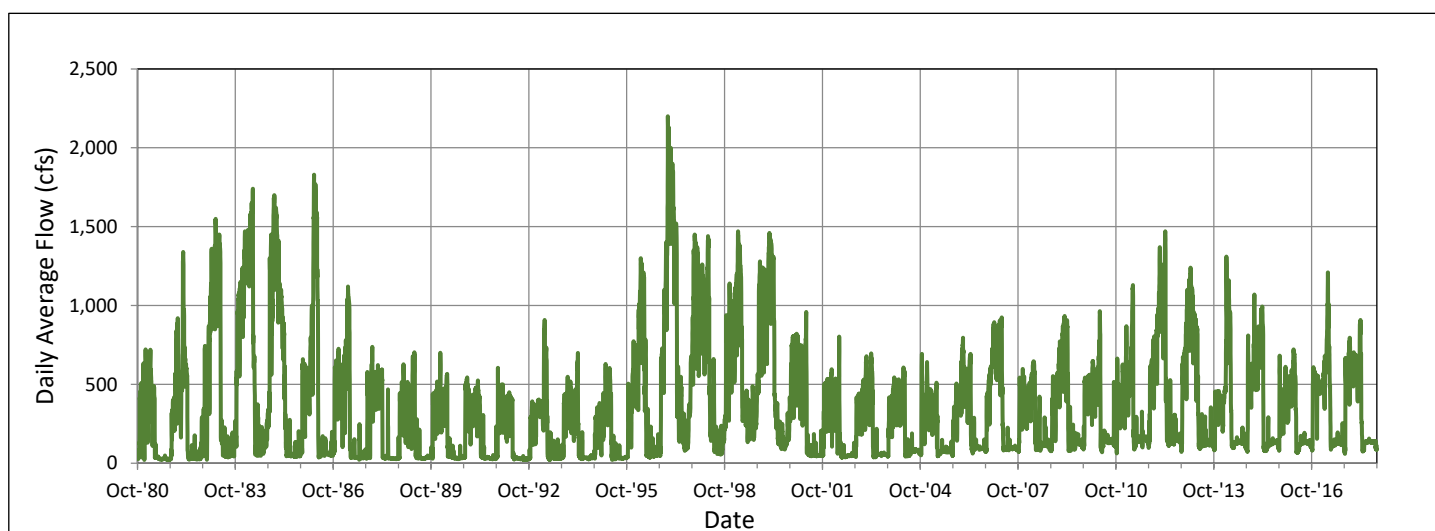


Figure 92. Reported flow in the Deschutes River downstream of Bend (RM 164) from 1981 through 2018. Source: OWRD 2020c.

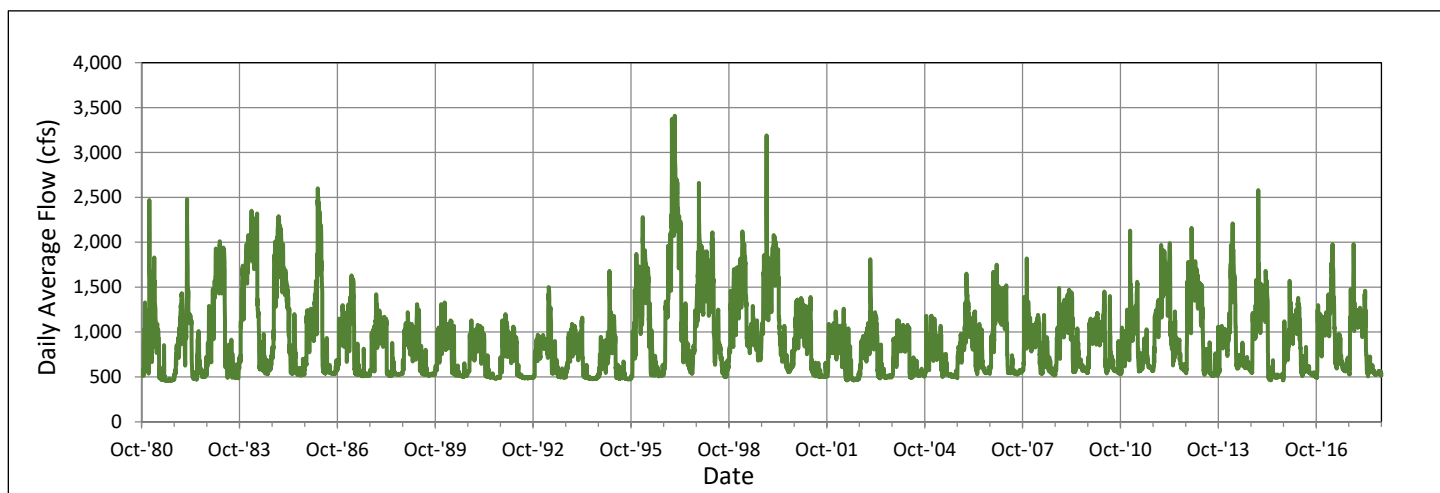


Figure 93. Reported flow in the Deschutes River at Culver (RM 120) from 1981 through 2018. Source: OWRD 2020d.

PBF 8: The Middle Deschutes River (from the PRB Dam to Bend) is designated under Oregon Administrative Rules (OAR) 340 Division 41 for all beneficial uses except commercial navigation and transportation (e.g., public and private domestic water supply, irrigation, livestock watering, recreation, hydropower, etc.; see DBHCP Table 4-2). A portion of the Middle Deschutes River, from RM 102.3 to 106.3, is listed as water quality limited for chlorophyll a and pH (Oregon’s 2012 Integrated Report).

PBF 9: In addition to bull trout, the Middle Deschutes River supports a variety of native and non-native predatory (e.g., lake trout), interbreeding (e.g., brook trout), and competing (e.g., brown trout) species (ODFW 2006). However, these species do not currently occur at levels within the action area that threaten the conservation of bull trout. In the recovery plan for bull trout, the Service recommends continued monitoring and, if needed, adaptive management to reduce distribution and abundance of brook trout in Warm Springs River, Shitike Creek, and Canyon Creek (USFWS 2015b).

5.3.2.2 Current Condition of Critical Habitat in the Lower Deschutes River

Designated critical habitat in the Lower Deschutes River includes roughly 68 miles of the Lower Deschutes River between its confluence with the Columbia River and the Pelton Reregulating Dam. Essential habitat associated with Tribal lands is excluded from the final designation rule under section 4(b)(2) of the Act and is managed by the Tribe. Additionally, critical habitat does not include the section of river and reservoir between Round Butte and the Reregulating dams because the area does not provide suitable bull trout habitat nor is there volitional passage through the dams. Land ownership along the Lower Deschutes River is a combination of Tribal, public (BLM and State of Oregon within the river canyon), and private (in the surrounding uplands). Land use is mostly range, agriculture (irrigated and dry land), and recreational. Population density along the Lower Deschutes River is very low. The entire reach from Pelton Reregulating Dam to the mouth is designated as *Recreational* under the Federal Wild and Scenic Rivers Act of 1968. Major tributaries to the Lower Deschutes River are the White River, Warm

Springs River, and Shitike Creek from the west; and Trout Creek and Willow Creek from the east.

Flow to the Lower Deschutes River is controlled by releases from the PRB complex, co-owned by PGE and the Tribe. The Lower Deschutes River is also influenced by DBHCP irrigation activities (storage, release, diversion, and return of water) occurring upstream of Pelton Round Butte Dam, but there is no storage or diversion of irrigation water covered by the DBHCP downstream of Pelton Reregulating Dam. The only DBHCP activities within the Lower Deschutes River are three small irrigation returns with a combined flow of less than 20 cfs between RM 90 and RM 98. Reclamation's Wapinitia Project is located on the White River, a tributary to the Lower Deschutes River near Maupin, Oregon.

PBF 1: Flows in the Lower Deschutes River come from the Upper Deschutes River, the Metolius River, the Crooked River, and several larger and smaller tributaries, including the Warm Springs River and the White River. These are supplemented by groundwater inputs (Yonkofski et al. 2016) and other named (e.g., Oak Springs) and unnamed springs occurring in the river canyon. Flow in the river increases more than twofold between Culver at RM 120 and Madras at RM 100, mostly due to groundwater inflow that originates as spring discharge to the Metolius River and Lower Crooked River. Little accretion of flows is observed in the Lower Deschutes River canyon below Buckhollow Creek (RM 42.7), although there are no systematic flow measurements in the lower canyon to fully exclude the possibility of exchanges along the course of the lower 40 miles of the river.

PBF 2: The Lower Deschutes River is important FMO habitat for local populations and as connectivity to essential Columbia River FMO habitat and adjacent core areas (USFWS 2010). A study conducted by the Tribe found that Deschutes River bull trout migrated from the Deschutes into the Columbia River (J. Graham, pers. comm., 2008).

The presence of the PRB dam complex at RM 100 creates a distinct separation point between the upper/middle and lower sections of the Basin, with fish originating from the Shitike and Warm Springs populations being restricted in distribution to the Lower Deschutes River below the dam and fish originating from the Metolius population complex above the dam largely being geographically separated from those in the lower Deschutes River. Trap and haul passage at the facility was established in 2012, but currently passage is not permitted for bull trout originating downstream of the Pelton Reregulating Dam (only small bull trout originating upstream are passed, as described in previous sections).

Although the Wapinitia Project is located in the lower Deschutes River in an area that is inaccessible to all species of anadromous and resident fish. The White River is impassable above RM 2 due to the presence of a barrier falls that precludes access of any fish species into the area where Federal and private irrigation facilities are located.

PBF 3: Bull trout prey species, including juvenile salmonids, are abundant in the action area. Habitat in the Lower Deschutes River subbasin is of good quality and supports native populations of mountain whitefish, rainbow trout, redband trout, summer steelhead, spring and fall Chinook salmon, sculpin, suckers, dace, and northern pikeminnow (ODFW 2007).

Introduced non-native game species such as kokanee, Atlantic salmon, brown and brook trout, and a variety of warm-water gamefish are abundant in the Lower Deschutes River subbasin and contribute to the forage base for bull trout (ODFW 2007).

PBF 4: Most of this reach is confined to a deep, narrow, steep-sided valley with very low sinuosity and a uniform gradient of about 0.23 percent (Fassnacht et al. 2003). Stream width averages 236 feet and varies from 30 to 560 feet. Channel stability is high, with very little migration from year to year and few side channels (Curran and O'Connor 2003, cited in NPCC 2004). A stable flow pattern in the Lower Deschutes supports healthy riparian communities, though in this arid region vegetation is generally limited to a narrow band of alder, willows, and grasses directly adjacent to the river channel.

PBF 5: The selective water withdrawal system at the PRB dam complex allows managers to control the temperature of water leaving Lake Billy Chinook in an effort to more closely reproduce temperatures in the Lower Deschutes River that would occur naturally if the PRB dam was not in place (Huntington et al. 1999). Restoring a more natural thermal pattern in the Lower Deschutes River waters was anticipated to facilitate spawning, emergence, and growth of anadromous fish. The efforts have been successful in providing cooler downstream river temperatures in the late summer and fall and warmer river temperatures during the spring.

This management of water temperatures leaving Lake Billy Chinook, in combination with the large volume and predominantly groundwater origin of flow near Madras, keep water temperatures in the Lower Deschutes River naturally low. The 7-DADM in the Deschutes River near Madras stays between 6 and 16 °C year-round. Downstream, however, naturally high levels of solar radiation and limited inflow of additional cool groundwater permit the river to warm. Near the mouth of the river at Moody, the 7-DADM often exceeds 20 °C in mid-summer.

The Lower Deschutes River is identified as water temperature limited under Section 303(d) of the Clean Water Act for exceeding the summer maximum 7-DADM of 17.8 °C for salmon and trout rearing and migration from the mouth to RM 46.4 (ODEQ 2017). It is also listed as water quality limited for exceeding the maximum 7-DADM of 12.8 °C for salmon and trout spawning from RM 46.4 to 99.8.

NUID operates eight irrigation returns to the Middle and Lower Deschutes River (see DBHCP, Section 3.5.5.7). These returns convey very small amounts of water, operate infrequently, and/or flow directly into one of the PRB complex reservoirs. All eight returns have maximum flows that amount to one percent or less of the flow in the receiving water at the point of return, and thus all are incapable of altering the temperature of the receiving water more than 0.1 °C (R2 and Biota Pacific 2013a).

PBF 7: Streamflow in the Lower Deschutes River is relatively uniform throughout the year due to a high contribution of spring fed waters from upstream springs and large surface water contributions from the upper Deschutes River, Metolius River, and Crooked River. These cumulative flows are punctuated by inputs from major and minor tributaries that extend between RM 97.6 (Shitike Creek) and RM 42.7 (Buckhollow Creek). As described in *PBF 1*, spring discharge to the Metolius River and lower Crooked River results in flow that more than doubles

in the Deschutes River between Culver (Figure 93 above) and Madras (Figure 94 below). The net effect of this large and relatively constant inflow is a reduction in the relative influence of upstream irrigation activities and less seasonal fluctuation in flow compared to the Middle Deschutes River. There is little change in flow in the lower 40 miles of the river because of the small contributing area. The Lower Deschutes River is characterized as having relatively stable flows (Gannett et al. 2003), but unusual precipitation events have resulted in high flows in rare years (e.g., 1964 and 1996).

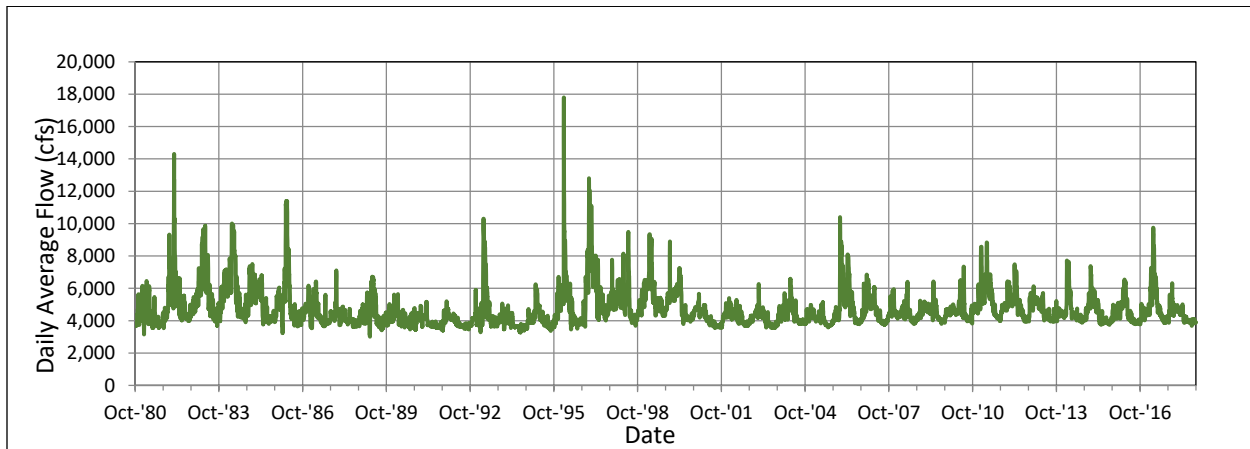


Figure 94. Reported flow in the Deschutes River downstream of Madras (RM 100) from 1981 through 2018. Source: OWRD 2020j

PBF 8: From Pelton Reregulating Dam to RM 83.8, the river is listed as water quality limited for falling below the minimum DO concentration of 11.0 mg/l for salmonid spawning. From the Reregulating Dam to RM 46.4, the river falls outside the fall/winter/spring pH range of 6.5 to 8.5. From RM 46.4 to the mouth, the river falls outside the same pH range during the summer.

PBF 9: In addition to bull trout, the Lower Deschutes River supports a variety of native and non-native predatory (e.g., smallmouth bass), interbreeding (e.g., brook trout), and competing (e.g., brown trout) species. However, these species do not currently occur at levels within the action area that threaten the conservation of bull trout within the Lower Deschutes River Core Area (USFWS 2015b). In the recovery plan for bull trout, the Service recommends continued monitoring and, if needed, adaptive management to reduce distribution and abundance of brook trout in Warm Springs River, Shitike Creek, and Canyon Creek (USFWS 2015b).

Hybridization has not been documented in the lower Deschutes River subbasin but brook trout are present in high lakes in both the Warm Springs River and Shitike Creek systems and the potential does exist. Competition between juvenile brook trout and bull trout for available resources may exist where both are present even if hybridization is not occurring. Additionally, competition with brown trout that escape downstream from Lake Simtustus is a concern in the upper reach of the lower Deschutes River and possibly Shitike Creek (ODFW 2007).

5.3.2.3 Current Condition of Critical Habitat in the Crooked River Subbasin

Designated critical habitat in the Crooked River extends from its confluence with Lake Billy Chinook upstream to the Highway 97 Bridge crossing at RM 14. However, recent completion of the Opal Dam fish ladder in November 2019 has opened access to over 100 miles of the Crooked River and its tributaries including Ochoco, McKay, and Lytle creeks. The Crooked River and its tributaries drain an area of about 4,500 square miles. The Crooked River and Ochoco Creek merge within the City of Prineville, the largest population center within the subbasin. McKay Creek flows into the Crooked River 0.5 mile downstream of Ochoco Creek, also within the City of Prineville.

About half of the subbasin is comprised of Federal lands (Forest Service and Bureau of Land Management) and about half private lands. Land uses include grazing, forest products, recreation, and irrigated agriculture. Most of the area adjacent to the Crooked River between Prineville and Terrebonne consists of pastures, agricultural fields, roads, homes, and other developments that have replaced woody riparian vegetation resulting in a lack of wood recruitment into the channel. The Crooked River was straightened and diked in the 1960s to attempt to control floods (WPN 2010). Between Terrebonne and Lake Billy Chinook, the channel is incised within a deep gorge. The 14.8-mile reach of the Crooked River between Bowman Dam down to Dry Creek is designated *Recreational* under the Federal Wild and Scenic Rivers Act of 1968.

The major storage facilities in the subbasin include Prineville Reservoir above Bowman Dam on the Crooked River and Ochoco Reservoir and Dam on Ochoco Creek. The primary diversions covered by the DBHCP in the subbasin are the OID Crooked River Diversion (RM 55.9), the NUID Crooked River Pumps (RM 22.4) and the Ochoco Main Canal at Ochoco Dam on Ochoco Creek (RM 10.5). Water is also diverted at several smaller structures on Ochoco Creek and McKay Creek that are covered by the DBHCP, as well as numerous small diversions that are not associated with the proposed action.

Irrigation infrastructure modernization is underway on McKay Creek in preparation for the McKay Water Exchange Project (McKay Water Switch) (01EOFW00-2021-I-0091), which allows landowners along the creek to trade their private McKay Creek surface water rights for OID water rights sourced from Prineville Reservoir. The cumulative effect of completing all components of the McKay Water Switch will substantially enhance streamflow and habitat conditions for fish and aquatic species in the Crooked River as well as in McKay Creek beginning in 2021.

Crooked River Act

The Crooked River Collaborative Water Security and Jobs Act of 2014 (Crooked River Act) was enacted by Congress in 2014 to “...amend the Wild and Scenic Rivers Act to adjust the Crooked River boundary, to provide water certainty for the City of Prineville, Oregon, and for other purposes.” In general, as part of “other purposes”, the Crooked River Act conditionally allocates quantities of water from otherwise uncontracted storage for “fish and wildlife purposes.” The 2014 Crooked River Act therefore authorizes the total volume of storage capacity within

Prineville Reservoir (148,633 AF) to be fully allocated to contracted irrigation, groundwater mitigation for the City of Prineville, supplemental water for NUID, contracted water for McKay Creek water users, and downstream fish and wildlife purposes.

The Crooked River Act also establishes the right of “first fill” to secure storage volumes for existing water contracts and mitigation water for Prineville subject to a minimum year-round flow release of 10 cfs from Bowman Dam as specified in the original authorizing legislation for this dam. In dry years, when Prineville Reservoir does not completely satisfy all of the contracted accounts described in the Crooked River Act, “first fill” gives priority storage for the City of Prineville and for other existing water contracts. In below average water years when Prineville Reservoir does not reach full fill of 148,633 AF, this prioritized “first-fill” requirement for contracted users results in less uncontracted storage water remaining or available for uncontracted “other purposes” such as to provide for fish and wildlife enhancement. In order to find ways in which more water could potentially be made available for fish and wildlife purposes in dry years, the Crooked River Act has a provision requiring Reclamation to develop a Dry Year Management Plan. This plan was drafted in 2015 and completed in 2018 (Reclamation 2018a).

PBF 1: The upper Crooked River subbasin experiences limited interchange between surface and groundwater due to geomorphology that has resulted in less permeable geologic surface deposits than exists in the majority of the rest of the Upper Deschutes River Basin to the west. Rather than recharging groundwater, most precipitation that falls in the upper subbasin becomes surface runoff that peaks rapidly and briefly during storm events and spring snowmelt. Other than discharge of about 20 cfs to the South Fork Crooked River, the Upper Crooked River and its tributaries receive little groundwater support and tend to drop dramatically after the end of snowmelt in early spring. Ninety-five percent of Prineville Reservoir’s annual inflow occurs during December through June; July through September accounts for less than one percent of inflows that are often less than 10 cfs during the summer period (Reclamation 2020).

Groundwater only becomes a significant source of streamflow downstream of Prineville Reservoir. Discharge of shallow groundwater fed largely by irrigation between Bowman Dam at RM 70.5 and Smith Rock at RM 25.5 contributes a net of about 27 cfs to the Crooked River on a seasonal basis (LaMarche 2008).

Downstream of Smith Rock, particularly in the lower 10 miles above Lake Billy Chinook, the Crooked River passes through a canyon of sufficient depth to intersect the regional groundwater table and gain approximately 1,000 cfs (Gannet and Lite 2004). This cold water inflow to the river between Lake Billy Chinook and the Highway 97 Bridge creates important cool water refugia for bull trout in summer months in the portion of the Crooked River that is designated as bull trout critical habitat. This portion of the river is suitable FMO habitat for bull trout year-round. Upstream of Highway 97, the Crooked River experiences low summer flow and high water temperatures that are unsuitable for bull trout from about April to October, though these areas may become suitable during winter months.

PBF 2: Water quality in the Crooked River upstream of Highway 97 may impede bull trout migration at certain times of the year. The river flows through agricultural lands and is

influenced by upstream irrigation water management, which results in degraded water quality and increased water temperatures.

For nearly 40 years, as described in the *Current Condition of the Species*, bull trout occupied only the lower 0.6 miles of designated critical habitat in the Crooked River, until fish passage was recently re-established at the Opal Dam (RM 0.6) in November 2019. The Opal Dam fish ladder has opened volitional access to the Crooked River up to Bowman Dam as well as its tributaries, allowing bull trout to use the full extent of designated critical habitat in this reach. The Bowman Dam and Ochoco Dam are complete barriers to volitional upstream movement in the Crooked River and Ochoco Creek, respectively, but both occur upstream of designated critical habitat.

PBF 3: Bull trout prey species, including juvenile salmonids, are abundant in the action area. The Crooked River provides good quality habitat for cold-water species up to Highway 97, and supports an abundant warm-water fish population upstream of the bridge. Habitat in the Project bypass reach is of good quality and supports redband trout, mountain whitefish, brown trout, bull trout, sculpin, suckers, and northern pikeminnow. Reintroduced anadromous species such as steelhead and spring chinook also contribute to the forage base.

PBF 4: The presence of dams forming Prineville and Ochoco reservoirs has significantly reduced the frequency and magnitude of habitat-forming, high flows which has resulted in simplified habitat and reduced recharge of the floodplain aquifer (WPN 2010). Storage releases during the irrigation season inundate areas adjacent to the low-flow channel preventing recruitment of riparian woody vegetation, and dams intercept substrate and large wood important for creating habitat complexity. As portions of the subbasin were developed for agriculture, riverbanks were hardened and dikes were built, leading to channelization and a lack of riparian vegetation in reaches of the Crooked River and Ochoco Creeks. Other portions of the subbasin occur in deep canyons lacking development.

PBF 5: Water temperatures in the Crooked River and Ochoco Creek are strongly influenced by irrigation storage, release and diversion. Upstream of Prineville Reservoir, the 7-DADM in the Crooked River can reach 28 °C in July and August due to low natural flow and high solar insolation. Ochoco Creek shows a similar pattern upstream of Ochoco Reservoir, with the 7-DADM reaching 22 °C or more. Immediately below the reservoirs, however, summer water temperatures are typically 8 to 10 °C cooler. The cooling effect of Prineville Reservoir persists for roughly 13 miles from Bowman Dam to the Crooked River Diversion due to the high volume of water (in excess of 200 cfs) released throughout the irrigation season. Downstream of the Crooked River Diversion, low flow and the general absence of riparian shade produce a warming trend, and by the time water reaches Lone Pine Road (RM 29.6) it is nearly back to the temperatures exhibited upstream prior to the reservoir's cooling effect. In Ochoco Creek, the warming process occurs more quickly due to the small size and lower overall flow of the creek.

Water temperatures in McKay Creek vary between 18 and 22 °C for most of the summer upstream of OID diversions as well as downstream. Water is not stored or impounded on McKay Creek, but a number of diversions and returns occur between the National Forest Boundary

(about RM 12) and Smith Inverted Weir (RM 0.6). Temperatures in lower Lytle Creek (RM 0.5) show a very similar pattern.

The Crooked River from Lake Billy Chinook to RM 51.0 is identified as water temperature limited under Section 303(d) of the Clean Water Act for exceeding the summer maximum 7-DADM of 17.8 °C for salmon and trout rearing and migration (ODEQ 2017). Lower Ochoco Creek (RM 0.0 to 22.4) and lower Lytle Creek (RM 0.0 to 4.2) have similar listings. Lower McKay Creek (RM 0.0 to 19.5) is identified as water quality limited for exceeding the year round maximum 7-DADM of 18.0 °C for salmon and trout rearing and migration.

Four of the covered irrigation districts (COID, LPID, NUID and OID) operate irrigation returns to the Crooked River and its tributaries (see DBHCP, Section 3.5). Some of these returns have the potential to influence temperatures in the receiving waters for one day or more during the irrigation season (see DBHCP, Table 4-11).

PBF 7: As described in *PBF 1*, the upper Crooked River subbasin differentiates from the western portion of the Upper Deschutes Basin with its low-permeability sediments. It also receives considerably lower annual precipitation than the rest of the upper Basin. Compared to the more than 200 inches of precipitation per year in the Cascade Range, the Crooked River subbasin receives less than 10 inches per year on average. With less permeable sediments and lower average precipitation, most precipitation becomes surface runoff that peaks rapidly and briefly during storm events and spring snowmelt. With little input from groundwater, streamflow tends to drop dramatically after the end of snowmelt in early spring. Flows in the Crooked River upstream of Highway 97 are also strongly influenced by irrigation water storage and release at Bowman Dam on the Crooked River and Ochoco Dam on Ochoco Creek.

Flows above Prineville Reservoir typically peak in spring during snowmelt and fall close to zero by late summer. In many years, storm events and/or heavy snowpack can result in short-term runoff events upstream of the reservoir well in excess of 3,000 cfs. Spring inflows contribute to reservoir storage, which in some years rapidly increases from a February low to maximum levels by early April. The reservoir storage volume typically remains at maximum levels through early June, when outflows to meet downstream irrigation needs exceed reservoir inflow. According to the reservoir rule curve, reservoir storage is drawn down through October and storage generally reaches a steady level by December. Flood control considerations also require the reservoir not to exceed 88,000 AF of storage between November 15 and February 15. Bowman Dam and Ochoco Dam are operated to minimize flooding on the Crooked River and Ochoco Creek.

Stored water is released from Prineville Reservoir to provide mitigation for groundwater pumping by Prineville (starting in 2018), fish and wildlife water, and irrigation water to water users downstream from Prineville Reservoir and the NUID pump station on the lower Crooked River. Downstream of Bowman Dam, the combination of irrigation storage and flood control eliminates flows over 3,000 cfs, reduces average winter flow, and increases average summer flow compared to unregulated conditions. At Terrebonne, which is downstream of all irrigation diversions, the cumulative effects of diversions and tributary inflow are apparent. Peak winter flow in the Crooked River at Terrebonne again exceeds 3,000 cfs in some years due to inflow

from Ochoco Creek and McKay Creek, but summer flow is much less than below Bowman Dam due to multiple irrigation diversions. As described in *PBF 1*, the large groundwater inflows of more than 1,000 cfs that enter the Crooked River in the 14 mile reach between Lake Billy Chinook and Highway 97 significantly reduce or eliminate, year-round, the influences of these storage and release activities by the time flows reach critical habitat for bull trout.

Historically low flows in the Crooked River downstream of Bowman Dam have been ameliorated in recent years by two actions. The Crooked River Collaborative Water Security and Jobs Act of 2014 (Crooked River Act) made over 62,000 acre-feet of uncontracted storage in Prineville Reservoir available for fish and wildlife use. This water is released from storage at various times of year to increase instream flow downstream of Bowman Dam. In addition, summer flows at Terrebonne have increased through an agreement between NUID and the Deschutes River Conservancy (DRC) that ensures NUID will not operate the Crooked River Pumps to divert water unless minimum flows of 50 to 181 cfs (depending on month and dry or non-dry year type) can be maintained at the Terrebonne Gage. The result of this agreement is that Crooked River flow at Terrebonne will not drop appreciably below the historical median in non-dry years or below the historical 80 percent exceedance level in dry years during the driest months of July and August (Figure 95).

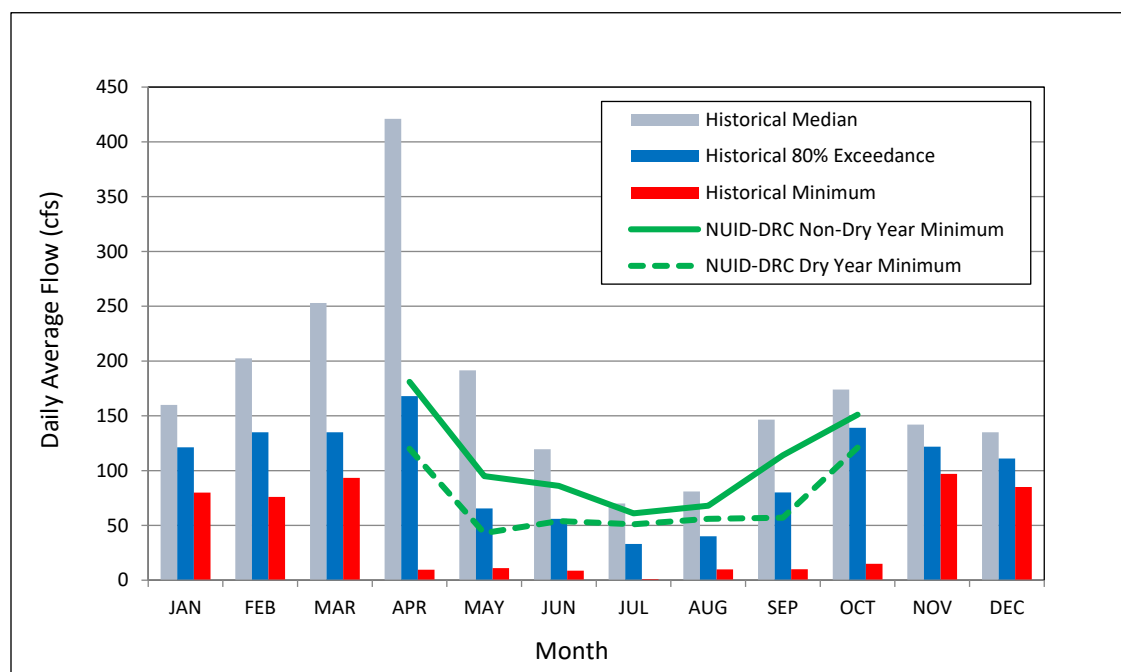


Figure 95. Comparison of historical (1994-2018) daily average flows in the Crooked River at Terrebonne (RM 27.0) to flows that will be provided under the original NUID-DRC Agreement.

Flow in Ochoco Creek below Ochoco Dam shows a seasonal pattern similar to the Crooked River below Bowman Dam, though much smaller in magnitude. Ochoco Creek flow is high immediately below the dam during the irrigation season when water is released, and low during the winter when water is stored. In 13 of 23 years between 1994 and 2016, it was necessary to release additional water from Ochoco Reservoir during the storage season to maintain flood

storage capacity. Between Ochoco Dam and the mouth of Ochoco Creek, summer flow is reduced by multiple irrigation diversions covered by the DBHCP.

As described above, the McKay Switch will restore natural hydrology of McKay Creek between RM 6.0 to RM 12.0. And following the significant amount of piping of the two high priority canals and water delivery laterals, up to 2,045 AF of water annually will be conserved and dedicated to instream flows in McKay Creek as well as the Crooked River. These improved instream flows will be protected as instream water rights by Oregon State water law.

PBF 8: Reservoir releases can have a significant impact on water quality including dissolved oxygen (DO), pH, nutrients, algae, and temperature. Portions of the covered lands within the Crooked River subbasin are listed under Section 303(d) of the Clean Water Act as water quality limited for temperature, flow modification, habitat modification, biological criteria, DO, pH, total dissolved gas (TDG), E. coli and chlorophyll a.

Oregon Department of Environmental Quality (ODEQ) has established a water quality station on the Crooked River at Lone Pine Road near Terrebonne. The ODEQ assigned the Crooked River at Lone Pine Road an Oregon Water Quality Index (OWQI) status of Poor for the water year range of 2009-2018. A status and trend was assigned to each of the eight water quality sub-indices: temperature was assigned a status of Fair with no apparent trend, pH was Poor with no apparent trend, dissolved oxygen was Fair with a declining trend, biochemical oxygen demand was Poor with an improving trend, total solids was Fair with no apparent trend, nitrogen was assigned Poor with an improving trend, phosphorous was Poor with an improving trend, and bacteria was Poor with an improving trend.

The OWQI status in the Crooked River is likely Poor for multiple reasons. Irrigation withdrawals, a lack of riparian shading, and irrigation return water that has been warmed contribute to high instream temperatures. Low flows and increased temperatures can contribute to reduced DO. The toxicity of elements and compounds present in the water can be increased by pH samples exceeding the State standard of 8.5. Supersaturation of nitrogen below Bowman Dam can occur when flow over the spillway exceeds 600 cfs, resulting in “gas bubble disease”. Flows exceeded 600 cfs in 13 of 21 years between 1989 and 2009 (WPN 2010).

All locations sampled on the Crooked River, Ochoco Creek and McKay Creek within and upstream of the covered lands showed similar trends in DO; concentrations were high in the spring and/or fall, and low during mid- to late summer. This is likely due to natural fluctuations in surface water temperature between winter and summer. Most of the sampled locations had reported DO concentrations above the State cold-water rearing habitat criterion of 8.0 mg/l.

Waters in the Crooked River, Ochoco Creek and McKay Creek are slightly basic, generally ranging in pH from 7.7 to 9.0. Upstream of Prineville Reservoir, pH levels in the Crooked River were above the State criterion of 8.5 throughout the irrigation season. Downstream of the reservoir, the seasonal pattern in pH was similar to that reported for DO; levels exceeding the State maximum of 8.5 occurred in the spring and fall while levels during the late summer were lower. Seasonal pH levels were less consistent in Ochoco Creek and McKay Creek.

Most turbidity levels for the Crooked River were between 4 and 12 nephelometric turbidity units (NTU), but maximum levels of over 40 NTU were reported at Lone Pine Road (Terrebonne). Turbidity in the Crooked River was slightly higher on average within the covered lands than immediately upstream of Prineville Reservoir, but it showed no consistent change (increase or decrease) with downstream distance from the reservoir. Turbidity levels in Ochoco Creek and McKay Creek were also between 2 NTU and 10 NTU in most locations, with spikes in turbidity at various times.

High concentrations of atmospheric gasses (primarily nitrogen and oxygen) in aquatic habitats are known to cause the formation of gas bubbles in the blood and tissue of fish and other aquatic organisms that can be harmful or fatal. Juvenile salmonids can tolerate TDG concentrations of 115 percent relative to atmospheric pressure for extended periods, and 120 percent for brief periods if they have access to deep water (Rulifson and Pine 1976; Johnson et al. 2005). To provide an additional margin of safety for shallow-water invertebrates that are important to aquatic food chains, the EPA and ODEQ regulate TDG as a toxic pollutant when concentrations exceed 110 percent of saturation. In hatchery-receiving waters and other waters less than 2 feet deep, the regulatory threshold is 105 percent of saturation.

Elevated TDG levels have been reported in the Crooked River below Bowman Dam. Air becomes entrained in water that is released from Prineville Reservoir through the outlet works or over the spillway and into the stilling basin, thereby increasing TDG concentration (Reclamation 2008, 2009). In April 1989, signs of gas bubble disease were observed in over 80 percent of the redband trout captured during electrofishing surveys below Bowman Dam (Reclamation 2008). In April of 2006, ODFW similarly observed signs of gas bubble disease in fish in the Crooked River (Reclamation 2008; Nesbit 2010).

Three independent studies have measured TDG levels downstream of Bowman Dam. Reclamation (2008) performed a study at six stations along 12 miles of the Crooked River throughout 2006 and 2007. They measured TDG levels during reservoir releases (all without use of the spillway) between 229 and 2,900 cfs. TDG level in the reservoir was 104 percent, while TDG levels just downstream of the stilling basin ranged from 106.4 percent at a release of 288 cfs to 122.5 percent at 2,600 cfs. Regression equations developed from the 2006 – 2007 data predict TDG concentrations below the dam reach the regulatory threshold of 110 percent at reservoir releases of 686 cfs or more (Table 44).

Reclamation found that TDG levels dissipated in the downstream direction during periods of high flow (greater than 789 cfs) and typically returned to 110 percent about 2 miles downstream from the stilling basin (Reclamation 2008). However, they also observed TDG levels increased again at monitoring stations further downstream in the Crooked River, even when saturation levels were initially low immediately below the dam. These in-river TDG increases were attributed to warming water temperatures and increased primary productivity associated with algae and other biological activity in the water column as the river flowed downstream.

Table 44. Predicted river flows where certain TDG levels are exceeded at the Bowman Dam tailrace based on various linear regression models.

TDG (%)	River Flow (cfs)		
	Reclamation (2008)	Nesbit (2010)	Sharp (2012)
110	686	530	520
115	1,579	893	964
120	2,471	1,255	1,418
125	3,364	1,617	1,873

Sources: Reclamation 2008, Nesbit 2010, Sharp 2012.

TDG monitoring was repeated at the same survey locations between April 2008 and April 2010 by Nesbit (2010). Although Nesbit collected data at lower maximum and lower minimum flows than Reclamation, the resulting regression equation still showed a strong positive correlation between flow and TDG concentration. The Nesbit (2010) data suggest TDG saturation levels below Bowman Dam exceed 110 percent at 530 cfs and exceed 115 percent at 893 cfs. Nesbit (2010) found elevated that TDG levels sometimes continued downstream 7.5 miles when flows were greater than 600 cfs, but unlike Reclamation, Nesbit did not differentiate between gases generated at the dam and gas level modifications due to in-river conditions.

More recently, Sharp (2012) collected TDG data in the Crooked River near Bowman Dam during October 2011 and again in April and May 2012. As summarized in Table 4-14, Sharp's TDG predictions are similar to Nesbit's, even though Sharp's tailrace sampling location was 200 feet downstream of both previous studies

PBF 9: The Crooked River has few non-native predator or competing species that interact with bull trout. The Crooked River provides good quality habitat for cold-water species up to Highway 97, and also supports an abundant warm-water fish population upstream of the bridge. Habitat in the Project area supports redband trout and mountain whitefish, brown trout, bull trout, sculpin, suckers, and northern pikeminnow.

5.3.2.4 Current Condition of Critical Habitat in Whychus Creek

Designated critical habitat in Whychus Creek extends from the mouth, which enters the Middle Deschutes River at RM 120, upstream 5.5 miles to the USFS 6360 road crossing. The major tributaries to Whychus Creek are Snow Creek, Pole Creek, and Indian Ford Creek. Whychus Creek flows through the city of Sisters, Oregon (RM 20) and drains over 250 square miles of forestland, irrigated farmland, unirrigated rangeland, residential development, and commercial development.

Water is diverted from Whychus Creek for irrigation and stock watering at multiple locations between RM 25.9 and RM 2.7. The largest diverter is Three Sisters Irrigation District (RM 24.2), which stores water in two out-of-channel reservoirs (Watson and McKenzie Canyon). There is

no in-channel storage of flow in Whychus Creek. Portions of the stream have been heavily modified (channelized) for flood control purposes and impacted by cattle grazing, to the detriment of aquatic, riparian and floodplain habitat functions (NPCC 2004). Flow restoration, physical habitat restoration and removal of man-made barriers are ongoing (Mork 2014).

PBF 1: Streamflows in Whychus Creek are influenced predominantly by headwater snowmelt (Deschutes National Forest 2013). Flows consistently peak in June, but extreme peak flows are often associated with mid- to late-winter rain-on-snow events. Upstream of the TSID diversion at RM 25.8, streamflow is also influenced by surface tributary contributions and groundwater exchange.

During the summer, a series of irrigation diversions remove most of the water from the creek below RM 24 (Courter et al. 2014). At times, portions of the stream have been known to run subterranean, primarily due to irrigation diversions (Ibid.). Flows gradually increase again between Sisters and Camp Polk Road with the discharge from a series of springs and irrigation return flows. Multiple small springs near Camp Polk Road contribute approximately 7 cfs to the creek. Indian Ford Creek, which joins Whychus Creek at RM 18, becomes dry due to irrigation diversions, but water lost in this tributary may later resurface as springs (NPCC 2005). Alder Springs (RM 1.4) contributes as much as 90 cfs to the lower 1.4 miles of the creek. Alder Springs and Whychus Creek eventually deliver a minimum of nearly 100 cfs to the Deschutes River due to the combined effects of groundwater springs (UDLAC 2003).

With the work of the Upper Deschutes Watershed Council, Deschutes River Conservancy, and TSID, current flows can be expected to be in excess of 15 cfs during the summer months through a segment that frequently was dry in the past due to irrigation diversions.

PBF 2: The Bull Trout Recovery Plan calls for restoring connectivity and opportunities for migration by securing instream flows in Whychus Creek. This area is important because it allows bull trout in Lake Billy Chinook to disperse out of the reservoir, which decreases the potential for population loss from cannibalism. Cannibalism can have significant effects on populations, particularly when other forage species are not available (Beauchamp and Shepard 2008, p. 6).

PBF 3: Water quality issues and historical channelization are the primary limiting factors for bull trout within Whychus Creek; in some areas of the creek these degraded conditions provide poor quality habitat for bull trout and other cold-water fish species. However, water quality has improved as instream flows have increased, and habitat has improved as a result of several habitat improvement projects.

PBF 4: There is no in-channel storage of flow in Whychus Creek. Portions of the stream have been heavily modified (channelized) for flood control purposes and impacted by cattle grazing, to the detriment of aquatic, riparian, and floodplain habitat functions (NPCC 2004). Flow restoration, physical habitat restoration, and removal of man-made barriers are ongoing (Mork 2014).

PBF 5: Summer water temperatures in Whychus Creek increase with downstream movement due to the combined effects of reduced flow and increased solar radiation. The 7-DADM in the

forested upper reach of the creek generally remains below 16 °C throughout the year. Downstream of the forest, between the TSID Diversion and Sisters, reductions in both flow and riparian shade result in 7-DADM levels that exceed 16 °C in June, July, and August of some years and have reached as high as 19 °C. Downstream of Sisters, water temperatures continue to increase and the 7-DADM regularly exceeds 20 °C in mid-summer. In lower Whychus Creek, discharge from Alder Springs provides a cooling effect that keeps the 7-DADM from exceeding 16 °C. Whychus Creek is identified as water temperature limited under Section 303(d) of the Clean Water Act for exceeding the year-round maximum 7-DADM of 18 °C for salmon and trout rearing and migration from the mouth to RM 40.3 (ODEQ 2017).

PBF 7: Natural flows upstream of Sisters consistently peak at 200 to 400 cfs in June and drop to 60 cfs or less in late winter. Extreme peak flows as high as 1,000 cfs have been reported during episodic winter storms.

Water is diverted from Whychus Creek for irrigation and stock watering at multiple locations between RM 25.9 and RM 2.7, reducing flows considerably from April through October and to a lesser extent from November through March (Figure 96). TSID is the largest diverter at RM 24.2; they store water in two out-of-channel reservoirs (Watson and McKenzie Canyon). During the irrigation season, TSID diverts flow for irrigation, reducing the instream flows downstream of the diversion. TSID has a water right for up to 160 cfs (Biota Pacific and R2 2013). In comparison, the estimated unregulated discharge of Whychus Creek at the TSID diversion is less than 50 cfs in winter and more than 150 cfs in the summer (Golden and Aylward 2006, p. 51). TSID would continue to divert approximately three quarters of the water in Whychus Creek during the summer months (Newton Consultants 2012). There are other diversions on Whychus Creek, but only the TSID diversion is part of the proposed HCP. Outside of irrigation season, the diversion has a nominal influence on streamflow. TSID recently completed the last phase of piping its main canals and OWRD has issued a water right for instream placement of the conserved water, bringing the total instream water right in Whychus Creek to 31.18 cfs.

PBF 8: Diversion of almost 90 percent of average summer flows and historic channelization of nearly 50 percent of the creek length have created conditions that contribute to elevated stream temperatures and compromise other water quality parameters (UDWC 2015, p. 2). In addition to being identified as water temperature limited, water quality and fish habitat in Whychus Creek are also reduced by high turbidity, high nutrient levels, streambank erosion, decreased stream flow, and a general lack of stream structure (Courter et al. 2014). Whychus Creek is listed as water quality limited due to flow modifications that are deleterious to fish or other aquatic life from RM 1.9 to RM 23.7.

PBF 9: Water quality issues and historical channelization are the primary limiting factors for bull trout within Whychus Creek; in some areas of the creek these degraded conditions provide poor quality habitat for bull trout and other cold-water fish species. However, water quality has improved as instream flows have increased, and habitat has improved as a result of several habitat improvement projects.

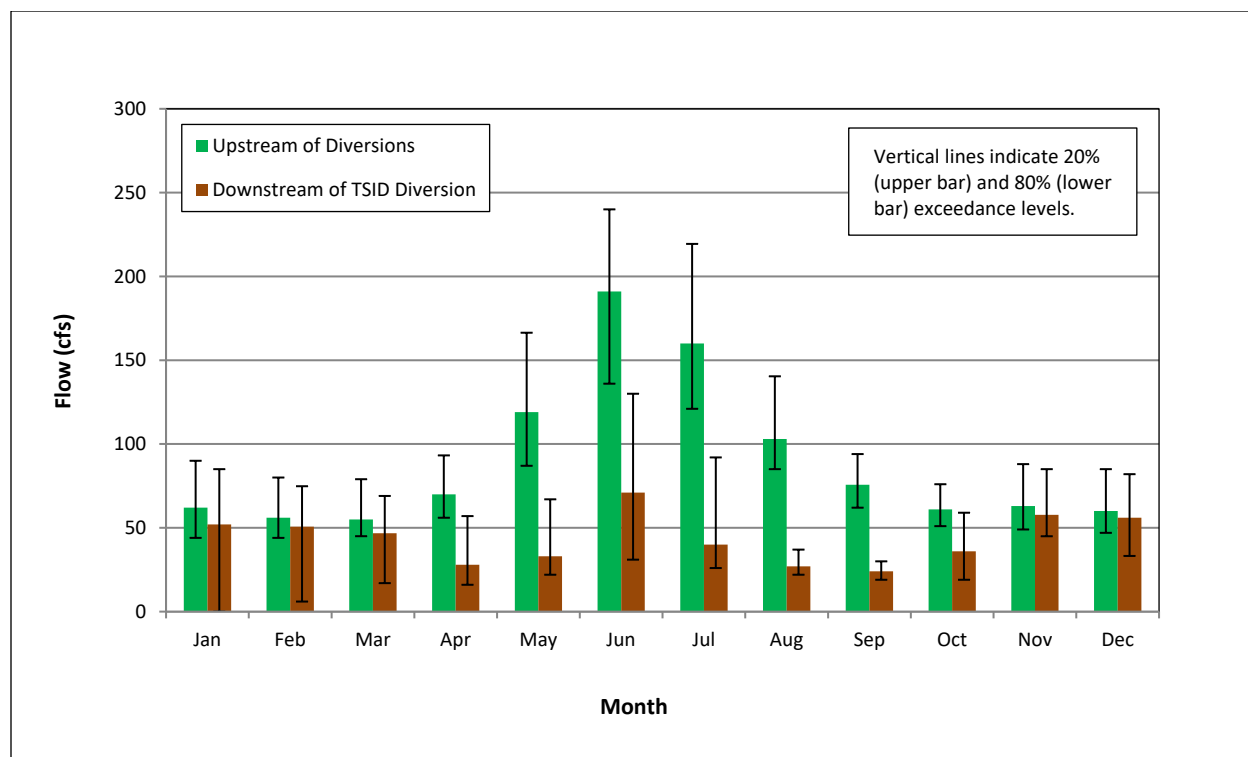


Figure 96. Monthly medians of daily average flows in Whychus Creek upstream and downstream of major irrigation diversions from 1983 through 2011.

5.3.3 Conservation Role of the Action Area

The action area overlaps with the Lower Deschutes River Core Area, including key foraging habitats in the mainstem Deschutes River from Big Bend to the confluence with the Columbia River, Lake Billy Chinook, the Crooked River subbasin, and Whychus Creek. The Lower Deschutes Core Area is essential to the conservation of bull trout because its populations are genetically diverse; exhibit diverse life history expressions including fluvial, adfluvial, and resident populations with extensive connectivity within and outside the Lower Deschutes River CHU; and are some of the most robust in the Coastal Recovery Unit. The Deschutes River Basin contains a variety of representative habitats including high Cascade headwater streams, glacially fed streams, spring systems, lake habitat, and mainstem river habitat. Bull trout critical habitat in the action area is designated for FMO; there is no suitable spawning and rearing habitat within the action area.

As explained in the *Environmental Baseline*, the Lower Deschutes River Core Area local populations are all supported by spawning and rearing habitat in subbasins that lie outside of the action area. Three of these populations are found in the Metolius River subbasin (known as the Metolius complex), and are so abundant and stable that they have been used as a donor stock for reintroduction efforts elsewhere. Although bull trout above the PRB complex can be found throughout the majority of the Basin up to Big Falls, all bull trout in reaches within the action area (i.e., Middle Deschutes, Whychus, Crooked River subbasin) appear to originate from the Metolius watershed since this is the only area where there is evidence of reproduction (Ratliff et al. 1996; Thiesfield et al. 1996). Bull trout from the Metolius populations disperse to habitat in

the action area to use for foraging, migration, and overwintering, and return to spawn in the Metolius watershed as 5-year-olds. The connectivity between the three Metolius local populations and with FMO habitat in the action area diminishes the risk of extirpation of the bull trout in the Lower Deschutes River Core Area that could result from habitat isolation and fragmentation.

These connections are essential to restore and maintain the metapopulation structure. Connectivity between these populations and the Columbia River also provides opportunity to connect the Deschutes River to other populations in the Coastal RU (USFWS 2010). Protecting and maintaining all five of the Lower Deschutes River Core Area populations will help ensure the long-term viability of these bull trout by protecting a geographically widespread distribution of unique but related bull trout (Ibid.). Therefore, the conservation role of the action area is to provide critical foraging, migration, and overwintering habitats for five local populations that are necessary for the conservation and recovery of the Coastal Recovery Unit.

5.3.4 Climate Change

There is widespread consensus within the scientific community that atmospheric temperatures on earth are increasing and that this will continue for at least the next several decades (IPCC, 2007). There is also consensus within the scientific community that this warming trend will alter current weather patterns and patterns associated with climatic phenomena, including the timing and intensity of events such as heat-waves, floods, storms, and wet-dry cycles.

Recent observations and modeling for Pacific Northwest aquatic habitats suggest that bull trout and other salmonid populations will be negatively affected by ongoing and future climate change. Rieman and McIntyre (1993) listed several studies which predicted substantial declines of salmonid stocks in some regions related to long-term climate change. Streams which acquire much of their flows from snowmelt may be particularly vulnerable to the effects of climate change (Battin et al., 2007). In the Pacific Northwest region, warming air temperatures are predicted to result in receding glaciers, which in time would be expected to seasonally impact turbidity levels, timing and volume of flows, stream temperatures, and species responses to shifting seasonal patterns. Changing climatic conditions are expected to similarly affect the Crooked River basin.

Battin et al. (2007) suggest that salmonid populations in streams affected by climate change may have better spawning success rates for individuals that spawn in lower-elevation sites. Higher elevation spawners would be more vulnerable to the impacts of increased peak flows on egg survival. They note that juvenile salmonids that spend less time in freshwater, such as anadromous species, may be less affected by low flows and high stream temperatures than resident species. Bull trout generally spawn in cold headwater streams, and juveniles may spend one to three years rearing before dispersing to mainstem river reaches such as the Crooked River. Therefore, bull trout may be less likely than some other salmonids to be able to adjust their spawning and rearing habitat needs related to water temperature.

Changes in climate have been identified that are occurring now or will occur over the next 50 to 100 years (Glick et al. 2007; Mote et al. 2005). The predicted changing precipitation patterns are

expected to result in more frequent severe weather events and warmer temperatures (Mote et al. 2005). Glaciers in the Cascades Mountains have been retreating during the past 50 to 150 years in response to regional warming. Regional warming can result in reduced winter snowpack, earlier occurrence of peak runoff, and reduced summer flows. If the current climate change models and predictions for Pacific Northwest aquatic habitats are relatively accurate, bull trout in the lower Deschutes River Core Area may be impacted through at least one or more of the following pathways.

1. Changes in distribution of bull trout within the Lower Deschutes River Core Area, such as reduced spawning habitat, and/or seasonal thermal blockage in the migratory corridors associated with increased stream temperatures.
2. Disturbance or displacement of eggs, alevins, juveniles, and adults of resident and/or migratory adults during winter flooding events.
3. Short-term or long-term changes in habitat and prey species due to stochastic events during winter floods.
4. Changes in flow and out-migration timing in the spring for bull trout and their prey species.
5. Increased migration stressors from lower stream flows and high stream temperatures during spawning migrations.

The spring-fed hydrology of the Lower Deschutes River Core Area spawning areas may help to mitigate the effects of increasing temperatures and reduced snowpack associated with climate change. (USFWS 2010, p. 257)

5.4 EFFECTS OF THE ACTION

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

5.4.1 Effects to Bull Trout

The following analysis evaluates the effects of the Service's issuance of a section 10(a)(1)(B) permit for implementation of the DBHCP and Reclamation's continued operation and maintenance of their Deschutes River Basin Project on the bull trout and its designated critical habitat. Bull trout are affected by the proposed action in occupied reaches of the action area, including the Middle and Lower Deschutes River from Big Falls to the mouth, the Crooked River subbasin, and Whychus Creek. These occupied reaches are used by foraging and migrating adult and sub-adult bull trout year round; there is no spawning and rearing activity within the action area.

As described in the *Environmental Baseline*, the Middle Deschutes River reach includes Lake Billy Chinook and lies downstream of water management activities (storage, release, diversion,

and return of water) that occur in the upper Basin at Crane Prairie, Wickiup, and Crescent Lake reservoirs, as well as downstream of significant diversions by six of the irrigation districts within or immediately upstream of Bend. The Lower Deschutes River reach is also influenced by all activities of the proposed action that occur upstream of the PRB complex, but there is no storage or diversion of irrigation water pertaining to this Opinion downstream of Pelton Round Butte Dam. Reclamation's Wapinitia Project is located on the White River, a tributary to the Lower Deschutes River that is unoccupied by bull trout. The area affected by the proposed action within the Crooked River subbasin has recently re-established fish access and includes the Crooked River and its tributaries (e.g., Ochoco, McKay, and Lytle creeks) up to Bowman Dam. The subbasin is impacted by operations at Prineville Reservoir on the Crooked River and Ochoco Reservoir on Ochoco Creek as well as by multiple diversions. Whychus Creek is impacted by upstream diversions and historical channelization that has led to habitat degradation, but does not include any in-channel storage facilities.

As previously explained in the *Description of the Proposed Action*, separating the effects of the Service's proposed action (i.e., DBHCP implementation by the Applicants) from the effects of Reclamation's proposed action (i.e., operation and maintenance of their Deschutes River Basin Project) is not practicable or feasible because the network of water management facilities, infrastructure, and authorities in the Basin are so highly coordinated and mixed. Therefore, the effects of both Federal proposed action are combined in this section 7 consultation. We will only tease apart the effects of the action by Federal nexus when it necessary to provide incidental take to one action agency but not another.

Implementation of the proposed action is anticipated to have adverse effects to bull trout and its critical habitat that vary depending on geography. In some portions of the action area, implementation of the proposed action is likely to include beneficial effects to bull trout and its critical habitat by improving habitat conditions (e.g., increasing or stabilizing instream flows). In other portions of the action area, water management operations are likely to maintain or exacerbate current, degraded habitat conditions caused by ongoing irrigation water storage, release, diversion, and return activities. As such, the effects analysis herein is organized by subbasin. The Middle Deschutes River subbasin is analyzed first followed by analyses for the Lower Deschutes River subbasin, the Crooked River subbasin, and Whychus Creek in each of the four sections below. Effects of consequences of the action that would not occur but for the proposed action (formerly interrelated and interdependent activities) are also evaluated herein.

The proposed action modifies implementation of irrigation water management activities that have been ongoing in the Basin for over 100 years. The *Environmental Baseline* thus includes conditions that are the result of completed actions (e.g., dam construction) and/or the result of ongoing activities within the daily to yearly discretion of Reclamation and the Applicants (e.g., water releases and diversions). As described in the *Environmental Baseline*, significant modification of the natural hydrograph to accommodate irrigation of crops in the growing season and water storage in the fall and winter has scoured and deepened the river channel to an extent that more water is needed in the winter compared to natural or historical conditions to fill the channel and support functional aquatic and riparian habitats. The proposed action retains many

of these activities and includes variations of others. Assessed here are the effects of only those water management activities that are proposed to be implemented by the Applicants and Reclamation as described in the *Description of the Proposed Action*. The goal of most of the 21 conservation measures of the DBHCP is to modify the hydrology of the waters in the Basin from historical conditions (i.e., past operation of irrigation reservoirs and diversions) to improve conditions for the covered species. These conservation measures are summarized in Table 3 of this Opinion; for full descriptions and rationale for each measure, see Chapter 6 of the DBHCP.

5.4.1.1 Effects to Bull Trout in the Middle Deschutes River subbasin

As described in the *Environmental Baseline*, bull trout occupy the Middle Deschutes River from Big Falls, a natural barrier to upstream movement at RM 132, to and including Lake Billy Chinook at the head of the PRB complex. Three of the five irrigation reservoirs covered by the proposed action impound water upstream of the Middle Deschutes River reach: Crane Prairie and Wickiup reservoir of the Upper Deschutes River, and Crescent Lake Reservoir of Crescent Creek. Waters released from Prineville and Ochoco reservoirs of the Crooked River subbasin also drain into Lake Billy Chinook; however, impacts from activities at these facilities are not anticipated to extend to Lake Billy Chinook, as described in the *Effects in the Crooked River subbasin* section below. Five of the eight covered irrigation districts (AID, COID, LPID, NUID and SID) divert all or most of their irrigation water from the mainstem Deschutes River within or immediately upstream of Bend. TID also diverts a significant portion of its irrigation water within this reach.

Effects of upper Basin storage, release, diversion, and release activities are most apparent in the Upper Deschutes and decrease in relative magnitude with downstream distance due to the counteracting influences of tributary and groundwater inflows, such the infusions of cool water from Tumalo Creek (RM 160) and a number of springs downstream of Big Falls (see *Environmental Baseline*). The substantial inflow of cold groundwater downstream of major irrigation activities maintains adequate habitat for bull trout in the Middle Deschutes River by reducing the influences of DBHCP- and Project-induced flow reductions and temperature increases to insignificant levels by the time flows reach the middle Basin.

The conservation measures of the DBHCP include two measures that will beneficially affect instream flows in the Middle Deschutes River reach: 1) WR-1 Wickiup Reservoir Operation and 2) DR-1 Middle Deschutes River Flow Outside of the Irrigation Season. To analyze the effects of these two measures on bull trout in the Middle Deschutes River, we reviewed flow and stream temperature data collected by the USGS in the mainstem Deschutes River at the town of Culver (RM 118) (USGS Station Number 14076500). The analysis of the effects from these two conservation measures downstream on the Lower Deschutes River reach are described in the next section, *Effects in the Lower Deschutes River subbasin*.

Measure WR-1 is designed to adjust the timing and volume of flow releases from Wickiup Reservoir to improve habitat conditions and support seasonal life stages of the spotted frog in the Upper Deschutes River (see *Section 4.4* for analysis of effects to OSF), but these flow changes will also increase winter flows in downstream reaches of the Deschutes River to the Columbia River. Implementing measure WR-1 progressively increases storage season minimum flows

from Wickiup Reservoir between September 16 and March 31. Wickiup flows will increase from the current 100 cfs winter flows to 300 cfs in years 8-12 (Phase 2) of DBHCP implementation, and will increase to 400-500 cfs in years 13-30 (Phase 3). Measure DR-1 is designed to benefit fish in the Deschutes River below Bend by limiting winter diversions and thereby increasing instream flows. This conservation measure limits stock water diversions during the winter months, if they would reduce flows in the Middle Deschutes River below a minimum daily average flow of 250 cfs. The result of these two conservation measures is to reduce variations in streamflow in the Middle Deschutes River during the winter.

During the winter storage season of 2011 to 2012, flows from Wickiup Reservoir were between 300 and 400 cfs for several months, similar to the flows proposed by WR-1 beginning in year 8 (USGS Station Number 14056500). Conversely, Wickiup flows during the 2018 to 2019 storage season accurately reflect the 100 cfs winter minimum that will be seen in Phase 1 (USGS Station Number 14056500). Together, flow and temperature data from these 2011/2012 (HCP surrogate) and 2018/2019 (existing condition) winter storage seasons provide a reasonable expectation of the range of instream conditions expected from the progressive implementation of WR-1 over the 30-year life of the DBHCP.

Flow data from the Culver gauge shows that the higher winter releases from Wickiup Reservoir in the 2011/2012 storage season resulted in increased instream flows downstream in the Middle Deschutes River (USGS Station Number 14076500). Flows at the Culver gauge averaged 1,386 cfs during the 2011/2012 season, while 2018/2019 averaged 926 cfs. These higher flows appear to have contributed to overall lower stream temperatures, suggesting that WR-1 and DR-1 will both help to maintain, or lower, instream temperatures by increasing flows. During the 2011/2012 storage season, the Culver gauge recorded 117 days that were colder than seen in the 2018/2019 season with lower flows (in comparison to 88 warmer days) (USGS Station Number 14076500). Review of the temperature data from the Culver gauge found that the 7-DADM temperature never exceeded the bull trout suitability threshold of 16 °C in either 2011/2012 or 2018/2019 storage seasons.

Based on the relationship between increased flows and decreased water temperatures, the Service expects that implementation of DBHCP conservation measures (WR-1 and DR-1) will maintain, or improve, downstream suitable winter habitat conditions for adult and sub-adult bull trout by increasing instream flows and decreasing 7-DADM temperatures, thereby increasing foraging opportunity for bull trout by increasing the extent and quality of FMO habitat.

Because the Middle Deschutes and Crooked rivers are influenced by the proposed action, bull trout in Lake Billy Chinook have the potential to be affected. However, Lake Billy Chinook is very large, with an estimated 76,000 AF year-round (maximum useable storage volume of 274,000 AF), and is operated as 'run-of-the-river' through operation of Round Butte Dam (i.e., volume of the reservoir remains approximately the same by receiving and releasing the same volume on a daily basis). These attributes minimize the impact of flow effects that originate upstream to negligible or discountable levels because regardless of changes to inflow that may result from releases and diversions upstream, the reservoir volume and water surface elevation

are kept constant. This means that total useable area and location of bull trout habitat also remains relatively constant. In addition, inflow variation into Lake Billy Chinook as a result of DBHCP activities is anticipated to have minimal impacts to water temperatures in the reservoir, and are expected to maintain temperatures below the 16 °C threshold for bull trout (DBHCP, Chapter 8.1.4). Irrigation returns covered by the DBHCP represent a small percentage of the inflows into Lake Billy Chinook (0.03 percent; 1.3 cfs) and are anticipated to have immeasurable effects on flow, water temperature, and water quality (DBHCP, 8.1.4). The dilutive effect of Lake Billy Chinook's size and 'run-of-the-river' operation is expected to minimize any effects from modified upstream flows to discountable levels within the reservoir.

Given that habitat within the action area is used for foraging, migration, and overwintering by individual adult and sub-adult fish that have dispersed from populations supported by subbasins outside of the covered lands (see *Environmental Baseline*), implementation of the proposed action is expected to have a relatively minor influence on the conservation and recovery of the bull trout within the Basin or across the species' range because the influence of upper Basin irrigation activities (e.g., flow reductions) is largely reduced to insignificant levels by the time flows reach the Middle Deschutes River. This is due to the substantial, natural cold-water inflows to the Deschutes River between approximately RM160 and RM 120 (Tumalo Creek to Culver) that provide suitable habitat conditions for bull trout year-round. Thus, hydrological and thermal effects to bull trout from proposed activities that occur upstream have an insignificant effect on bull trout critical habitat.

We conclude that the proposed action is not likely to adversely affect bull trout in occupied reaches of the Middle Deschutes River and Lake Billy Chinook. As noted above, implementing the conservation measures of the DBHCP will improve habitat quality by increasing flows and maintaining, or lowering, cold water flows over the life of the permit, beneficially affecting the species by increasing the extent and quality of habitat available for foraging, migration, and overwintering.

5.4.1.2 Effects to Bull Trout in the Lower Deschutes River Subbasin

As explained in the *Environmental Baseline*, limited numbers of bull trout from primarily the Shitike and Warm Springs local populations use the Lower Deschutes River as FMO habitat. Flow to this reach, which extends from the base of the Pelton Reregulating Dam at about RM 100.5 to the river's confluence with the Columbia River, is controlled by releases from the PRB complex (operated as 'run-of-the-river'). While only three small DBHCP irrigation returns occur within the mainstem Deschutes River below the PRB complex, the reach is influenced by upstream storage and release at all five dams described in the proposed action, as well as by all of the covered water diversions and agricultural returns. Reclamation's Wapinitia Project is located on the White River, a tributary to the Lower Deschutes River near Maupin, Oregon. Bull trout are not known to occupy the White River.

As described in the previous section, effects of proposed storage, release, diversion, and return activities are most apparent in the upper Basin and decrease in relative magnitude with downstream distance due to the counteracting influences of tributary and groundwater inflows, such the infusions of cool water from Tumalo Creek (RM 160) and a number of springs

downstream of Big Falls (see *Environmental Baseline*). Flow in the river further increases more than twofold between Culver at RM 120 and Madras at RM 100, mostly due to groundwater inflow that originates as spring discharge to the Metolius and Lower Crooked rivers. The substantial inflows of cold water downstream of irrigation activities that occur in the Upper Deschutes and Crooked River subbasins maintains adequate habitat for bull trout in the Lower Deschutes River by reducing the influences of upstream flow reductions and temperature increases to insignificant levels by the time flows reach the middle and lower reaches of the Deschutes River.

The DBHCP conservation measures 1) WR-1 Wickiup Reservoir Operation and 2) DR-1 Middle Deschutes River Flow Outside of the Irrigation Season, which were analyzed in the preceding section for their *Effects in the Middle Deschutes River subbasin* (see previous section for analysis), also have the potential to affect instream flows further downstream in the Lower Deschutes River.

Flows in the Lower Deschutes River under the proposed action are anticipated to be higher than historical flows in all months (Figure 97; Biota Pacific 2020). Flow increases during the storage season (October through March) and early irrigation season (April) will be the result of increased flows in the Upper Deschutes River required by WR-1 (Biota Pacific 2020, Chapter 8.1.5). The largest increases will be 11 percent in March and April (Ibid.). Flow increases during the irrigation season are increases from historical conditions that have already occurred as the result of conservation projects. Since 2001, the minimum instream flow in the Deschutes River below Bend during the peak of the irrigation season (mid-May to mid-September) has increased from 109 cfs to 143 cfs (minimum flows during shoulder seasons are less than this).

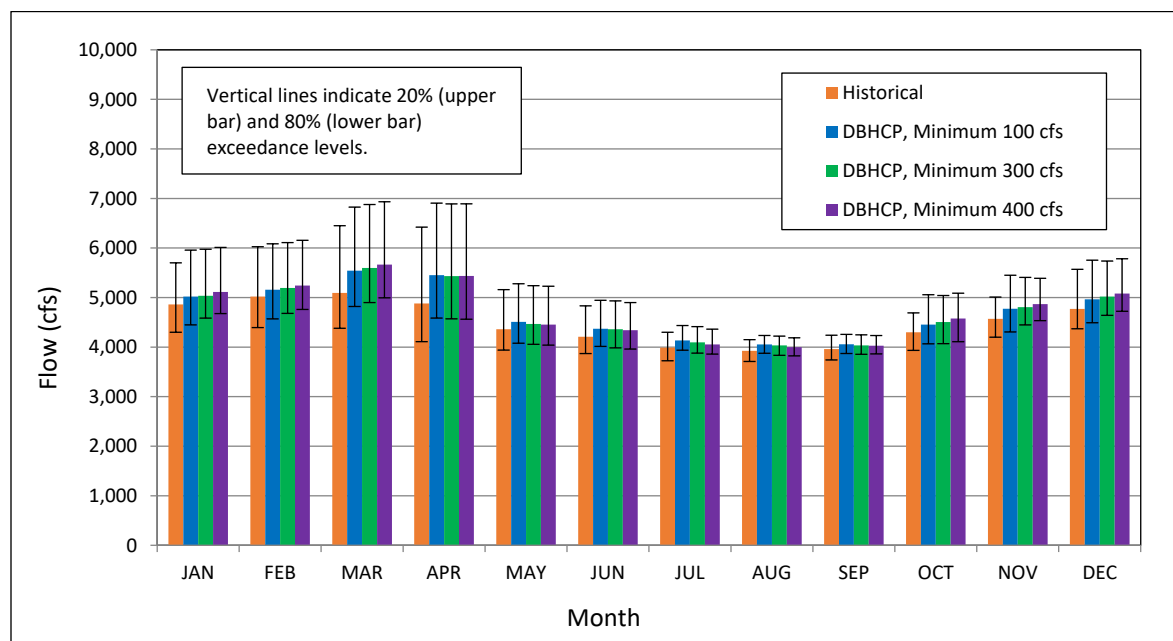


Figure 97. Monthly medians of daily average flows in the Deschutes River near Madras from 1981 through 2018. (DBHCP Figure 8-21)

The proposed action will result in a small improvement in habitat for bull trout foraging, migration, and overwintering in the Lower Deschutes River. Higher year-round flows correspond to increases in the total area of suitable habitat, increasing foraging opportunity for bull trout. Any changes in water temperature associated with the higher flows will be inconsequential to bull trout. The largest increases in flow will come in March and April when water temperatures at Madras are well below the upper habitat threshold of 16 °C for adult and sub-adult bull trout making them relatively insensitive to an increase or decrease in temperature that might occur with a change in flow. In July, when water temperatures at Madras are at the annual high, the recent increase in flow has increased 7-DADM an estimated 0.5 °C, but the 7-DADM at Madras is still expected to remain below 16 °C year round resulting in high quality bull trout habitat.

Given that habitat within the action area is used for foraging, migration, and overwintering by individual adult and sub-adult fish that have dispersed from populations supported by subbasins outside of the covered lands (see *Environmental Baseline*), implementation of the proposed action is expected to have a relatively minor influence on the conservation and recovery of the bull trout within the Basin or across the species' range because the influence of upper Basin irrigation activities (e.g., flow reductions) is largely reduced to insignificant levels by the time flows reach the Lower Deschutes River. This is due to the substantial, natural cold-water inflows to the Deschutes River between approximately RM 160 and RM 100 (Tumalo Creek to Madras) that provide suitable habitat conditions for bull trout year-round. Thus, hydrological and thermal effects from proposed activities that occur upstream have an insignificant effect on bull trout in the Lower Deschutes River.

Few bull trout would be exposed to potential effects of the Wapinitia Project, located on the White River. As described in the *Environmental Baseline*, bull trout can only access the lower two miles of the river (below Celestial Falls) and only infrequently use the Deschutes River below the confluence with the White River for FMO. Reclamation's continued authorization of the Wapinitia Project, which includes storage and release of water at Wasco Dam/Clear Creek Reservoir, results in slightly lower flows in the White River year round. Flows from Clear Creek Reservoir are a relatively small contribution to flow in the White River and an even smaller contribution to the Lower Deschutes River. Typical peak irrigation releases from the dam vary between 20-45 cfs and the typical maximum diversion is 50 cfs. In comparison, the average discharge at Celestial Falls is 423 cfs and the average summer flow in the Lower Deschutes below the White River confluence is 5,000 cfs.

Based on this dilutive effect of significant inflows to the mainstem Deschutes River from Tumalo Creek to Madras, as well as the relatively small contribution the White River represents to the Deschutes River, the Service expects adult and sub-adult bull trout within the Lower Deschutes River are not likely to be adversely affected by the proposed action. We anticipate that implementation of DBHCP conservation measures (WR-1 and DR-1) will maintain, or improve, downstream suitable winter habitat conditions for adult and sub-adult bull trout by increasing instream flows and decreasing water temperatures, thereby increasing foraging opportunity for bull trout by increasing the extent and quality of FMO habitat.

We conclude that the proposed action is not likely to adversely affect bull trout in occupied reaches of the Lower Deschutes River and the White River. Implementing conservation measures of the DBHCP may improve habitat quality by increasing flows over the life of the permit, beneficially affecting the species.

5.4.1.3 Effects to Bull Trout in the Crooked River subbasin

As described in the *Environmental Baseline*, recently constructed fish passage at the Opal Springs Dam less than a mile upstream of Lake Billy Chinook has re-established access for bull trout to the Crooked River and its tributaries including Ochoco and McKay creeks.

The major storage facilities in the subbasin include Prineville Reservoir above Bowman Dam on the Crooked River and Ochoco Reservoir and Dam on Ochoco Creek. The primary diversions covered by the DBHCP in the subbasin are the OID Crooked River Diversion (RM 55.9), the NUID Crooked River Pumps (RM 22.4), and the Ochoco Main Canal at Ochoco Dam on Ochoco Creek (RM 10.5). Water is also diverted at several smaller structures on Ochoco Creek and McKay Creek that are covered by the DBHCP, as well as numerous small diversions that are not associated with the proposed action.

Irrigation activities could affect conditions for adult and sub-adult bull trout foraging in the mainstem Crooked River, Ochoco Creek, and McKay Creek. Concurrent implementation of the DBHCP, as carried out by the Applicants, and the Crooked River Act, as implemented by Reclamation, will increase flows in the Crooked River during the winter when bull trout may be present. These effects will occur indirectly through the changes in hydrology and water quality described in detail in Chapter 6 of the DBHCP and in the section 7.3.6 Effects to Hydrology of the Assessment. The conservation measures described in Chapter 6 of the DBHCP have been designed to address both indirect and direct effects of the covered activities to bull trout.

Effects of DBHCP Implementation

The reach of the Crooked River affected by Applicant activities (OID, NUID, and Prineville) extends from the base of Bowman Dam at RM 70.5 to the river's confluence with Lake Billy Chinook. OID irrigation operations include activities in three areas of the subbasin: the Crooked River, involving releases from Bowman Dam and diversions at their Crooked River Diversion at RM 55.9; Ochoco Creek, involving releases from Ochoco Dam and diversions at the dam; and McKay Creek, involving diversion of live flow from the creek. NUID irrigation operations include activities in the Crooked River, involving releases of stored irrigation water at Bowman Dam and diversions of Crooked River flow at their pumps at RM 22.4. Prineville covered activities include municipal groundwater withdrawal, discharge of municipal effluent, and surface water diversions.

The lower Crooked River will benefit from the concurrent implementation of the DBHCP and the Crooked River Act to increase flows during the winter when bull trout may be present. As described in the DBHCP and in section 7.2.1 of the Assessment, winter flow releases out of Wickiup Reservoir increase starting in year 8 of the permit term, reducing NUID's stored water supply in the Deschutes. This will likely result in NUID using its available stored water from

Prineville Reservoir (up to 10,000 AF) more frequently and to a greater extent. This, combined with increased winter minimum flows in the Crooked River (CR-1), would result in increased Prineville Reservoir storage releases in dry and very dry years. Additionally, increasing bypass flows in McKay Creek and Ochoco Creek and protecting stored water under temporary instream leases for Ochoco ID patrons (CR-2, CR-3, and CR-4) may contribute to increasing OI stored water releases in years that Prineville Reservoir does not fill. The DBHCP will also require fish screen maintenance to prevent entrainment of juvenile salmonids (CR-5), and will establish a conservation fund to support conservation measures and projects that benefit listed species in the Crooked River subbasin (CR-4). Minimum flow requirements below the NUID Pumping Plant (CR-6) has been discussed with the effects of contracted and uncontracted storage releases. CR-7 was designed primarily to benefit young steelhead outmigration, but the pulse flows do not adversely affect adult and sub-adult bull trout.

The DBHCP is based on the assumptions that Reclamation will use the City of Prineville's 5,100 AF of mitigation storage in combination with uncontracted storage to maintain at least 50 cfs in the lower Crooked River during the winter (see the *Description of the Proposed Action* for more details of the storage accounts held in Prineville Reservoir and the minimum flow requirements in the Crooked River). Prineville sewage effluent treatment discharge is not anticipated to have adverse effects on bull trout. All effluent discharges will provide slight increases in instream flow, which will have positive effects on fish habitat. Discharges directly to the Crooked River will occur only during the fall, winter, and early spring (November 1 through April 30) when water temperatures in the river are well below the upper thresholds for bull trout. Direct discharges will occur at dilution rates of at least 15:1 and thus will have negligible potential to increase or decrease river water temperature (DBHCP, Chapter 8).

The DBHCP will have adverse and beneficial effects (overall neutral) on bull trout in Ochoco and McKay creeks. The Service anticipates that some bull trout will enter the tributaries during storage season. Bull trout use of these reaches is expected to be limited to small numbers of adults and sub-adults during the winter. The DBHCP will increase minimum winter flows in Ochoco Creek from historical conditions, but the number of bull trout expected to benefit from these flows is small. If bull trout forage in Ochoco Creek during the storage season, the DBHCP will not adversely affect this behavior. Summer water temperatures conditions in the McKay Creek are naturally too warm for bull trout. The covered irrigation activities alter flows in McKay Creek during the summer, but the creek is unaffected by the covered activities during the winter when bull trout could be present.

Effects of Reclamation's proposed action

Reclamation identified eight components that comprise their proposed action (see full list and summaries in *2.1.2 Bureau of Reclamation Proposed Action*). There are specific activities elemental to implementing these project components that affect bull trout. These are operational activities of Bowman Dam and consist of the following:

1. Release of contracted irrigation storage from Prineville Reservoir and its proposed subsequent legal downstream diversion as live instream flow.

2. Release of uncontracted storage from Prineville Reservoir and its subsequent legal downstream diversion as live instream flow, which is reasonably certain to occur without protections from an instream secondary water right.
3. Flood control operations resulting in high flow releases

The effects of these activities to bull trout and bull trout critical habitat are analyzed in the subsections below.

5.4.1.3.1 Effects from Release of Contracted Irrigation Storage and Diversion

Crooked River Storage, Release, and Delivery Overview

Reclamation stores and releases water from Prineville Reservoir. A total of up to 68,273 AF is managed by OID for contracted water accounts, plus an additional 10,000 AF of NUID supplemental water during the irrigation season (April 1 to October 15) each year. Most of this water (58,273 AF) is diverted by OID at the OID Diversion at RM 55.9, and 10,000 AF is diverted by private irrigation districts (Rice-Baldwin, Peoples Ditch, and Crooked River Central Diversions) with live flow and storage rights at or downstream of the OID diversion. The reservoir stores and releases an additional 10,000 AF authorized for irrigation purposes by the Crooked River Act, available first to NUID and subsequently to other irrigation storage contract holders. As previously stated, Reclamation and the Services assume that NUID will call for the use of the full 10,000 AF of supplemental water every year. This NUID supplemental water remains instream until its point of diversion at the NUID Pumping Plant at RM 22.4. For a description of the allocation of contracted storage water rights served by Prineville Reservoir, refer to the *Bureau of Reclamation Proposed Action*, section 2.1.2, and Table 6.

These irrigation season water releases result in flows between 180 to 240 cfs from Prineville Reservoir during the irrigation season. Water releases vary between this range based on water availability, weather conditions, and the amount of water needed to meet downstream flow commitments. The release of contracted storage during the irrigation season benefits fish below Bowman Dam by providing significant instream flows. This beneficial effect can be seen for 14.6 miles from the point of release at Prineville Reservoir until the first major diversion on the Crooked River at RM 55.9. See Figure 98 for a representation of typical irrigation (August) season stream flows and diversions that occur between Prineville Reservoir and Lake Billy Chinook.

The majority of contracted storage released from Prineville Reservoir is diverted to OID project lands at the OID Diversion (into the Crooked River Feed Canal) at RM 55.9. Instream flow reductions from these considerable withdrawals at the OID Diversion reduce the physical extent of instream habitat available for bull trout. These resulting low flows are susceptible to solar radiation that results in increased water temperatures, reducing the quality of the FMO habitat left instream for bull trout. While the majority of storage releases are diverted at the OID Diversion, releases from the 10,000 AF NUID supplemental account remain instream past RM 55.9 and continue to provide marginal benefits to stream temperatures and fish habitat. Approximately 60 cfs bypasses the OID Diversion to provide water to other downstream

irrigation diverters with rights to either natural flows or contracted storage water, and to maintain flows in the Crooked River.

Water releases are managed to meet all contracted water rights and to meet minimum flow targets at the Crooked River low-flow point near Prineville to prevent the river from reaching undesirably low flow levels. Since 2015, this low flow point has been monitored using the CAPO gauge at RM 46.7, which is operated and maintained by OWRD. Downstream of the CAPO gauge, tributary inflows from Ochoco, McKay, and Lytle creeks increase Crooked River streamflows. Irrigation system return flows contribute to this increase to a smaller extent.

Water released from Prineville Reservoir that is attributable to the NUID supplemental storage account remains instream until it reaches its ultimate point of withdrawal at the NUID Pumping Plant at RM 22.4. Any beneficial effects to bull trout from increased flows as a result of storage releases at Prineville Reservoir cease with final delivery to the NUID pumps. NUID uses the pumping station to divert both water from the 10,000 AF supplemental water contract account and Crooked River live flow, up to 200 cfs from the Crooked River. Per agreement with NUID and as included in the DBHCP, NUID will allow 50 cfs or the DRC agreement flows (whichever is greater) to pass by the NUID pumps during irrigation season if sufficient live or protected

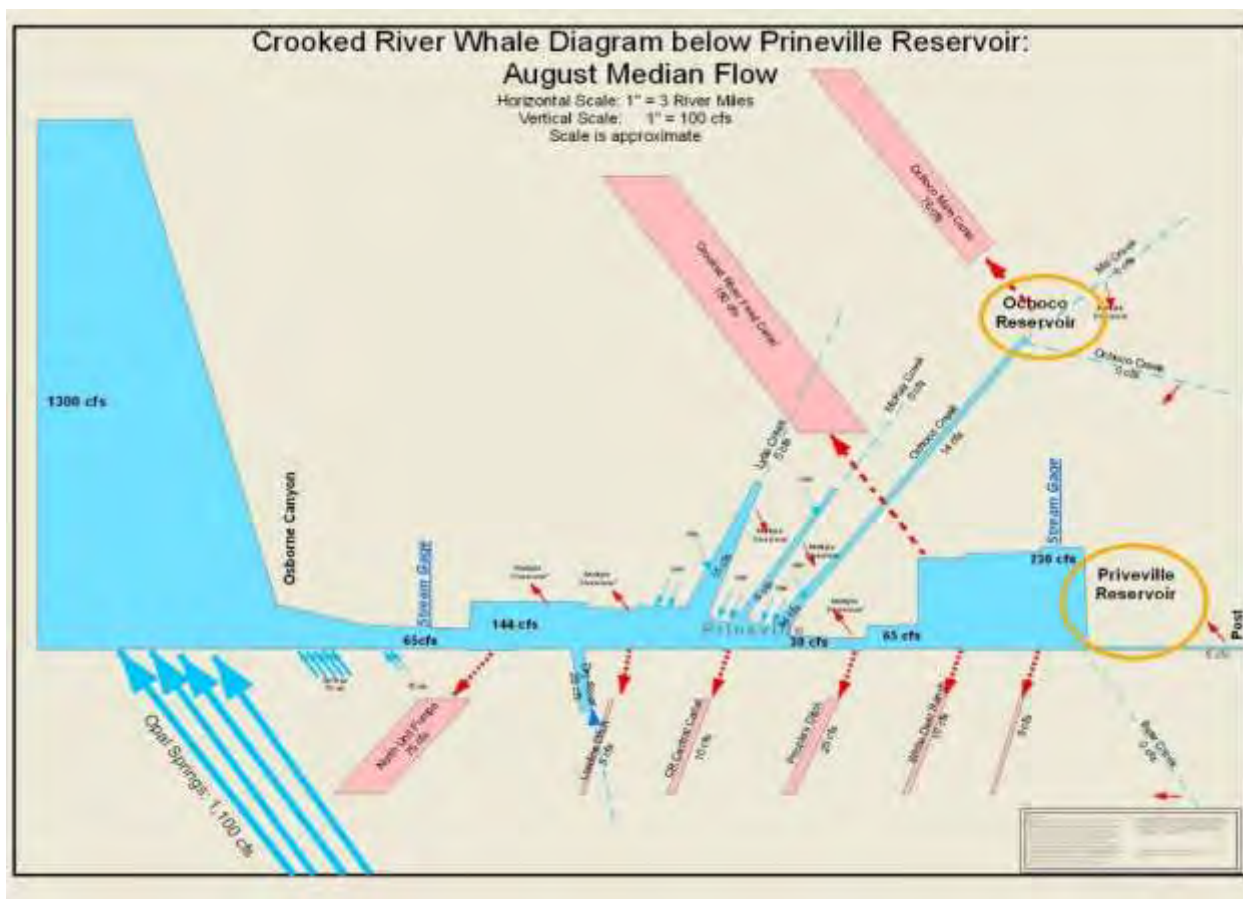


Figure 98. Crooked River Whale Diagram showing relative location and amounts of diversions, tributary inflows, irrigation return flows, and spring inputs between Prineville Reservoir and Lake Billy Chinook. (Assessment, Figure 61)

flows are present (Assessment, Table 13); this excludes flows released from the 10,000 AF supplemental account. As seen upstream, diversions at the NUID pumps reduce flows and increase instream temperatures, reducing the extent and quality of instream habitat available for bull trout.

The NUID pumps represent the last major diversion before Crooked River flows reach Osborne Canyon at RM 7.3. Downstream of Osborne Canyon, the Crooked River begins to gain flow from significant spring and groundwater inputs of about of 1,000 cfs that augment and increase river flows with cool water (Figure 98). Typically, irrigation season flows in the reach between the NUID Pumping Plant and Osborne Canyon range between 50 to 180 cfs. Reclamation anticipates that these irrigation season flow ranges will continue under the proposed action.

The substantial cold water discharges into the Crooked River downstream of Osborne Canyon reduce or eliminate the influences of flow changes from upstream storage, release, and diversion activities, maintaining suitable habitat conditions for bull trout year-round in the reach of the Crooked River below Osborne Canyon to its confluence with Lake Billy Chinook. As such, habitat available for foraging opportunity to adult and sub-adult bull trout is expected to be maintained in this reach (below Osborne Canyon) under the proposed action.

Stream Temperature Analysis

The Service analyzed effects from streamflows to stream temperature using three sources of information:

- 1) Portland State University temperature study: The Applicants contracted with Portland State University (PSU) to model Crooked River temperature effects that could result from implementing the DBHCP.
- 2) OWRD and Reclamation temperature data: OWRD and Reclamation collect flow and water temperature data at several locations on the Crooked River. These include the PRVO gauge at the base of Bowman Dam at RM 70.5; the CAPO gauge in Prineville at RM 46.7; the CRSO gauge at Smith Rock at RM 19.9; and the Osborne Canyon gauge at RM 7.3.
- 3) Hobotemp temperature data: The Service collected Crooked River water temperature data from about June 24, 2019, to October 10, 2020, using underwater temperature data loggers (Hobotemp). The Service deployed sensors at five locations: Elliot Lane at RM 40.1, Lone Pine Bridge at RM 24.6, Smith Rock at RM 20.4, Holochek at RM 14.6, and Osborne Canyon at RM 7.3. The Service also used temperature data from the OWRD's CAPO gauge in Prineville at RM 46.7.

The 2019 and 2020 data show a relationship between stream flow and stream temperature. These are illustrated below for two reaches of the Crooked River: Bowman Dam to CAPO gauge, as shown by flow and temperature effects at CAPO (Figures 99-102); and Lone Pine Bridge to Osborne Canyon, as shown by flow and temperature data at Lone Pine Bridge and Smith Rock (Figures 9-12).

In July of 2019, flows at CAPO increased from about 28 cfs on July 19 to 90 cfs on July 21. During that same period, stream temperatures dropped from 22.2 °C to 18.4 °C, a decline of about 3.8 °C in two days (Figure 99). In 2020 on about April 29, flows at CAPO increased from 125 cfs to 418 cfs; during this period temperatures declined from 14 °C down to 9.7 °C, a drop of 5.3 °C. On May 3, flows dropped to about 107 cfs, and temperatures rose by about 4.6 °C (Figure 100) to 14.3 °C. In 2020, on about June 3, flows at CAPO increased from 18 cfs to 122 cfs; during this period stream temperatures declined from 23 °C to 11.7 °C, a drop of about 11.3 °C. Flows then declined back to about 25 cfs by June 14, and temperatures rose by 7 °C (Figure 101).

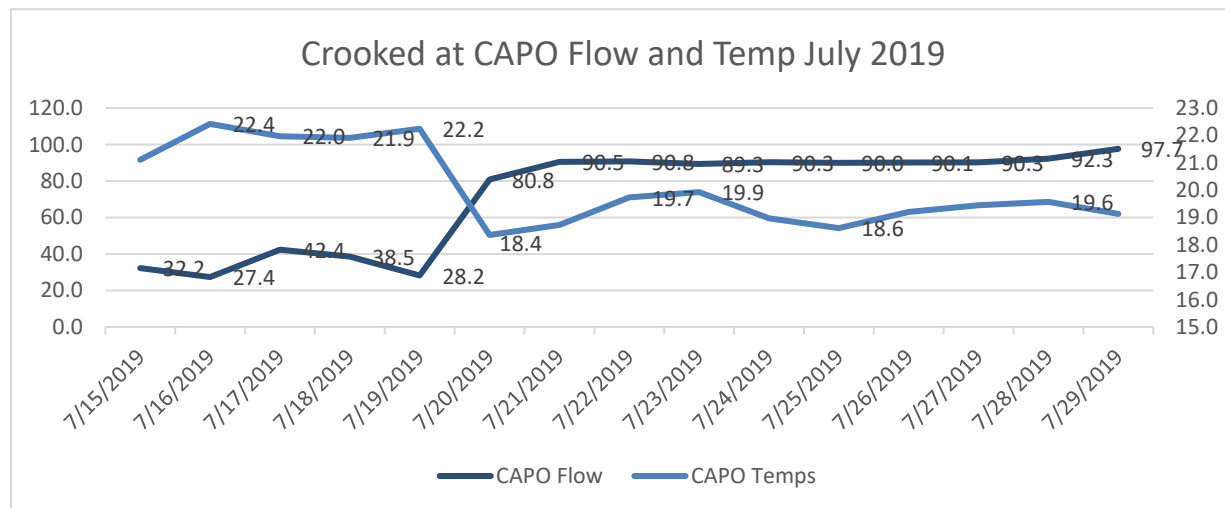


Figure 99. Crooked River Temperature and Flow at the CAPO gauge, July 2019.

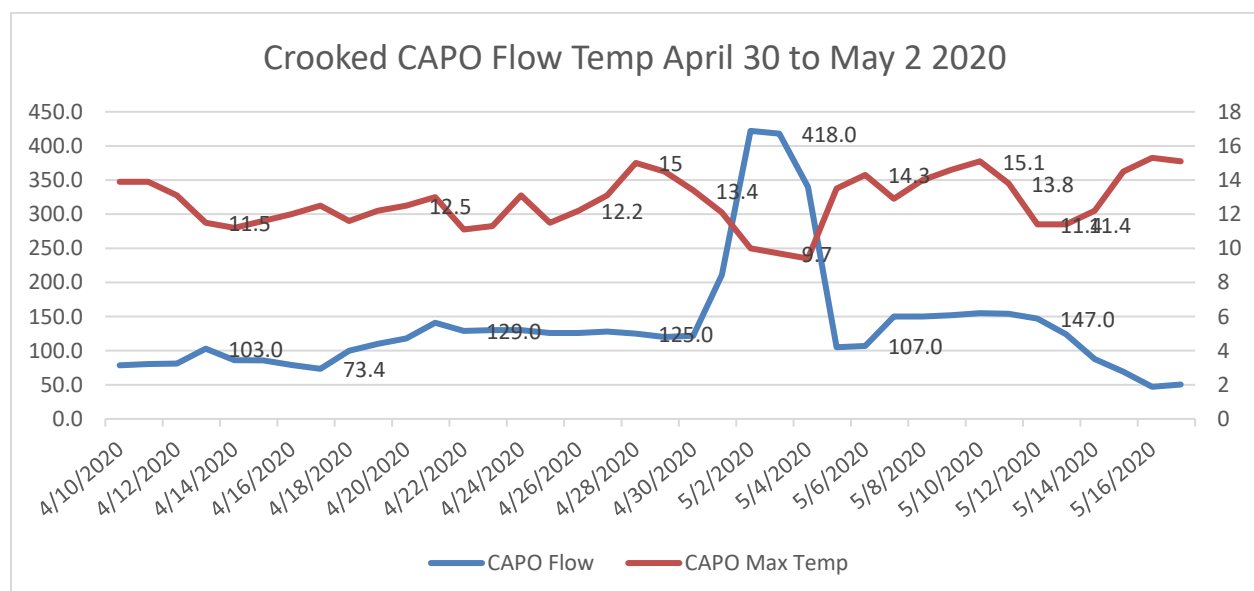


Figure 100. Crooked River Temperature and Flow at the CAPO gauge, April to May 2020.

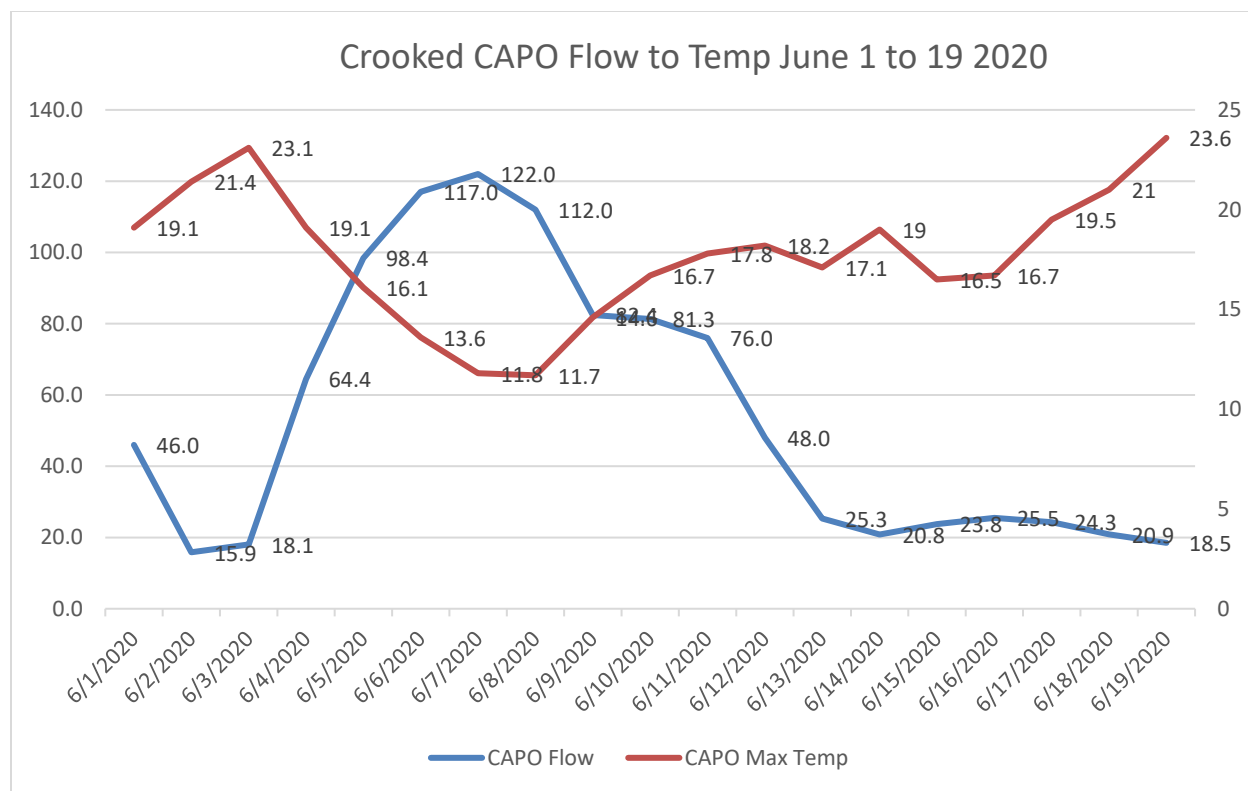


Figure 101. Crooked River Temperature and Flow at the CAPO gauge, June 1-19, 2020.

Temperature and flow data for several locations between Lone Pine Bridge at RM 24.6 and Osborne Canyon at RM 7.3 are illustrated in Figure 102, demonstrating the inverse relationship between temperature and flows. Because of the complexity of this graph, the Service has also examined several temperature and flow monitoring locations separately. In May of 2020, flows at Lone Pine Bridge increased from 213 cfs up to 442 cfs; during this period stream temperatures declined from 16.2 °C to 12.7 °C, a drop of about 3.5 °C (Figure 103). Flows then declined from 442 cfs down to 112 cfs, and temperatures rose from 12.7 °C up to 23.2 °C, an increase of 10.5 °C. Figure 104 illustrates flows at Smith Rock for the same period as the previous graph, but reflects lower stream flows due to diversions at the NUID pumps. In May of 2020, flows at Lone Pine Bridge increased from 102 cfs up to 326 cfs; during this period stream temperatures declined from 15.2 °C to 13.6 °C, a drop of about 1.6 °C. Flows then declined from 326 cfs down to 51 cfs, and temperatures rose from 13.6 °C up to 21.7 °C, an increase of 8.5 °C.

Figure 105 illustrates flows at Holocheck RM 14.6 and Osborne Canyon RM 7.3 for the same May 2020 period as the Lone Pine/Smith Rock graph previous. The flow to temperature relationship is similar, though flows are lower due to the diversions at the NUID pumps at RM 22.4. Flow data is from the Osborne gauge; between the Smith Rock and Osborne gauges the Crooked River gains about 50 to 60 cfs of spring inflow. The temperature effects of these cold springs is shown in the temperature data, where Osborne temperatures at RM 7.3 are from 1 °C to 2.7 °C colder than Holocheck at RM 14.6. Beginning on about May 17, 2020, flows increased from 143 cfs up to 365 cfs. During this period stream temperatures at Holocheck declined from

15.8 °C to 13.5 °C, a drop of about 2.3 °C; at Osborne temperatures declined from 15.8 °C down to 14.1 °C, a 1.7 °C decrease. After about May 19, flows decreased from 365 cfs down to 102 cfs, and temperatures rose from 13.5 °C up to 22.4 °C at Holochek (8.9 °C increase), and rose from 14.1 °C to 19.7 °C at Osborne (5.6 °C increase).

From these data, stream flows are shown to have a strong, inverse relationship with instream temperatures. As instream flows increase in the Crooked River, water temperatures are shown to decrease. And as instream flows decrease, water temperatures exhibit a correlating increase. From this we can surmise that flow reductions as a result of irrigation season diversions will increase instream temperatures under the proposed action, which decreases foraging opportunity for bull trout by reducing the quality of available habitat for bull trout. Low flows in the Crooked River also reduce the physical extent of FMO habitat available for adult and sub-adult bull trout, also reducing foraging opportunity.

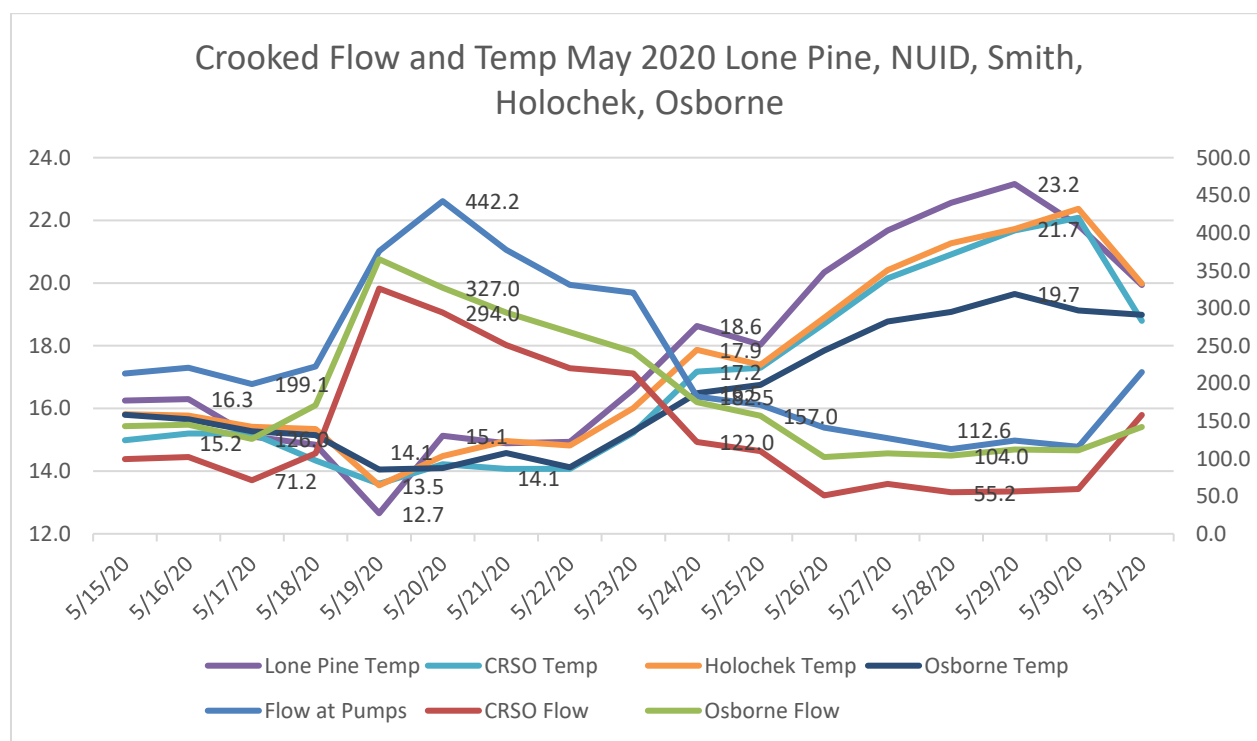


Figure 102. Crooked River Flow and Temperature, May 2020.

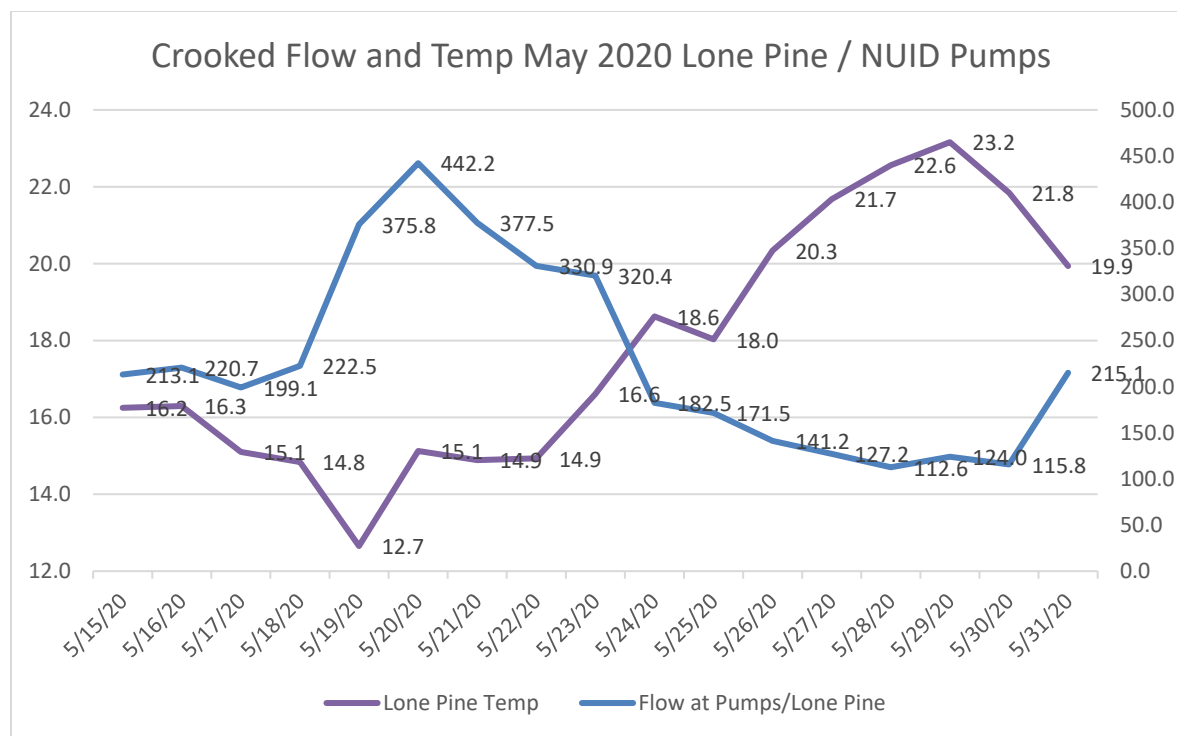


Figure 103. Crooked River Flow and Temperature, May 2020.

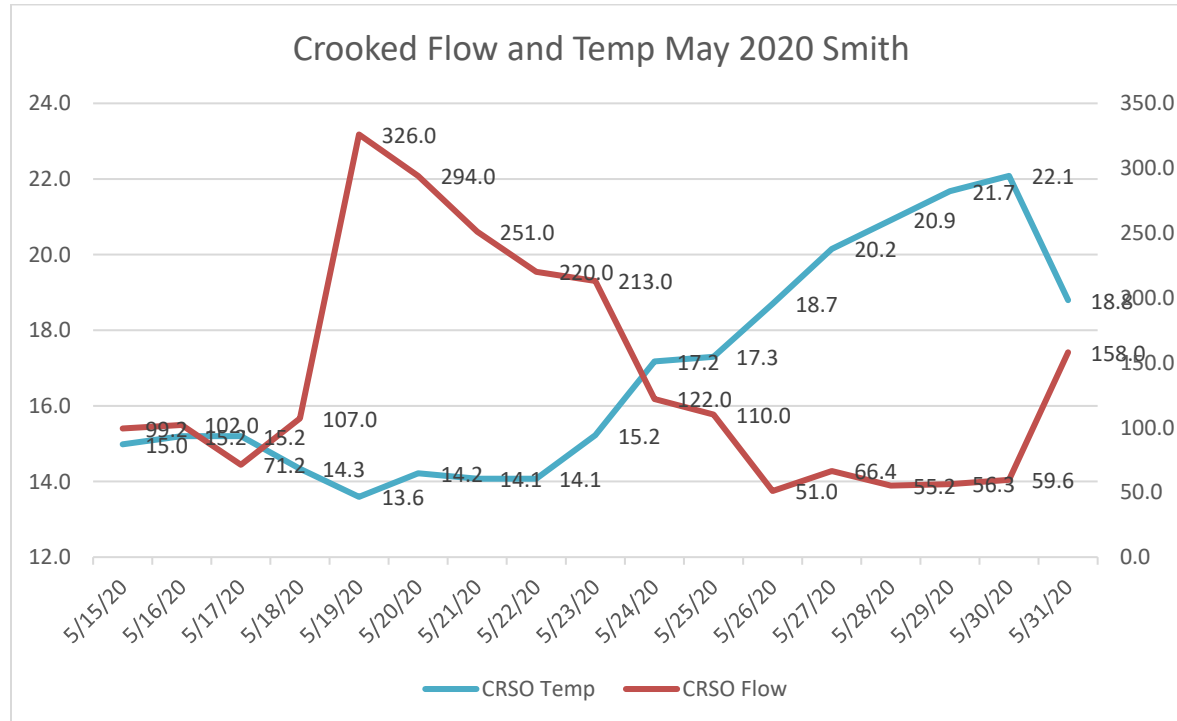


Figure 104. Crooked River Flow and Temperature at Smith Rock, May 2020.

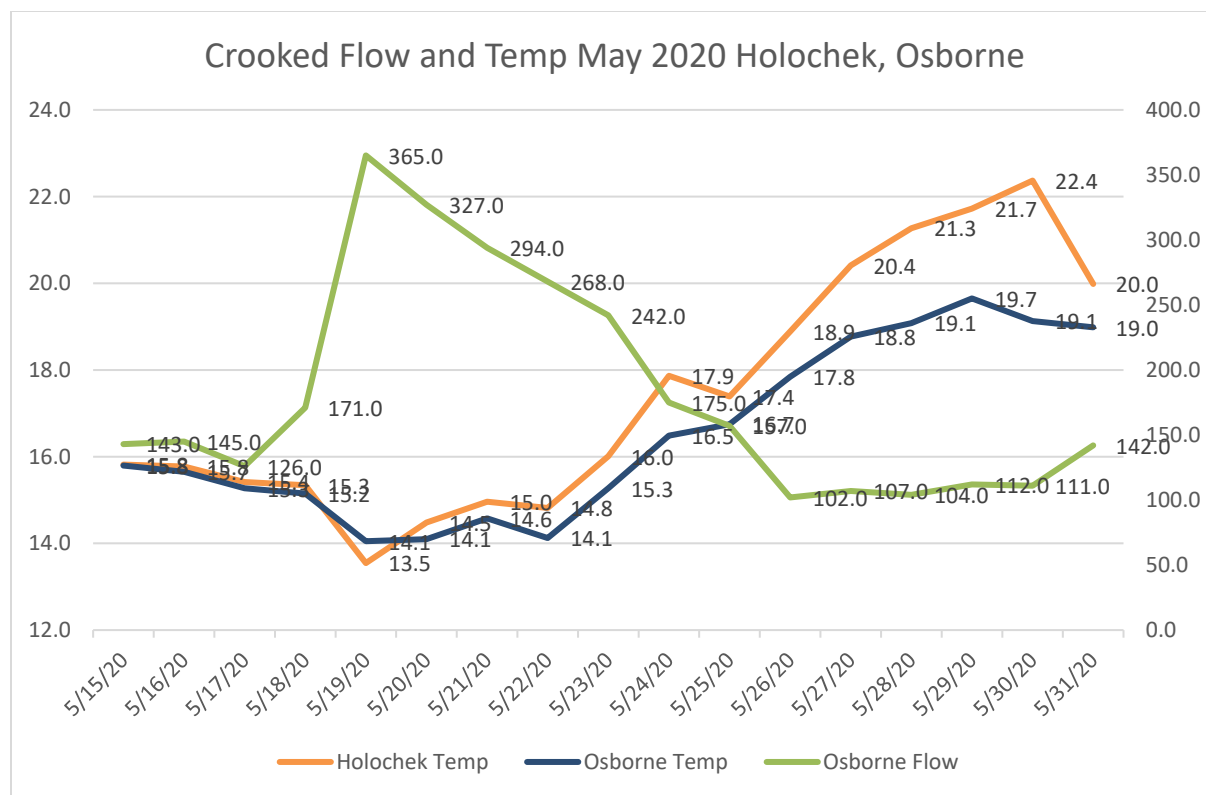


Figure 105. Crooked River Flow and Temperature, May 2020, Holocheck, Osborne.

5.4.1.3.2 Effects from Uncontracted Storage Release

The Crooked River Act authorized up to 62,520 AF of uncontracted storage to provide supplemental flows for fish and wildlife enhancement and instream flow improvement purposes during both the irrigation and storage periods each year. Each year, the Services work with Reclamation to develop a release schedule for this uncontracted storage that maximizes the benefits to fish and wildlife in the Crooked River. Reclamation intends to implement the base flow regimes presented in Tables 9-12 of their Assessment, which were developed through coordination and deliberation with the Services. However, these base flow proposals may be altered depending on each year's specific recommendation from the Services and prevailing hydrologic conditions in the Crooked River subbasin. As such, the base flow tables represent a starting point or "worst case scenario" of flow regimes that will be provided in the Crooked River by Reclamation for any given storage year type.

Because Reclamation releases this uncontracted storage without protecting it with a secondary water right, all uncontracted storage releases for fish and wildlife are considered to be live flow under Oregon law and may legally be diverted by any party with a live flow water right that has not been fully met in that water year. There are about 51.73 cfs of live flow diversion rights between Bowman Dam and the CAPO gauge in Prineville, and about 49.48 cfs between the CAPO gauge and the Smith Rock CRSO gauge, which is downstream of the NUID Pumping Plant (Jennifer Johnson, pers. comm., 2019). In addition, it appears that OID can take up to

190 cfs of live flow if it is available and NUID has a live flow right of about 200 cfs. This suggests that all of the Reclamation's uncontracted storage release could be diverted either between the Bowman Dam and CAPO gauge, or between the CAPO gauge and CRSO gauge.

It is the Service's understanding that diverters that have live flow and/or storage water rights would maximize their use of live flow in the early months of the irrigation season while live flow is available, and then transition to their storage rights (if any) once live flow declines. Since passage and implementation of the Crooked River Act, the release of fish and wildlife flow from uncontracted storage as live flow has made additional live flow available. It has also made live flow available for diversion in the later months of the irrigation season such as July, August, September, and October, assuming that a diverter has not already taken their full live flow water right for the year. Because diversion of uncontracted storage releases as legal instream live flow is reasonably certain to occur, the following analysis of the effects of uncontracted storage releases to bull trout includes consideration of the potential for some or all of these releases to be diverted downstream.

Flow releases made from uncontracted storage without protection from a secondary water right results in adverse effects to bull trout manifested in two ways: diversion of uncontracted storage releases as live flow which results in reduced flows and increases in stream temperature, and lower annual instream flow recommendations from the Services under the Crooked River Act than there would be if the Services could be certain that the full amount of releases benefit downstream fish and wildlife by remaining instream.

The Service has analyzed the effects to stream temperature from releasing uncontracted storage without secondary protection. The diversion of uncontracted releases can have effects to temperature during the entire April to October irrigation season. Water temperature data collected by Service Hobotemps and Reclamation/OWRD monitoring stations show that stream temperatures begin to exceed the bull trout suitability threshold of 16 °C early during the irrigation season, and do not decline below 16 °C until late in the season. These temperature effects will affect bull trout distribution in the Crooked River during the April to October period. The Service anticipates that bull trout will move from stream reaches that have increasing temperatures to find areas of the Crooked River that have more suitable temperatures, either upstream or downstream. The irrigation season flows and temperature are shown in Figure 106 (CAPO RM 46.7) and Figure 107 (Smith Rock RM 19.9) below.

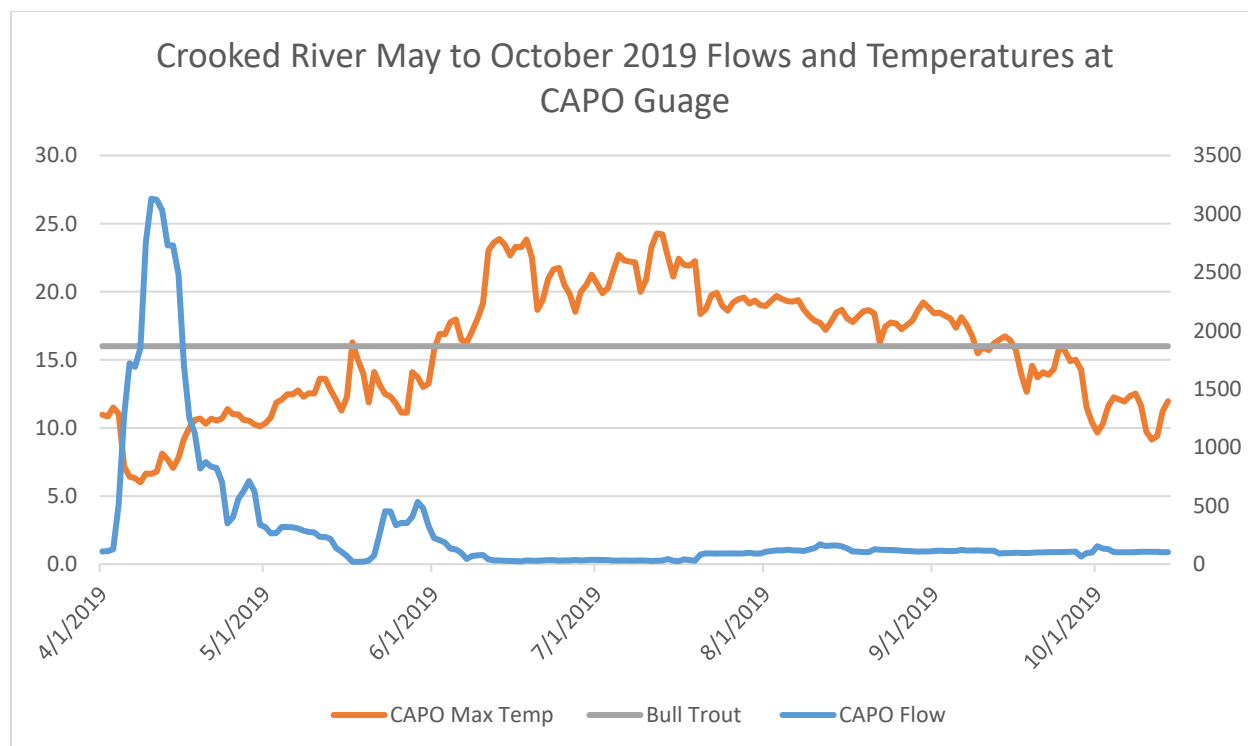


Figure 106. Crooked River Flow and Temperature at the CAPO gauge, May to October 2019.

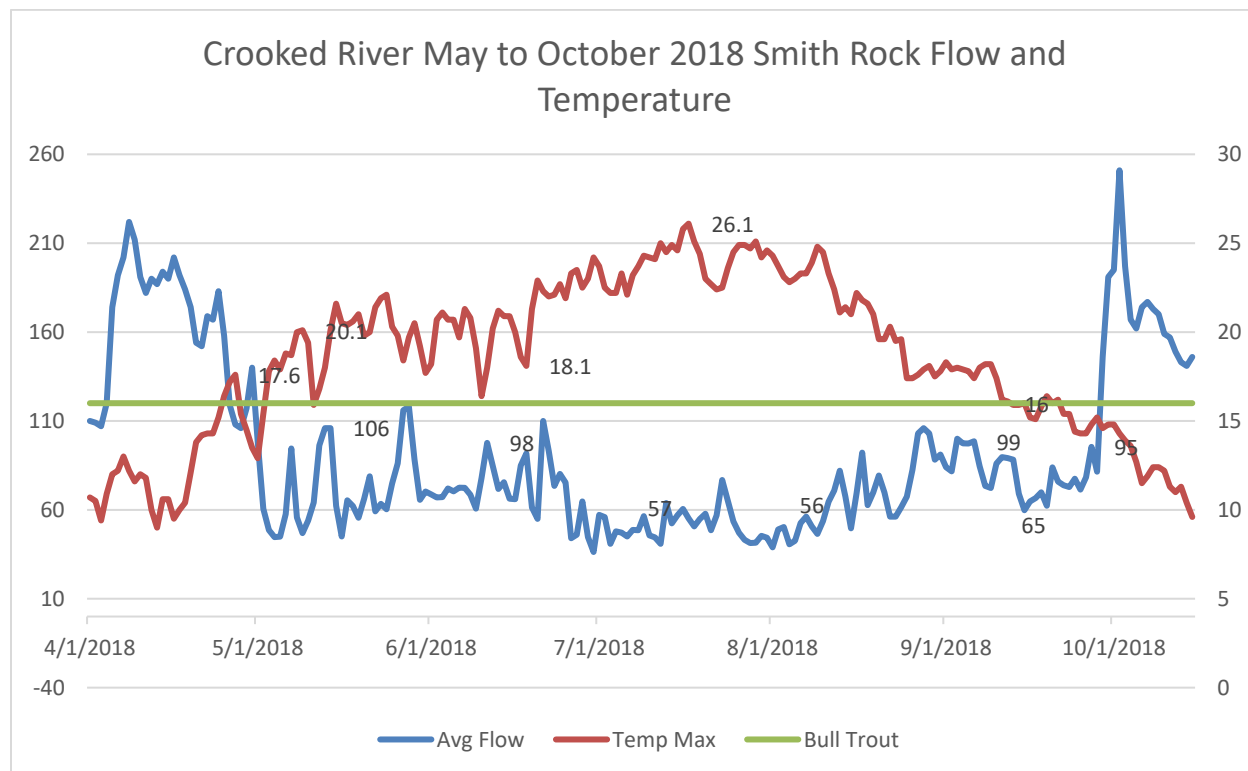


Figure 107. Crooked River Flow and Temperature at the Smith Rock gauge, May to October 2018.

Instream Flow Effects of Uncontracted Release between Bowman Dam and CAPO Gauge

The Service analyzed the instream flow and habitat effects of Reclamation releasing three volumes of uncontracted storage (20 cfs, 30 cfs, and 80 cfs) from Bowman Dam during irrigation season, based on the four proposed base flow scenarios described in Section 4.2.6 of the Assessment. As shown in Table 7 of the Assessment, 20 cfs flow would occur during the Dry and Very Dry base flow years, while 30 cfs would be released during the Average base flow year. The 80 cfs release represents the highest irrigation season flow the Service anticipates would be requested and released for fish and wildlife under the Crooked River Act. Based on our review of instream flow data for recent water years and releases from uncontracted storage, contracted irrigation storage, and live flow releases, the Service believes that the risk that these uncontracted releases would be diverted as live flow before reaching the CAPO gauge is minimal. We also acknowledge that Reclamation proposes to reduce uncontracted storage releases during the irrigation season in proportion to increases in streamflow that result from NUID's call for water from the 10,000 AF supplemental account. However, our review of the available data found that: 1) the live flow diversion water rights upstream of the CAPO gauge exceed the 20 cfs, 30 cfs, and 80 cfs flow volumes; and, 2) there are periods at the beginning and end of the irrigation season when NUID is not calling on the 10,000 AF account.

To analyze the effects from diversion of uncontracted storage as live flow, the Service assumed that the instream flow reductions could result in a likely maximum stream temperature increase of 5 °C. This temperature is based on our review of the streamflow to stream temperature relationship observed in the temperature data, and which was described above. Using 2019 as an example, the Service reviewed data on stream temperatures at CAPO for the April 1 to October 15 irrigation season (Figure 108). Temperatures began to exceed 16 °C on June 1 and remained above 16 °C until September 16.

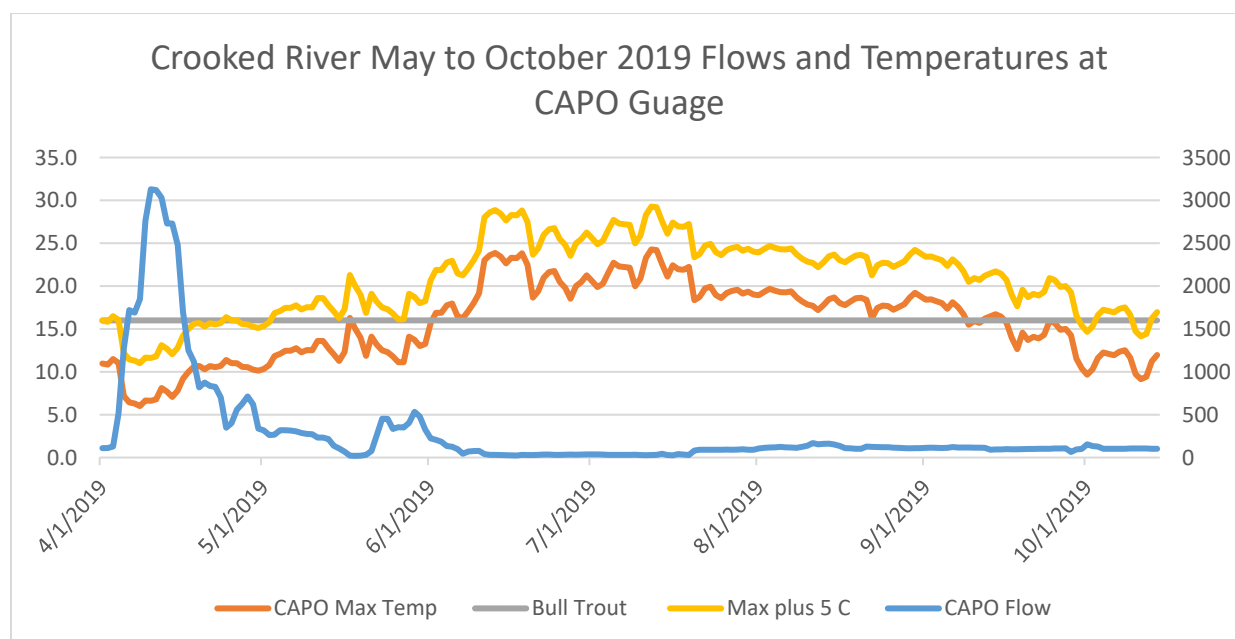


Figure 108. Crooked River Flow and Temperature at the CAPO gauge, May to October, 2019.

During the 197-day irrigation season, temperatures at CAPO were above 16 °C for a total of 104 days, while there were 95 days below 16 °C. If stream temperatures for that same period increased by 5 °C, they would begin to exceed 16 °C on May 2 and remain above 16 °C until October 9. During the 197-day irrigation season, temperatures at CAPO would have been above 16 °C for a total of 161 days, while there would have been 36 days below 16 °C.

CAPO gauge 2019 data	Period Above 16 °C	Days Above 16 °C	Days Below 16 °C
2019 Temperature Data	June 1 to Sept 16	104	95
Projection of Unprotected Uncontracted Storage Releases (2019 data plus 5 °C)	May 2 to Oct 9	161	36

Instream Flow Effects of Uncontracted Release between Lone Pine Bridge and Smith Rock Gauge

The Service analyzed the potential effects from diversion of uncontracted release diversions at the NUID Pumping Plant (RM 22.4) as measured by flows at the Smith Rock gauge (CSRO) at RM 19.9. Flow compliance at the NUID pumps is determined using two gauges: 1) the Lone Pine gauge at RM 24.6, which measures flow reaching the NUID pumps; and 2) the CSRO at RM 19.9, which measures flow passing the NUID pumps. As described above, the Service analyzed the instream flow and habitat effects of releasing three proposed volumes of uncontracted storage from Bowman Dam during irrigation season: 20 cfs, 30 cfs, and 80 cfs.

In contrast to the previous analysis using flow data at the CAPO gauge, the Service has concluded that it is significantly more likely that instream flow releases from uncontracted storage will be diverted before reaching the Smith Rock gauge. This conclusion is based on our review of instream flow data from recent water years for recent releases from uncontracted storage, contracted irrigation storage, and live flow releases. Our review of the available data found that: 1) the live flow diversion water rights at the NUID's pumps exceed the 20 cfs, 30 cfs, and 80 cfs flow volumes and, 2) a comparison of calculated flows reaching the pumps, pumping data, and flow data from the Smith Rock gauge suggest that uncontracted storage releases are being diverted as live flow at the NUID pumps. Thus, we have analyzed the effects to bull trout from uncontracted storage releases under circumstances that are reasonably certain to occur; these circumstances being that the uncontracted storage releases will be diverted before reaching the CSRO gauge.

The amount of stream flow passing the pumps is governed by conservation measures in the DBHCP. One result of the structure of the measures is that downstream of the NUID pumps, there is less instream flow benefit from protecting uncontracted storage release. As described below, even if the 20 cfs and 30 cfs uncontracted storage releases have secondary protection, this protection does not result in higher instream flows past the NUID pumps. Streamflow past the

pumps does not benefit from either increased uncontracted storage releases or secondary protection until uncontracted releases exceed 50 cfs, which is the minimum flow that NUID is required to maintain past their pumps under the DBHCP (CR-6).

Our analysis of the instream effects of uncontracted storage releases below assumes a reasonably realistic irrigation season base flow of 40 cfs in addition to the volumes of each storage release scenarios, and accounts for the NUID requirement to pass a minimum of 50 cfs of live flow when available.

When 20 cfs of uncontracted storage is released from Prineville Reservoir (presumably during a Dry or Very Dry base flow year), we anticipate the same volume of water to pass the NUID pumps with or without protection from a secondary water right. This is because uncontracted storage releases are less than the 50 cfs minimum that NUID is required to pass. For example:

$$40 \text{ cfs base} + 20 \text{ cfs uncontracted} = 60 \text{ cfs arrives at NUID} \rightarrow \mathbf{50 \text{ cfs instream below NUID}}$$

(NUID passes 50 cfs minimum, which includes 20 cfs uncontracted if protected)

When 30 cfs of uncontracted storage is released from Prineville Reservoir (presumably during a Average base flow year), we still anticipate the same volume of water to pass the NUID pumps with or without protection from a secondary water right even with higher release flows:

$$40 \text{ cfs base} + 30 \text{ cfs uncontracted} = 70 \text{ cfs arrives at NUID} \rightarrow \mathbf{50 \text{ cfs instream below NUID}}$$

(NUID passes 50 cfs minimum, which includes 30 cfs uncontracted if protected)

When 80 cfs of uncontracted storage is released from Prineville Reservoir (highest anticipated flow recommendation), we expect that a higher volume of water would pass the NUID pumps with protection from a secondary water right than without. This is because uncontracted storage releases are higher than the 50 cfs minimum that NUID is required to pass, so NUID would have to pass the higher volume if the releases were protected:

$$40 \text{ cfs base} + 80 \text{ cfs uncontracted} = 120 \text{ cfs arrives at NUID} \rightarrow \mathbf{50 \text{ cfs instream below NUID}}$$

*(NUID passes 50 cfs minimum; legally diverts all other **unprotected** live flow)*

VS

$$40 \text{ cfs base} + 80 \text{ cfs uncontracted} = 120 \text{ cfs arrives at NUID} \rightarrow \mathbf{80 \text{ cfs instream below NUID}}$$

*(NUID passes 80 cfs **protected** uncontracted, which includes 50 cfs minimum)*

Without protection by an instream secondary water right, which is the existing circumstance under the proposed action, any uncontracted releases in excess of 50 cfs can be legally diverted by NUID as live flow. If uncontracted releases were protected, any uncontracted flows in excess of the 50 cfs minimum would also be required to pass the NUID pumps. For the reasons shown above, we thus do not anticipate instream flow effects from uncontracted storage releases to vary based on secondary water right protections until uncontracted releases exceed 50 cfs (i.e., the minimum flow NUID is required to pass under the DBHCP).

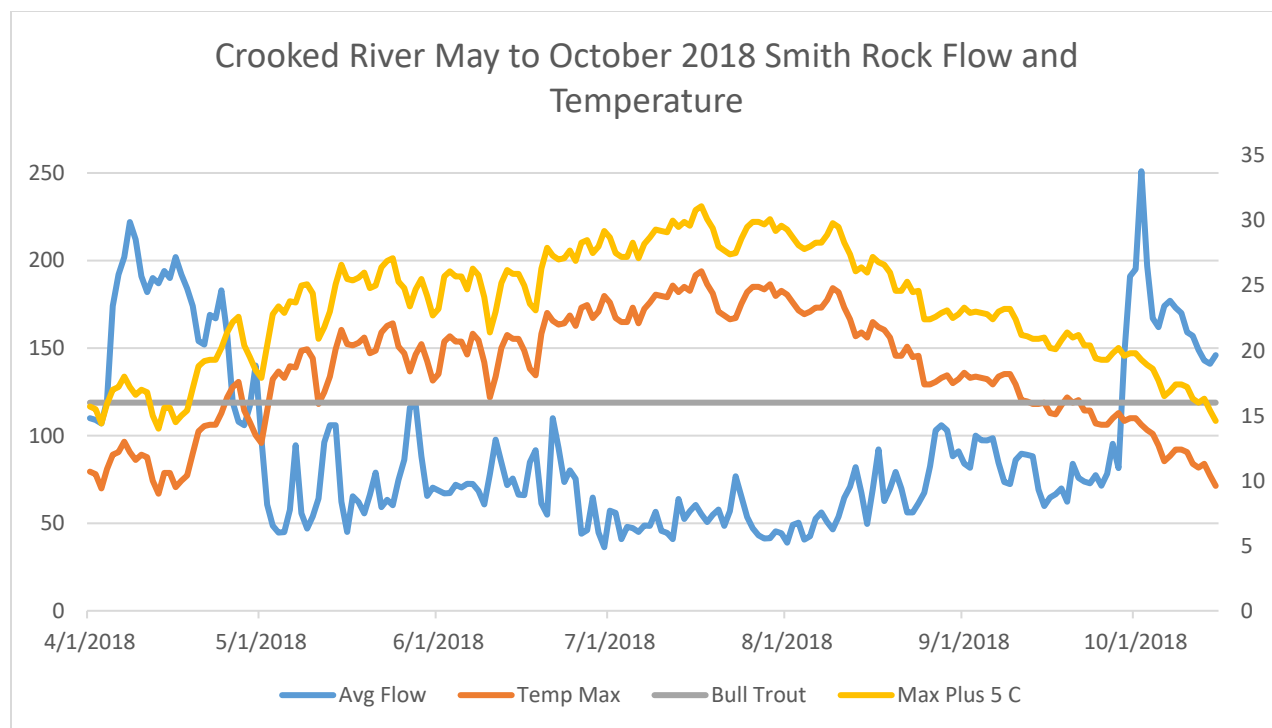


Figure 109. Crooked River Flow and Temperature at the Smith Rock gauge, May to October 2018.

To analyze the effects from diversion of uncontracted storage as live flow, the Service assumed that the instream flow reductions could result in a stream temperature increase of 5 °C. This temperature is based on our review of the stream flow to stream temperature relationship observed in the temperature data, and which was described above. Using 2018 as an example, the Service reviewed data on stream temperatures at Smith Rock for the April 1 to October 15 irrigation season. Temperatures began to exceed 16 °C on April 25 and remained above 16 °C until September 12 (Figure 109). During the 197-day irrigation season, temperatures at Smith Rock were above 16 °C for a total of 139 days, while there were 59 days below 16 °C. If stream temperatures for that same period increased by 5 °C, they would begin to exceed 16 °C on April 19 and remain above 16 °C until October 12. During the 197-day irrigation season, temperatures at CAPO would have been above 16 °C for a total of 185 days, while there would have been 13 days below 16 °C.

Table 45. Smith Rock Temperature Data

CSRO gauge 2018 data	Period Above 16 °C	Days Above 16 °C	Days Below 16 °C
2018 Temperature Data	April 25 to Sept 12	139	59
Projection of Unprotected Uncontracted Storage Releases (2018 data plus 5 °C)	April 19 to Oct 12	185	13

Summary of Effects from Uncontracted Storage Release

Uncontracted storage from Prineville Reservoir released without secondary protection (existing circumstance under the proposed action) becomes live flow after release and can be diverted by any party holding a live flow right, anywhere between Bowman Dam at RM 70.5 and the Crooked River's confluence with Lake Billy Chinook. Significant diversions do not occur until the OID Diversion at RM 55.9, thus in the 14.6 miles from Bowman to the OID Diversion, releases from Prineville Reservoir are anticipated to benefit bull trout through increased flows and lower instream temperatures resulting in increased quality and extent of habitat available for foraging. Beyond that, diversion of uncontracted releases is considered reasonably certain to occur and are likely to adversely affect bull trout. Individual bull trout will be impacted by decreases in stream habitat as flow is reduced and by increased stream temperatures caused by flow reductions, which both reduce foraging opportunity.

These diversions are likely to reduce instream flows and increase instream temperatures, reducing the extent and quality of instream FMO habitat available for adult and sub-adult bull trout from the OID Diversion to Osborne Canyon, where large groundwater discharges of about of 1,000 cfs begin to enter the Crooked River, and reduce or eliminate the effects of upstream irrigation activities to insignificant levels. Further, the Services are unlikely to make annual instream flow recommendations under the Crooked River Act to the full benefit of downstream fish and wildlife if they cannot be reasonably certain that the full amount of uncontracted releases will remain instream for fish and wildlife use. That is, the Services would likely make lower flow recommendations than if the releases were certain to remain instream, further reducing flows in the Crooked River from their maximum beneficial extent to bull trout from Bowman Dam to Osborne Canyon.

If uncontracted storage releases were protected by an instream secondary water right, these releases would remain instream in their entirety for the benefit of downstream bull trout and other fish. Instream uncontracted release flows could benefit bull trout by mitigating diversions such as the substantial withdrawals at the OID Diversion, through increased instream flows and lower water temperatures that enhance foraging opportunity. There would be no adverse effects anticipated from uncontracted storage releases if they were certain to be left instream.

5.4.1.3.3 Effects from Flood Control Operations

Reclamation discusses the flow effects of their flood control operations in section 7.4.1 of their Assessment, and analyzes the biological effects of these operations in section 7.4.2 (Reclamation 2020).

Reclamation manages Prineville Reservoir and Bowman Dam based on a two-part rule curve that includes: 1) a static space requirement of 60,000 AF until February 15 of each storage season, and 2) a Dynamic Storage Reservation Diagram (DSRB) described in section 4.3 of the Assessment. The reservoir's fill after February 15 is based on the DSRB. The maximum allowable reservoir discharge is 3,000 cfs. The Assessment states that all flow releases from Prineville Reservoir, including flood releases, are discretionary Federal actions; thus, the effects of flood control are addressed in this consultation.

Reclamation analyzed discharges from Bowman Dam from 2000 to 2019. To assess what effects, if any, the Crooked River Act had on flow management, Reclamation also evaluated flow releases from 2014 to 2019. In addition to reviewing data on releases, Reclamation also modeled flow releases using RiverWare and did not find any significant differences between the pre-2014 and post-2014 flood releases. They also used RiverWare to extend the period of analysis to 100 year and 500 year flood regimes. The model predicted that the frequency of 100-year flood flows would increase by about 5 percent, and 500-year events would increase by about 8 percent under the proposed action. Reclamation concluded that, overall, these would not affect flood risk in the Crooked River.

Flood flow effects to flow velocity, depth, and turbidity can adversely affect bull trout, as described in Section 7.4.3 of the Assessment. Analysis of recent data on Bowman Dam flow releases and RiverWare modeling show that there will be periods of flood flow release from Bowman Dam that will have sublethal behavior effects to bull trout such as avoidance of unsuitable conditions in which bull trout will move to other suitable habitats. With the mobility of individual fish anticipated to potentially be present (i.e., adult and sub-adult life stages) in the Crooked River downstream of flood releases, the Service does not anticipate any adverse effects from flood flow effects to flow velocity, depth, and turbidity that rise to the level of harm (actually injures or kills) to individual bull trout. The Service does, however, anticipate adverse effects to bull trout from high flow releases that result in gas supersaturation below the dam, as analyzed in the following paragraphs.

Total Dissolved Gas Effects from Flood Control Actions

Flood releases from Bowman Dam can increase downstream concentrations of total dissolved gas (TDG), which can be harmful to fish above certain concentrations as described below. This occurs when plunging flow releases entrained air into the water column, creating gas supersaturation. The degree of supersaturation is also influenced by water temperature, barometric pressure, and photosynthesis. The U.S. Environmental Protection Agency (EPA) has established a maximum biological TDG criterion of 110 percent. Flows that result in TDG levels in excess of 110 percent are in violation of Federal water quality standards. Studies on Crooked River TDG suggest that gas supersaturation levels can reach 110 percent when Bowman Dam flows are around 600 cfs (Assessment, Table 67). However, when compensating depths are available, short-term exposure to TDG levels up to 120 percent do not produce significant adverse effects on juvenile and adult salmonids (Johnson 2005). Crooked River TDG levels reach 120 percent at flows above 1,500 cfs. According to Table 66 of the Assessment, flows above 600 cfs occur 11.35 percent of days, and flows above 1,500 cfs occur 2.04 percent of days (these percentages are used later in this section to calculate the number of bull trout anticipated to be affected by elevated levels of TDG).

Reclamation also assessed possible TDG effects from spill at Ochoco Dam on Ochoco Creek. The frequency of spill at this dam is much lower than at Bowman Dam. The Ochoco spillway is sloped at an angle of less than 10 percent, which avoids direct fall of water releases into a plunge pool as occurs at Bowman Dam. Based on this information, Reclamation concluded that possible TDG effects were minimal, and did not further evaluate possible TDG effects from Ochoco

Dam. The Service also concludes that TDG levels resulting from Ochoco Dam flood releases are not likely to adversely affect bull trout in Ochoco Creek. Reclamation summarizes the biological effects of elevated TDG on fish in section 7.4.2.4 of their Assessment. Analysis of TDG effects anticipated from Bowman Dam flood releases are described below.

Four independent TDG studies have been conducted in the Crooked River downstream of Bowman Dam. The TDG are studies are 1) BOR 2008, 2) Nesbit 2008-2010, 3) Sharpe 2011-2012, and, 4) Mt. Hood Environmental (MHE) 2019. These studies occurred at a variety of flows and environmental factors such as water temperature, barometric pressure, and photosynthetic activity. As a result, the studies found a range of possible TDG levels associated with specific Bowman Dam flow releases. Reclamation (BOR 2008) found lower TDG levels at various flows, while both the Nesbit and Sharpe studies had more similar results; they observed higher TDG levels than Reclamation, regardless of flow release. These studies also came to different conclusions regarding the distance that elevated TDG persisted downstream. Reclamation's study found that TDG levels decreased to 110 percent about two miles downstream of the dam. However, Nesbit found that elevated TDG continued downstream about 7.5 miles at flows greater than 600 cfs (which is the conservative measure the Service has used in our analysis). The MHE study monitored TDG at flows between 406 cfs and 3,100 cfs. They observed TDG ranging from 109 percent to 124 percent, and found that TDG remained above 120 percent until flows dropped below 1,000 cfs. Data from the Crooked River studies suggests that TDG increases as flood flow releases increases, and could reach 135 percent to 140 percent (figure 110). Both Nesbit and Sharpe predicted that flows between 2,000 and 3,000 cfs can produce TDG levels of up to 144 percent.

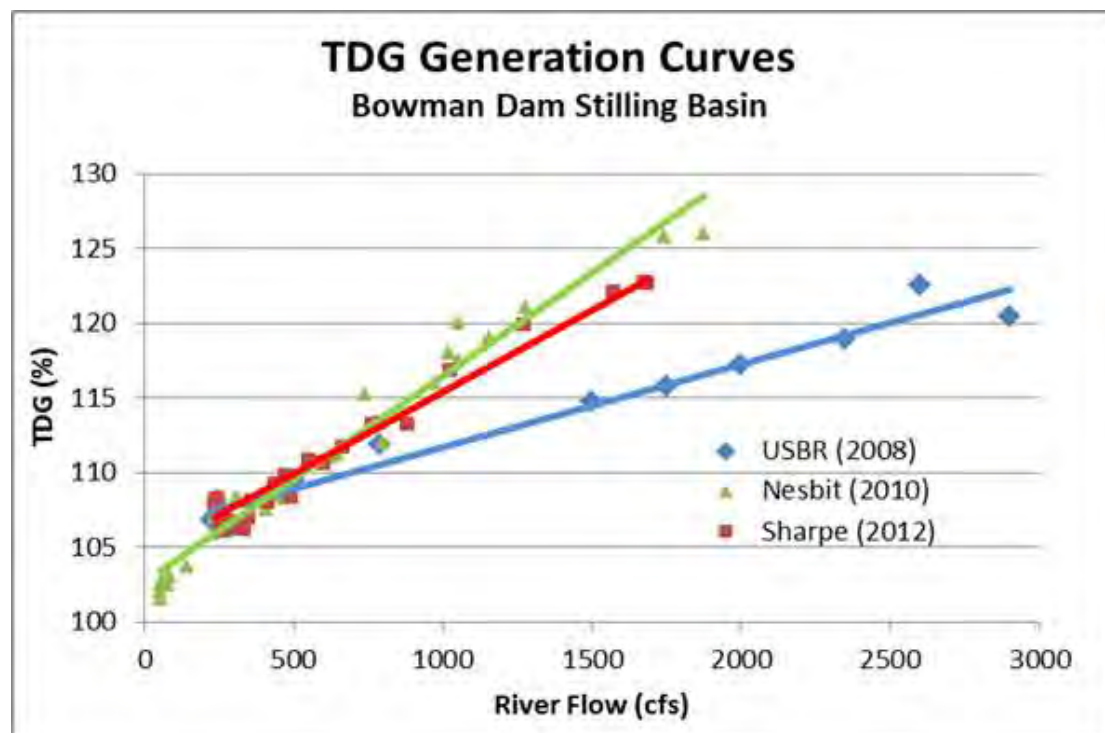


Figure 110. Total Dissolved Gas (TDG) Curves at Bowman Dam Stilling Basin

In addition to these four studies that collected data on TDG levels in the river during spill, the ODFW has conducted other studies that collected data on the biological effects of spill. In 1989 and 2006, ODFW collected data on fish affected by TDG levels downstream of Bowman Dam. In both years, ODFW observed significant adverse effects to Crooked River salmonids. In 1989, flow releases with the potential to cause significant TDG levels lasted about 30 days. In 2006, flow releases with the potential to cause significant TDG levels lasted about 28 days.

Flood flow events in the 1,500 cfs to 3,000 cfs range could occur on average once every two to three years, and these flows could result in impacts to bull trout from increased flow velocity, depth, and turbidity. These effects will largely be in the form of avoidance behavior, causing bull trout to move from preferred habitats. However, Reclamation suggests that there will still be sufficient cover or deep pool refugia for bull trout even during these high flows, and that the bull trout's strong swimming ability should allow them to access those habitats.

Flood events in the 1,500 cfs to 3,000 cfs range could cause TDG levels in excess of 120 percent, which could persist for several miles downstream of Bowman Dam. However, Reclamation's Assessment suggested that effects to bull trout would be reduced by several factors such as depth compensation, avoidance, and the infrequency of flood events causing high TDG. Reclamation suggested that bull trout can move downstream to areas with lower TDG. While such behavior is possible, Reclamation did not cite any information or studies that verify this behavior.

Reclamation also suggested that bull trout can move to nearby areas of deeper water which will compensate for the effects of high TDG. As described in Reclamation's Assessment, every meter of increased depth is equivalent to a 10 percent reduction in TDG. For example, if a fish is exposed to TDG of 110 percent at the water surface, and moves one meter deeper in the water column, it will experience a TDG level of 100 percent. While such behavior is possible, Reclamation did not cite any information or studies that verify this behavior. However, the Service acknowledges that bull trout are typically found in deeper water, and prefer areas around the streambed. This may pre-dispose bull trout to already be present in areas of lower TDG. At flows above 2,000 cfs, TDG effects would likely exceed the refuge offered to fish by sounding to maximum depths. This suggests that, even with depth compensation, bull trout will still be vulnerable to adverse effects from TDG as described below.

Elevated TDG can result in a condition called Gas Bubble Disease (GBD; also known as Gas Bubble Trauma), which refers to the development of gasses in a fish's bloodstream and tissue that can block vascular blood flow or cause uncontrolled expansion of a fish's air bladder, leading to mortality. Common signs of GBD include bubbles or blisters under the skin, especially between the fin rays, but also in the head, lining of the mouth, and gills (Weitkamp and Katz 1980; Marotz et al. 2007; Weitkamp et al. 2003a, b). Adverse effects to fish with GBT include blindness, stress, fungal infection, decreased lateral line sensitivity, sudden loss of ability to swim against a current, inability to avoid obstacles, increased predation, loss of equilibrium, loss of direction, or violent movement and then periods of inactivity (Dawley and Ebel 1975; Weitkamp and Katz 1980). These effects could result in a bull trout's inability to effectively feed or shelter from predation. In addition, behavioral responses to elevated TDG may be exhibited such as area avoidance and moving to deeper water (Weitkamp et al. 2003a). Mortality from

GBD generally occurs from anoxia resulting from slowing or stoppage of blood flow, but sublethal effects can also lead to death. (Weitkamp and Katz 1980).

The amount of direct mortality to bull trout is unknown due to a lack of studies on GBD in bull trout. However, impacts are likely similar to other salmonids. The Service's July 24, 2020 Opinion for the Columbia River System Operations (01EOW00-2017-F-1650) stated that the primary risk to bull trout from elevated TDG levels is GBD. Bull trout that are present in the Crooked River downstream of the dam are expected to experience behavioral effects such as avoidance, sublethal effects such as disorientation, and lethal effects as described above for a conservative extent of 7.5 miles downstream of Bowman Dam.

Analysis of recent data on Bowman Dam flow releases and RiverWare modeling show that there will be periods of flood flow release from Bowman Dam that will result in increased TDG. We calculated the number of days in which flood releases could result in TDG reaching or exceeding 110 percent, since 110 percent is the Federal water quality standard. Flows above 600 cfs (which correspond to TDG levels of 110 percent) occur 11.35 percent of days, which is 41 days per year on average. The extent of effect over the duration of the proposed action = 30 years x 41 days per year = 1,243 days; affecting 7.5 miles of Crooked from Bowman Dam at RM 70.5 downstream to RM 63.

Flows over 1,500 cfs resulting in TDG levels exceeding 120 percent, can have sublethal and lethal effects to bull trout. Flows above 1,500 cfs occur 2.04 percent of days, which is 8 days per year on average. The extent of effect over the duration of the proposed action = 30 years x 8 days per year = 240 days; affecting 7.5 miles of Crooked from Bowman Dam at RM 70.5 downstream to RM 63. However, TDG studies and the ODFW's data on TDG effects to Crooked River fish species show that in some years flood flow releases can result in TDG events lasting up to 30 days. Therefore, while we anticipate adverse effects to bull trout from elevated TDG an average of 8 days per year over the life of the DBHCP, this will be an average of annual variations that can include years with as many as 30 days of flows above 1,500 cfs.

5.4.1.3.4 Effects from Safety of Dams Inspections and Extraordinary Maintenance (throughout the Deschutes Basin)

As described in Reclamation's Assessment, Reclamation's Dam Safety Program consists of required Reviews of Dam Operations and Maintenance Activities (RO&M) and Safety Evaluations of Existing Dams (SEED). After the RO&M and SEED program examinations are completed, Reclamation dam maintenance and safety of dam engineering staff may make recommendations for follow up repair and other extraordinary maintenance actions to bring Reclamation-owned dams into compliance with established maintenance and safety protocols. Sections 4.6 and 4.7 of the Assessment detail Reclamation's processes and schedules for examination of their facilities. The RO&M and SEED program examinations and extraordinary maintenance process will both require reducing flow releases from Reclamation facilities for varying durations (a few hours to several days) and to as low as 0 cfs up to 500 cfs; details of the schedules activities are summarized in the *Description of the Proposed Action* and Tables 17-23 of the Assessment.

The majority of the scheduled routine operational, inspection, and extraordinary maintenance activities will occur at Crane Prairie and Wickiup Dams. As described in the *Effects to Bull Trout in the Middle/Lower Deschutes River Subbasin* sections above, the influence of dam operations, and corresponding flow reductions, in the upper Basin are largely reduced to insignificant levels by the time flows reach these sections of the Basin due to substantial, natural cold-water inflows to the Deschutes River between approximately RM 160 and RM 100 (Tumalo Creek to Madras). Since the upper limit of bull trout dispersal in the Deschutes River is at RM 132, scheduled activities at Crane Prairie and Wickiup Dams are not likely to adversely affect bull trout.

There are a few scheduled inspection and operational testing activities that will occur at Ochoco (that will reduce flow to 0 cfs for 4 hours) and Bowman (25 cfs for 8 hours) dams, and one extraordinary maintenance activity at Ochoco Dam (2 cfs for 6 days). There are no scheduled extraordinary maintenance activities at Bowman Dam; should any RO&M, SEED, or maintenance activities not defined in the Assessment (Tables 17-23) be required, they will be consulted on separately. While bull trout have recently regained access to the Crooked River subbasin with the fish passage at Opal Dam, the Service anticipates dispersal to be limited, especially at the time of year these activities are scheduled to occur (August-November) and at the upper extent of access (i.e., base of dams). What individuals are present could be affected from reduced instream habitat resulting from lower flows and avoidance behavior as bull trout move from preferred habitats as flows decline. However, because of the short duration of these activities that will result in only temporary reductions of flow, these affects are not anticipated to rise to the level of harm (which actually kills or injures). Because of the low likelihood of individuals directly below the dams at the time of these scheduled activities, ramping rate provisions to prevent stranding of fish, mobility of the life stages of any bull trout present (adult and sub-adult), and the short duration of flow reductions, the Service concludes that scheduled RO&M, SEED, and extraordinary maintenance activities at Ochoco and Bowman dams are not likely to adversely affect bull trout.

5.4.1.3.5 Summary of Effects in the Crooked River Subbasin

Conservation measures of the DBHCP are not likely to adversely affect bull trout in the Crooked River subbasin; they will likely beneficially affect the species by providing minimum flow requirements that will stabilize and enhance the extent and quality of available FMO habitat. The DBHCP will also require fish screen maintenance to prevent entrainment of juvenile salmonids, and will establish a conservation fund to support conservation measures and projects that benefit listed species in the Crooked River subbasin. Releasing storage flows from Prineville Reservoir may benefit the species in the upper subbasin by increasing flows up to the first major diversion at OID.

Bull trout in the Crooked River from Bowman Dam to Osborne Canyon are affected by numerous aspects of the water management infrastructure and activities that are part of the proposed action as outlined in the *Description of the Proposed Action*. These include effects from releases and diversions of stored water from Prineville Reservoir and operational activities at Bowman Dam for flood control.

Diversions of contracted and uncontracted storage releases (legal diversions of uncontracted releases as live flow are considered reasonably certain to occur under current conditions) are likely to reduce instream flows and increase instream temperatures in the 48.6 miles from the OID Diversion to Osborne Canyon, where large groundwater discharges in excess of 1,000 cfs reduce or eliminate the effects of upstream irrigation activities. These flow and temperature changes are likely to adversely affect bull trout during the irrigation season when storage releases are made (approximately April 1 – October 15; 197 days), by reducing the extent and quality of instream habitat available for foraging bull trout. Storage release flows from Bowman Dam to the OID Diversion are anticipated to beneficially affect bull trout in this reach due to the opposite effect: increased instream flows and corresponding cool water temperatures, resulting in improved quality and extent of habitat available for foraging.

Under current circumstances, the Services are unlikely to make annual instream flow recommendations under the Crooked River Act to the full benefit of downstream fish and wildlife because we cannot be reasonably certain that the full amount of uncontracted releases will remain instream for fish and wildlife use. That is, the Services would likely make lower flow recommendations (at 50 cfs or less) than if the releases were certain to remain instream, further reducing flows in the Crooked River from their maximum beneficial extent under the Crooked River Act to bull trout from Bowman to Osborne Canyon. If uncontracted storage releases were protected by an instream secondary water right, these releases would remain instream in their entirety for the benefit of downstream bull trout. Instream uncontracted release flows could benefit bull trout by mitigating diversions such as the substantial withdrawals at the OID Diversion, through increased instream flows and lower water temperatures. There would be no adverse effects anticipated from uncontracted storage releases if they were certain to be left instream.

Flood control operation effects to flow velocity, depth, and turbidity may result in avoidance behavior in bull trout such as leaving preferred habitats to find velocity refuges; however, these effects are not likely to rise to the level of harm. Flood releases from Bowman Dam can increase downstream concentrations of TDG for several miles, which produce significant adverse effects to juvenile and adult salmonids when TDG levels reach 120 percent (flows above approximately 1,500 cfs), which are anticipated. Bull trout that are present in the Crooked River downstream of the dam are expected to experience behavioral effects such as avoidance, sublethal effects such as disorientation, and mortality as described in Section 5.4.1.3.3 for a conservative extent of 7.5 miles downstream of Bowman Dam. Flows over 1,500 cfs can result in TDG levels exceeding 120 percent on average 8 days per year, and up to 30 days in a single year.

While significant to the individual bull trout experiencing these effects, the impact of flow changes and flood control operations from proposed activities to bull trout at the population level are relatively minimal. Given that habitat within the action area is used for foraging, migration, and overwintering by individual adult and sub-adult fish that have dispersed from populations supported by subbasins outside of the covered lands (see *Environmental Baseline*), implementation of the proposed action is expected to have a relatively minor influence on the conservation and recovery of the bull trout within the Basin or across the species' range. A large

number of sub-adult and adult bull trout from the Metolius population complex use FMO habitat in Lake Billy Chinook but by comparison, a small proportion of these Lake Billy Chinook bull trout disperse into the action area.

We conclude that the proposed action is likely to adversely affect bull trout in occupied reaches of the Crooked River subbasin due to: 1) contracted storage release and diversion from Prineville Reservoir; 2) uncontracted storage release and anticipated diversion from Prineville Reservoir; and 3) flood control operations at Bowman Dam.

5.4.1.4 Effects to Bull Trout in the Whychus Creek subbasin

Bull trout that use Whychus Creek as FMO habitat originate from the Metolius population complex, having dispersed into Lake Billy Chinook and migrated into the reservoir's tributaries. Their distribution in the creek has been reduced due to historical irrigation activities that have heavily modified the stream channel and degraded habitat, as described in the *Environmental Baseline*. While there are no storage dams on Whychus Creek, flows are affected by DBHCP diversions at the TSID Diversion Dam (RM 24.2). TSID can divert up to 127 cfs from Whychus Creek, significantly reducing instream flow during the irrigation season. Since the TSID's water right has no designated season of use, diversions can occur at any time during the year; however, most irrigation activity occurs between March and October.

The conservation measures of the DBHCP include seven measures that will affect instream habitat conditions in Whychus Creek: 1) WC-1 Whychus Creek Instream Flows, 2) WC-2 Whychus Creek Temporary Instream Leasing, 3) WC-3 Whychus Creek Diversion Fish Screens and Fish Passage, 4) WC-4 Piping of Patron Laterals, 5) WC-5 Whychus Creek Diversion Ramping Rate, 6) WC-6 Whychus Creek Habitat Conservation Fund, and 7) WC-7 Plainview Dam Removal.

Conservation measures in Whychus Creek establish minimum flows resulting from a complete modernization of the TSID system. A system-wide district piping effort was completed over the course of the 12-year development of the DBHCP, with 31.18 cfs of water permanently protected instream. Bull trout historically avoided using most of Whychus Creek in the summer because of high water temperatures. Flow enhancements, restoration projects, and instream leasing are all likely to enhance habitats in Whychus Creek for the bull trout by lowering water temperatures and increasing foraging opportunities.

Conservation Measure WC-1 is designed to modify operation of the TSID Diversion to improve habitat for listed fish. WC-1 increases instream flow in Whychus Creek by establishing a 34.18 cfs minimum flow past the diversion, with senior water rights that are converted to permanent instream flow added to this minimum. Conservation Measures WC-2 and WC-4 will promote further increases in instream flow by supporting on-farm conservation and temporary instream leasing. Fish screens at the TSID diversion will be maintained according to measure WC-3 to avoid entrainment of covered species, and ramping rates in measure WC-5 will protect fish downstream of the diversion from sudden changes in water depth. Measure WC-6 will provide funding for habitat restoration work in Whychus Creek and WC-7 will support the removal of a small dam (Plainview Dam) that has blocked fish movements in the creek.

High water temperatures limit fish dispersal in the portions of Whychus Creek where flows are reduced by irrigation diversions due to a combined effect with increased solar radiation. To analyze the effects of implementation of the DBHCP on instream temperatures in Whychus Creek, we reviewed stream temperature data collected by the Upper Deschutes Water Council (UDWC) at several points along the creek in 2018. Because the DBHCP does not modify current instream flows that were proactively established by TSID and others during DBHCP development, water temperature data from recent water years (UDWC, pers. comm. 2019) suggests conditions that will exist under the proposed action. We focused on 2018 (mid-April to mid-October) because it appears to be an average water year, represents all currently available instream flow rights, and has temperature monitoring data for several sites in the affected reach of the creek. Review of temperature data from these locations found that the 7-DADM temperature exceeded the bull trout suitability threshold of 16 °C for extended periods at all upstream points of the creek, and exceeded the lethal threshold of 23 °C above the cold inflows of Alder Springs (Table 46).

Table 46 Whychus Creek 2018 Water Temperatures (°C) (UDWC, pers. comm., 2019)

Monitoring Location	River Mile	Days 16-23°C	Days >23°C
<i>TSID</i>	26.0	55	0
<i>Sisters</i>	24.25	75*	0
<i>Camp Polk</i>	18.25	91	0
<i>USFS Road 6360</i>	6.0	121	33
<i>Alder Springs</i>	1.5	98	0
<i>Confluence</i>	0.25	0	0

*estimated (gauge not operational July 27-Sept 3)

To summarize the maximum extent of effects from temperature threshold exceedance during the 2018 irrigation season (April 12 to October 12), sublethal temperatures affected 20 stream miles (RM 26 to RM 6) for a total of 121 days, and lethal temperatures affected 4.5 miles (RM 6 to RM 1.5) for a total of 33 days. To determine the total number of days in the sublethal and lethal categories, the furthest upstream site's temperature days are added to the additional incremental days at the sites downstream (sublethal: $55 + (75-55) + (91-75) + (121-91) = 121$). Whychus Creek's warming trend from RM 26 to RM 6 is reversed beginning at RM 1.5 Alder Springs, where large cold springs enter the creek and the number of sublethal days begins to decline. Since this effect is independent of the proposed action, the Service's assessment of the Action's effects do not include temperature data downstream of RM 1.5. Temperatures likely continue to seasonally decline after October 12, thus the summary above represents the conservative maximum extent of temporal and spatial effects from sublethal and lethal temperatures anticipated during the irrigation season for the proposed action.

The increased temperatures that result from reduced flows are also correlated with lower dissolved oxygen levels (Courter et al. 2014), further contributing to reduced habitat quality. Low flows also indicate a physical reduction of habitat area available instream for fish use. These environmental effects decrease foraging opportunity for bull trout by reducing the extent and quality of FMO habitat available.

The number of bull trout exposed to reduced quantity and quality of foraging habitat over the 30-year term of the proposed action is unknown. The Metolius subbasin supports some of the most robust populations of bull trout in Oregon, but only a fraction of those are expected to try to forage in Whychus Creek in any given year as adults and sub-adults. Individuals in Whychus Creek between the TSID diversion to Alder Springs would be adversely affected during the irrigation season from mid-April to mid-October each year.

Based on extensive periods of high temperatures exhibited in Whychus Creek resulting from the TSID's significant flow reductions which will continue under the DBHCP, we expect that the extent and quality of FMO habitat in the creek will continue to be reduced by TSID diversion activities, reducing foraging opportunity for adult and sub-adult bull trout. Current habitat quality during the irrigation season may improve from historical conditions over the length of the DBHCP due to implementation of the conservation measures and water conservation efforts by parties such as the Deschutes River Conservancy, but degraded habitat conditions are expected to persist.

We conclude that implementing the DBHCP is likely to adversely affect bull trout due to continued large flow diversions by TSID and the resulting low instream flows and high stream temperatures, which reduce foraging opportunity for bull trout by decreasing the extent and quality of FMO habitat available. Conservation measures implemented by the DBHCP may improve habitat conditions in Whychus Creek, but baseline conditions are so degraded that early efforts may not immediately translate to suitable conditions that benefit the species.

5.4.1.5 Summary of Effects to Bull Trout

The proposed action is likely to affect bull trout in different ways. Some activities benefit the species, while others are likely to adversely affect individual bull trout. Increased instream flows in the Deschutes River, Crooked River, and Whychus Creek will benefit bull trout by increasing foraging opportunity from improved extent and quality of available FMO habitat. Diversions in the Crooked River and Whychus Creek, and flood control operations at Prineville Reservoir are likely to adversely affect bull trout as summarized below. Given that habitat within the action area is used for foraging, migration, and overwintering by individual adult and sub-adult fish that have dispersed from populations supported by subbasins outside of the action area (see *Environmental Baseline*), implementation of the proposed action is expected to have a relatively minimal influence on the conservation and recovery of the bull trout within the Basin or across the species' range.

Middle and Lower Deschutes River

The influence of adverse effects anticipated from upstream Basin irrigation activities (e.g., flow reductions) is largely reduced to insignificant levels by the time flows reach the Middle and Lower Deschutes River reaches. This is due to the substantial cold-water inflows to the Deschutes River between approximately miles 160 to 100 (Tumalo Creek to Madras) that support, year-round, the habitat conditions that support foraging, migration, and overwintering behavior. Thus, effects to bull trout from proposed activities that occur upstream are not

significant at the population scale, core area scale, or any larger scale within the range of bull trout..

Based on the dilutive effect from inflows to the mainstem Deschutes River from Tumalo Creek to Madras, as well as the relative small contribution that the White River represents to the Deschutes River, the Service expects current suitable FMO habitat conditions for adult and sub-adult bull trout within the Lower Deschutes River are not likely to be adversely affected under the proposed action. We anticipate that implementation of DBHCP conservation measures (WR-1 and DR-1) will maintain, or improve, downstream suitable winter habitat conditions for adult and sub-adult bull trout by increasing instream flows and thereby increasing the area of suitable habitat available and increasing foraging opportunity.

We conclude that the proposed action is not likely to adversely affect bull trout or its critical habitat in the Middle or Lower Deschutes River. Implementing conservation measures of the DBHCP may improve habitat quality by increasing flows over the life of the permit, beneficially affecting the species.

Crooked River Subbasin

As summarized in *Section 5.4.1.3.5 Summary of Effects in the Crooked River Subbasin* above, storage release flows from Prineville Reservoir are anticipated to beneficially affect bull trout from Bowman Dam to the OID Diversion due to increased instream flows and corresponding cool water temperatures. Diversions in the Crooked River from the OID Diversion to Osborne Canyon and in Whychus Creek are likely to adversely affect bull trout due to reduced instream flows and increased water temperatures reducing the extent and quality of FMO habitat available. Crooked River flood control operations involve high volume flow releases that result in unsuitable water quality including high levels of TDG, which is likely to adversely affect bull trout from sublethal and lethal GBD effects.

Whychus Creek

Based on extensive periods of high temperatures exhibited in Whychus Creek resulting from severe flow reductions expected under the DBHCP, we expect that the extent and quality of FMO habitat in the creek will continue to be reduced by TSID diversion activities. Current habitat quality during the summer may improve from historical conditions over the length of the DBHCP, but degraded habitat conditions are expected to persist. Since Whychus Creek only supports a very small percentage of the core area's sub-adult and adult bull trout, these degraded conditions, while adversely affecting the individual fish in this system, are not likely to preclude bull trout survival and recovery in the action area or any larger scale area within the range of the bull trout.

We conclude that the proposed action is likely to adversely affect bull trout. Conservation measures implemented by the DBHCP may improve habitat conditions in Whychus Creek, but baseline conditions are so degraded that early efforts may not immediately translate to suitable conditions that benefit the species.

5.4.2 Effects to Critical Habitat in the Action Area

As described in the *Environmental Baseline*, bull trout critical habitat designated within the action area includes roughly 68 miles of the Lower Deschutes River between its confluence with the Columbia River and the Pelton Reregulating Dam (excludes portions of the river under jurisdiction of the Tribe and inaccessible portions between the dams of the PRB complex), Lake Billy Chinook, approximately 15 miles of the mainstem Deschutes River upstream from the head of Lake Billy Chinook to Big Falls, about 14 miles of the Crooked River from the head of Lake Billy Chinook to the Highway 97 Bridge, and the lower 5.5 miles of Whychus Creek upstream to the USFS 6360 road crossing.

Critical habitat within the action area is designated as FMO habitat; there is no suitable spawning and rearing habitat within the action area. The connectivity between the Basin's local populations and with FMO habitat in the action area diminishes the risk of extirpation of the bull trout in the Lower Deschutes River Core Area that could result from habitat isolation and fragmentation.

See the *Environmental Baseline* (Section 5.3.2) for a description of the PBFs of critical habitat potentially affected by the proposed action. As described in that section, PBF 6 (spawning and rearing habitat) is not applicable to the proposed action because the action area does not contain breeding habitat. A full description of these PBFs of bull trout critical habitat and the role they play in the conservation and recovery of the species can be found in Appendix B, *Status of Bull Trout Critical Habitat*.

5.4.2.1 Effects to Bull Trout Critical Habitat in the Middle Deschutes River Subbasin

As described above in the analysis of effects to bull trout in this reach (section 5.4.1.1), based on the relationship between flows and instream water temperatures, the Service expects that implementation of the proposed action and DBHCP conservation measures (WR-1 and DR-1) will maintain or improve downstream bull trout critical habitat in the Middle Deschutes River and Lake Billy Chinook by increasing instream flows and decreasing 7-DADM temperatures. This will also benefit bull trout critical habitat by improving PBFs 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality).

PBF 1 (subsurface flows) is not anticipated to be affected by the proposed action in the Middle Deschutes River because instream flows are not expected to be change to the extent that groundwater recharge is altered.

PBF 2 (migration habitat) is not anticipated to be affected by the proposed action in the Middle Deschutes River because instream flows are not expected to be change from baseline conditions to the extent that formation of complex river features are affected.

Increased flows and decreased water temperatures may benefit prey fish species (PBF 3 abundant food base) in the Middle Deschutes River in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately benefit prey species or bull trout to the point that current relationships between these fish populations in this reach appreciably changes (i.e., prey availability will not disproportionately decrease from the proposed action).

PBF 4 (habitat complexity) is not anticipated to be affected by the proposed action in the Middle Deschutes River because instream flows are not expected to be change from baseline conditions to the extent that formation of complex river features are affected.

PBFs 5 (thermal refugia) is anticipated to improve in the Middle Deschutes River as conservation measures implemented under the DBHCP increase flows, which results in decreased instream temperatures.

PBF 7 (natural hydrograph) is anticipated to improve in the Middle Deschutes River as conservation measures implemented under the DBHCP increase and maintain minimum storage season (winter) flows and limit or decrease irrigation season (summer) flows from baseline conditions.

PBF 8 (water quality) is anticipated to improve in the Middle Deschutes River as conservation measures implemented under the DBHCP increase instream flows and decrease water temperatures.

Increased flows and decreased water temperatures may benefit non-native predatory, interbreeding, or competing fish species (PBF 9 non-natives) in the Middle Deschutes River in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately benefit non-natives species or bull trout to the point that current relationships between these fish populations in this reach appreciably changes (i.e., threat from these species will not disproportionately increase from the proposed action).

However, the influence of the effects of the proposed action on the PBFs of bull trout critical anticipated from upstream Basin irrigation activities (e.g., flow reductions) habitat as described above is largely reduced to insignificant levels by the time flows reach the Middle Deschutes River. This is due to the substantial cold-water inflows to the Deschutes River between approximately miles 160 to 120 (Tumalo Creek to Culver) that support the physical or biological features of critical habitat essential to the conservation of the bull trout year-round. Because of this dilutive effect of significant inflows to the mainstem Deschutes River from Tumalo Creek to Culver, the Service expects that effects to bull trout critical habitat in the Middle Deschutes River from proposed activities that occur upstream are not significant.

The dilutive effect of Lake Billy Chinook's size and 'run-of-the-river' operation as described in the effects to the species section (5.4.1.1), is expected to minimize any effects from modified upstream flows to discountable levels within the reservoir.

We conclude that the proposed action is not likely to adversely affect bull trout critical habitat designated within the Middle Deschutes River or Lake Billy Chinook. Implementing conservation measures of the DBHCP may improve the extent and quality of critical habitat in this reach by improving PBFs 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality), but these effects may be minimal.

5.4.2.2 Effects to Bull Trout Critical Habitat in the Lower Deschutes River Subbasin

As described above in the analysis of effects to bull trout in this reach (section 5.4.1.2), based on the relationship between flows and instream water temperatures, the Service expects that implementation of the proposed action and DBHCP conservation measures (WR-1 and DR-1) will have similar effects to critical habitat in the Lower Deschutes River subbasin as described in the previous section for the Middle Deschutes reach. The proposed action will maintain or slightly improve downstream bull trout critical habitat in the Lower Deschutes River by increasing instream flows and decreasing 7-DADM temperatures. This will also benefit bull trout critical habitat by improving PBFs 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality).

PBF 1 (subsurface flows) is not anticipated to be affected by the proposed action in the Lower Deschutes River because instream flows are not expected to be change to the extent that groundwater recharge is altered.

PBF 2 (migration habitat) is not anticipated to be affected by the proposed action in the Lower Deschutes River because instream flows are not expected to be change from baseline conditions to the extent that formation of complex river features are affected.

Increased flows and decreased water temperatures may benefit prey fish species (PBF 3 abundant food base) in the Lower Deschutes River in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately benefit prey species or bull trout to the point that current relationships between these fish populations in this reach appreciably changes (i.e., prey availability will not disproportionately decrease from the proposed action).

PBF 4 (habitat complexity) is not anticipated to be affected by the proposed action in the Lower Deschutes River because instream flows are not expected to be change from baseline conditions to the extent that formation of complex river features are affected.

PBFs 5 (thermal refugia) is anticipated to improve in the Lower Deschutes River as conservation measures implemented under the DBHCP increase flows, which results in decreased instream temperatures.

PBF 7 (natural hydrograph) is anticipated to improve in the Lower Deschutes River as conservation measures implemented under the DBHCP increase and maintain minimum storage season flows (winter) and limit or decrease irrigation season (summer) flows.

PBF 8 (water quality) is anticipated to improve in the Lower Deschutes River as conservation measures implemented under the DBHCP increase instream flows and decrease water temperatures.

Increased flows and decreased water temperatures may benefit non-native predatory, interbreeding, or competing fish species (PBF 9 non-natives) in the Lower Deschutes River in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately benefit non-natives species or bull trout to the point that current relationships

between these fish populations in this reach appreciably changes (i.e., threat from these species will not disproportionately increase from the proposed action).

However, the influence of the effects of the proposed action on the PBFs of bull trout critical anticipated from upstream Basin irrigation activities (e.g., flow reductions) habitat as described above is largely reduced to insignificant levels by the time flows reach the Lower Deschutes River. This is due to the substantial cold-water inflows to the Deschutes River between approximately miles 160 to 100 (Tumalo Creek to Madras) that support the physical or biological features of critical habitat essential to the conservation of the bull trout year-round. Because of this dilutive effect of significant inflows to the mainstem Deschutes River from Tumalo Creek to Madras, as well as the relatively small contribution the White River represents to the Deschutes River, the Service expects that effects to bull trout critical habitat in the Lower Deschutes River from proposed activities that occur upstream are not significant.

We conclude that the proposed action is not likely to adversely affect bull trout critical habitat designated within the Lower Deschutes River. Implementing conservation measures of the DBHCP may improve the extent and quality of critical habitat in this reach by improving PBFs 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality), but these effects may be minimal.

5.4.2.3 Effects to Bull Trout Critical Habitat in the Crooked River Subbasin

The full extent of critical habitat designated within the Crooked River, from the Highway 97 Bridge at RM 14 downstream to Lake Billy Chinook, has recently been made accessible to bull trout occupation with the Opal Dam fish ladder at RM 0.6 in November 2019. As described above in the analysis of effects to bull trout in this reach (section 5.4.1.3), based on the relationship between flows and instream water temperatures, the Service expects that implementation of the proposed action will degrade downstream bull trout habitat in the Crooked River subbasin by decreasing instream flows and increasing 7-DADM temperatures. These flow and temperature changes will negatively affect bull trout critical habitat by degrading PBF 1 (subsurface flows), PBF 2 (migration habitat), PBF 4 (habitat complexity), PBFs 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality).

Habitat degradation from reduced instreams flows and high stream temperatures that reduce the quality and extent of occupied habitat, is most severe in the Crooked River during the irrigation season above the groundwater inflows of Osborne Canyon at RM 7.3. The dilutive effect of these substantial contributions in excess of 1,000 cfs below Osborne Canyon as described in the effects to the species section (5.4.1.3), is expected to minimize any effects from modified upstream flows to insignificant levels in the Crooked River from RM 7.3 to Lake Billy Chinook, which is an FMO habitat stronghold for bull trout dispersing from the Metolius watershed.

PBF 1 (subsurface flows) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) by flow reductions of sufficient duration and/or severity so as impairment to the ability of groundwater to properly recharge could occur, thereby reducing the beneficial effects of groundwater-surface water interchange (i.e., increased flows, low water temperatures).

PBF 2 (migration habitat) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) by flow reductions that increase water temperatures above suitable conditions for bull trout, creating a thermal barrier restricting upstream movement.

Decreased flows and increased water temperatures may adversely affect prey fish species (PBF 3 abundant food base) in the Crooked River above Osborne Canyon in the same ways that these changes are likely to adversely affect bull trout. However, we do not anticipate this benefit to disproportionately affect prey species or bull trout to the point that current relationships between these fish populations from RM 14 to RM 7.3 appreciably changes (i.e., prey availability will not disproportionately decrease from the proposed action).

PBF 4 (habitat complexity) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) because reductions in geomorphically significant flows means that complex river features are not formed, as described in PBF 1.

PBFs 5 (thermal refugia) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) by flow reductions that increase water temperatures above suitable conditions for bull trout, creating a thermal barrier restricting upstream movement.

PBF 7 (natural hydrograph) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) by irrigation season diversions and winter water storage that reduce instream flows.

PBF 8 (water quality) is likely to be adversely affected by the proposed action in the Crooked River (from RM 14 to RM 7.3) by flow reductions that increase water temperatures above suitable conditions for bull trout, as described above. Water quality is also severely degraded (dissolved oxygen, turbidity, and flow velocity) in the 7.5 miles below Bowman Dam when flood control operations necessitate releases in excess of 1,500 cfs, but these effects are not anticipated to extend downriver to critical habitat at RM 14.

Decreased flows and increased water temperatures may adversely affect non-native predatory, interbreeding, or competing fish species (PBF 9 non-natives) in the Crooked River above Osborne Canyon in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately affect non-natives species or bull trout to the point that current relationships between these fish populations from RM 14 to RM 7.3 appreciably changes (i.e., threat from these species will not disproportionately increase from the proposed action).

The upper extent of critical habitat in the Crooked River, from the Highway 97 Bridge crossing at RM 14 to Osborne Canyon at RM 7.3 is likely to deteriorate PBFs 1, 2, 4, 5, 7, and 8 as described above. PBF 8 is additionally affected in the 7.5 miles directly below Bowman Dam.

We conclude that the proposed action is likely to adversely affect 6.7 miles of bull trout critical habitat designated within the Crooked River from the upper extent of critical habitat at RM 14 to the groundwater inflows at RM 7.3. The proposed action is not likely to adversely affect the lower 7.3 mile reach of bull trout critical habitat from Osborne Canyon to Lake Billy Chinook.

The dilutive effect of groundwater inflows in excess of 1,000 cfs below Osborne Canyon at RM 7.3 is expected to minimize any effects from modified upstream flows to critical habitat to insignificant levels in the Crooked River from RM 7.3 to Lake Billy Chinook

Implementing conservation measures of the DBHCP may improve the extent and quality of critical habitat in this reach by improving PBF 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality), but these effects may be minimal.

5.4.2.4 Effects to Bull Trout Critical Habitat in Whychus Creek

Designated critical habitat in Whychus Creek extends from the USFS 6360 road crossing at RM 5.5 downstream to the mouth, which enters the Middle Deschutes River at RM 120. As described above in the analysis of effects to bull trout in this reach (section 5.4.1.4), based on the relationship between flows and instream water temperatures, the Service expects that implementation of the proposed action will degrade downstream bull trout habitat in Whychus Creek by severely decreasing instream flows and increasing water temperatures. These flow and temperature changes will negatively affect bull trout critical habitat by degrading PBF 1 (subsurface flows), PBF 2 (migration habitat), PBF 4 (habitat complexity), PBF 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality).

Habitat degradation from significant diversions that reduce instreams flows and lead to high water temperatures begins at the TSID Diversion at RM 26 and continues downstream until Alder Springs at RM 1.5. The inflows of Alder Springs, as described in the effects to the species section (5.4.1.3), is expected to reduce the effects of modified upstream flows.

PBF 1 (subsurface flows) is likely to be adversely affected by the proposed action in Whychus Creek (from RM 5.5 to RM 1.5) by severe irrigation season flow reductions that likely impair the ability of groundwater to properly recharge, thereby reducing the beneficial effects of groundwater-surface water interchange downstream (i.e., increased flows, low water temperatures).

PBF 2 (migration habitat) is likely to be adversely affected by the proposed action in Whychus Creek (from RM 5.5 to RM 1.5) by flow reductions that increase water temperatures above suitable conditions for bull trout, creating a thermal barrier restricting upstream movement.

Decreased flows and increased water temperatures may adversely affect prey fish species (PBF 3 abundant food base) in the Whychus Creek above Alder Springs in the same ways that these changes are likely to adversely affect bull trout. However, we do not anticipate this benefit to disproportionately affect prey species or bull trout to the point that current relationships between these fish populations from RM 5.5 to RM 1.5 appreciably changes (i.e., prey availability will not disproportionately decrease from the proposed action).

PBF 4 (habitat complexity) is likely to be adversely affected by the proposed action in Whychus Creek (from RM 5.5 to RM 1.5) because reductions in geomorphically significant flows means that complex river features are not formed, as described in PBF 1.

PBFs 5 (thermal refugia) is likely to be adversely affected by the proposed action in Whychus Creek (from RM 5.5 to RM 1.5) by severe flow reductions that increase water temperatures above suitable conditions for bull trout (increased to levels that exceed the threshold for which sublethal and lethal effects to bull trout will occur). Temperature increases also create a thermal barrier restricting upstream movement as low as at RM 1.5, as identified in PBF 2.

PBF 7 (natural hydrograph) is likely to be adversely affected by the proposed in Whychus Creek (from RM 5.5 to RM 1.5) by heavy irrigation season diversions that severely reduce instream flows.

PBF 8 (water quality) is likely to be adversely affected by the proposed action in Whychus Creek (from RM 5.5 to RM 1.5) by heavy flow reductions that increase water temperatures above suitable conditions for bull trout. These high temperatures can contribute to degradation of other water quality standards (dissolved oxygen, pH, etc.), as described in the *Environmental Baseline*.

Decreased flows and increased water temperatures may adversely affect non-native predatory, interbreeding, or competing fish species (PBF 9 non-natives) in Whychus Creek above Alder Springs in the same ways that these changes benefit bull trout. However, we do not anticipate this benefit to disproportionately affect non-natives species or bull trout to the point that current relationships between these fish populations from RM 5.5 to RM 1.5 appreciably changes (i.e., threat from these species will not disproportionately increase from the proposed action).

The upper extent of critical habitat in Whychus Creek, from the highest upstream point at RM 5.5 to Alder Springs at RM 1.5 is likely to deteriorate PBFs 1, 2, 4, 5, 7, and 8 as described above.

We conclude that the proposed action is likely to adversely affect 4.0 miles of bull trout critical habitat designated within Whychus Creek from the upper extent of critical habitat at RM 5.5 to the groundwater inflows at RM 1.5. Implementing conservation measures of the DBHCP may improve the extent and quality of critical habitat in this reach by improving PBF 5 (thermal refugia), PBF 7 (natural hydrograph), and PBF 8 (water quality), but based on baseline conditions in Whychus Creek, we expect degraded conditions to persist.

5.5 CUMULATIVE EFFECTS

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they will require separate consultation pursuant to section 7 of the Act.

As described in the *Description of the Proposed Action* section above, the action area for this proposed Federal action is based on the geographic extent of augmented hydrology as depicted in Figure 1. We consider the action area to be the seasonally or permanently wetted area extending from all reservoirs listed in this Opinion to the mouth of the Deschutes River where it meets the Columbia River.

The portions of the action area that influence the subbasins where bull trout occur are influenced by activities on Federal, State, Tribal, county, and private lands, resulting in a wide variety of actions that may affect bull trout and/or bull trout critical habitat. While the activities occurring on Federal lands (BLM and USFS) are tied to Federal land management plans that have already undergone Section 7 consultation with the Service, and therefore are not considered a Cumulative Effect by the definition above, there are rarely regulated divisions or boundaries between the activities throughout these river stretches that lend themselves to parsing out the Federal from the non-Federal actions. Except for activities that are only allowed on Federal lands, these Cumulative Effects may include the effects from activities that originate or cross over Federal lands, or otherwise involve an unknown Federal nexus. By being more inclusive, we are taking a conservative approach and erring on the side of the species.

The activities we believe are reasonably certain to occur within the action area outside of those actions covered in the DBHCP and Reclamation's proposed action largely include long-standing activities that fall into a few categories: recreational (such as fishing, camping, hiking, biking, and boating), municipal (regulated discharges into the rivers), and agricultural (point and non-point discharges in the rivers).

The Middle and Lower Deschutes reaches are world-renown for the angling and boating opportunities they provide. These activities may potentially affect bull trout in numerous ways:

- Boaters may disturb bull trout, particularly in areas of low water
- Campers may disturb bull trout by swimming or playing in the water where bull trout spawn, migrate, or overwinter
- Hikers and bikers may disturb bull trout by using water from occupied bull trout reaches
- Anglers may injure or kill bull trout by inadvertently catching them and not returning them to the river, as required by Oregon State law, in a speedy manner
- Biking may cause erosion on riverside trails that could result in increased localized turbidity

While all of these actions have the potential to impact bull trout, these effects are expected to be relatively minor to bull trout populations given the localized nature of these activities, the relatively large size of the rivers where bull trout occupy the action area such that they can move away from disturbances, and existence of regulations to protect bull trout as a listed species. While there are limited examples of anglers maliciously targeting bull trout, these situations are very rare.

Future municipal discharges that are not included in the proposed action will be required to meet water quality standards by conforming to a National Pollution Discharge Elimination System (NPDES) permit, which is issued by the Federal Environmental Protection Agency. Because these permits have or will undergo Section 7 consultation, any impacts do not qualify as a Cumulative Effect.

Agricultural discharges comprised of growing field runoff and non-point runoff from private grazing operations do not require an NPDES permit and so may not have a Federal nexus, and so

are considered Cumulative Effects. Effects from agricultural and grazing activities have been ongoing for many decades, and now constitute part of the Basin's baseline.

Portions of the lands adjacent to, and hydrologically connected to, the action area's rivers and streams are used for private grazing operations (Federally-permitted grazing does not qualify as a Cumulative Effect). Grazing cows generate significant amounts of solid and liquid wastes which seep into the ground, some proportion of which will enter the rivers and streams. These nutrient contributions can impact the water quality (which is largely a function of the proportion of the effluent to the flow within the channels) and may contribute to algal growth downstream.

Agricultural and grazing activities could affect individual bull trout. These effects could result from impaired water quality due to increased turbidity and sedimentation. Agricultural runoff can result in increased levels of fertilizer and pesticides in FMO habitat, although bull trout FMO habitat has remained functional despite these effects, some of which have been reduced in recent years by improved agricultural practices. Collectively, these impacts could result in some impairment of bull trout feeding and migratory behaviors, but not at any severity or magnitude appreciably greater than the baseline conditions within the action area.

As stated above, all of these reasonably foreseeable Cumulative Effects are ongoing activities that have contributed to the baseline condition for years or decades. We do not foresee any particular increase in these activities and are not aware of planned activities that would have impacts beyond what currently exists within the action area. Therefore, we do not anticipate a worsening of habitat conditions, a worsening of impacts to individual bull trout, or a worsening of the effects to the PBFs of critical habitat as a result of Cumulative Effects.

5.6 SUMMARY AND SYNTHESIS

5.6.1 Bull Trout

Reclamation and the Service have proposed action that would result in the storage and diversion of water across the Deschutes River Basin for 30 years. Although the implementation of the DBHCP includes conservation measures that minimize, and mitigate for, effects to listed species, the water management regime is a continuation of decades of actions that have significantly altered the rivers, lakes, and wetlands in the action area. Reclamation's implementation of the Crooked River Act is another key part of the proposed action. In this Summary and Synthesis, we will not explicitly separate the effects of the Service's proposed action from the effects of Reclamation's proposed action, and instead provide a more thorough evaluation of whether Federal actions will jeopardize bull trout or adversely modify their critical habitat.

Range-wide, bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alteration (associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, and poor water quality), incidental angler harvest, entrainment, and introduced non-native species (64 FR 58910 [Nov. 1, 1999]). Since the listing of bull trout, there has been very little change in the general distribution of bull trout in the coterminous United States, and we are not aware that any known, occupied bull trout core areas have been extirpated (USFWS 2015b, p. iii). Overall bull trout abundance is "stable" range-wide (USFWS 2015b, p. iii). However, abundances and trends

across the 109 bull trout core areas are highly variable. Similarly, the condition of bull trout critical habitat varies across its range from poor to good. Threats to critical habitat include but are not limited to the proliferation of dams and water diversions, altered water flow and temperature regimes, degradation of spawning and rearing habitat, and the spread of non-native fish species.

Bull trout in the action area are all members of five local populations that together comprise the Lower Deschutes River Core Area. Two populations are located downstream of the PRB dams in Shitike Creek and the Warm Springs River, and three are upstream of the dams in the Metolius River and its tributaries. Bull trout do not spawn in the action area. Bull trout populations in Lake Billy Chinook and upstream into the Metolius are so abundant and stable that the Service has described the Lower Deschutes River Core Area as one of the strongholds in the Coastal Recovery Unit (USFWS 2015c, p. 79). However, the quality of foraging, migrating, and overwintering habitat in tributaries to Lake Billy Chinook is spatially and seasonally degraded. Habitat degradation is most severe in Whychus Creek above Alder Springs at RM 1.5 and in the Crooked River above Osborne Canyon RM 7.3 where reduced instreams flows and high stream temperatures prevent bull trout use during the irrigation season. Bull trout were extirpated from the Crooked River subbasin when the Opal Springs Dam at RM 0.6 on the Crooked was increased in height in 1983, which eliminated upstream passage of bull trout in the Crooked River from Lake Billy Chinook. Fish passage was restored in November of 2019, following the completion of a fish ladder at the Opal Springs Dam. Stream conditions have degraded over several decades due to irrigation activities that have contributed to channel simplification, down-cutting, and sedimentation.

Bull trout critical habitat in the action area is mostly functional for the needs of the species. In the Middle Deschutes River, spring flows that begin in the area of Big Falls at RM 132 significantly improve streamflow and water quality. The Lower Deschutes River has consistent flows and good water quality that provides good FMO habitat for bull trout all year. The Crooked River's critical habitat is also maintained by large inflows of cold, high quality springs that maintain suitable conditions for much of the year.

Foraging habitats in Whychus Creek, the Middle Deschutes River, and the Crooked River are particularly important for sub-adult bull trout which may have greater foraging success and less predation risk in riverine habitats as compared to Lake Billy Chinook. Dispersal out of the reservoir, even temporarily, decreases the potential for population loss from cannibalism. We concluded that the conservation role of the action area is to provide foraging, migration, and overwintering habitats for the three local populations upstream of the PRB dams that are necessary for the conservation and recovery of the Coastal Recovery Unit, though the majority of irreplaceable value is generated by Lake Billy Chinook.

Metolius River bull trout disperse into Lake Billy Chinook as juveniles and sub-adults, some of which subsequently migrate into the Crooked River. The number of bull trout fry and juveniles produced by these three spawning populations is largely unknown. However, hydroacoustic data collected for Tribe suggests that there are a large number of sub-adult and adult bull trout present in Lake Billy Chinook. For example, the December, 2015, hydroacoustics survey done for the

Tribe (CTWS 2008) found that there were about 72,368 fish larger than 400 mm in the reservoir; 13,424 of these were in the Crooked River arm of the reservoir. The survey cannot identify fish to species. However, the majority of fish in the reservoir which can reach or exceed 400 mm in length are generally considered to be bull trout. In addition, the number of adult bull trout in the three populations can be estimated from the annual Metolius bull trout redd count data. Over the last five years, the three Metolius bull trout populations have averaged about 1,000 adult spawners.

Previous Tribe hydroacoustic surveys have noted that since bull trout are not considered a limnetic species like kokanee, hydroacoustic data should be considered a conservative population estimate (CTWS 2008). The abundance estimates for fish in the largest size class, 400 mm or greater, have a strong seasonal pattern that alternates between high estimates in summer and low estimates in winter (CTWS 2015).

Individuals from the three Metolius River populations will be affected by activities in the action area. However, we anticipate that only a small proportion of the sub-adult and adult bull trout originating from the Metolius populations will be affected. As previously noted, only a small number of foraging bull trout have been detected in Whychus Creek. Similarly, about 200 sub-adult bull trout have passed upstream of the Opal Springs Dam since pass was re-established in November of 2019. We do not have data on the number of bull trout present in the Middle Deschutes River downstream of Big Falls at RM 132, but the available information suggests that only a small number of bull trout are present.

We anticipated that the proposed Federal actions would not jeopardize the continued existence of the bull trout in the Lower Deschutes River, White River, Lake Billy Chinook, or the Middle Deschutes River by reducing appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution. We do, however, anticipate that bull trout would experience a loss of foraging, migration, and overwintering habitat in certain reaches during certain times of year. Those adverse effects would sometimes result in a reasonably likelihood of injury or death and sometimes result in simply a disruption of normal behaviors of individual bull trout, depending on the physical condition of the affected bull trout and its ability to relocate to more suitable habitats. The following is a summary of anticipated adverse effects (Table 47):

- Crooked River: Reduced instream flows associated with the DBHCP. These occur downstream of the OID's diversion at RM 55.9 and persist past the NUID pumps at RM 22.4 until groundwater and spring flows improve conditions beginning at Osborne Canyon at RM 7.3.
- Crooked River: Flood flow effects from Reclamation operations, which result increased TDG from Bowman Dam flow releases in excess of 1,500 cfs, from Bowman Dam downstream for 7.5 miles.
- Whychus Creek: Reduced instream flows during the irrigation season downstream of the TSID's diversion dam at RM 24.2, until creek flows improve beginning at Alder Springs at RM 1.5.

Implementation of the DBHCP's conservation measure CR-4 Crooked River Conservation Fund will reduce the severity of these adverse Crooked River effects by funding projects that lease additional water, and/or increase stream shading, habitat features, and groundwater exchange. Use of uncontracted storage water for fish and wildlife habitat under the Crooked River Act is also likely to reduce the adverse effects of the proposed action by increasing flows during times of years when bull trout are likely to benefit. However, as described in this Opinion, Reclamation's release of uncontracted storage without an instream water right makes these releases live flow, and thus legally available for irrigation diversion.

In analyzing the effects of the proposed action on bull trout individuals and populations, we consider likely effects to reproduction, numbers, and distribution. Since bull trout spawn outside of the action area, and since the bull trout that would be adversely affected are mostly sub-adults from very robust populations, we do not expect that reproduction or numbers would be reduced. The sustainable harvest of bull trout in Lake Billy Chinook demonstrates that the adult abundance of the three local populations that use the lake are probably driven by density-dependent mortality. Adverse effects to a moderate number of sub-adult bull trout in tributaries to Lake Billy Chinook is not likely to have a measurable effect on the total population of breeding adult bull trout in the core area.

The proposed action would, however, result in a continued reduction in bull trout distribution. Whychus Creek downstream of the TSID diversion at RM 24.2 will continue to be adversely affected by irrigation season diversions. Similarly, the Crooked River downstream of the OID Diversion at RM 55, and downstream of the NUID pumps at RM 22.4 will continue to be adversely affected by irrigation season diversions.

The anticipated reduction in bull trout distribution is not likely to reduce the probability of population persistence for any local population or the likelihood of recovery for local populations (or the core area). The anticipated reduction of foraging habitat in the Crooked River is significant, but bull trout only recently gained access to much of the Crooked River as a result of the November 2019 completion of fish passage facilities at the Opal Springs Dam at RM 0.6 on the Crooked River. Any seasonal foraging habitat they are able to use is additional to what they have been successfully using since 1983 when Opal Dam restricted upstream passage. Water management in the Deschutes Basin has been occurring for decades, and so the environmental baseline is already largely a result of the anticipated adverse effects. The quality of bull trout spawning habitat in the Metolius subbasin and the quality of Lake Billy Chinook as FMO habitat essentially ensures that the Lower Deschutes River Core Area remains a stronghold for the species in the Coastal Recovery Unit, and while functional tributary FMO habitat can improve that condition, continued adverse effects in those tributaries does not represent a reduction in the probability of persistence or the likelihood of recovery. Similarly, we expect that critical habitat will remain functional for its intended recovery role in the action area and at all larger scales.

Table 47. Bull Trout summary of Effects.

Affected Reach	Project Element/Activity	Waterbody	Activity Season/dates	Operators	Effects Determination	
					Bull Trout	Critical Habitat
Middle Deschutes River subbasin	Upper Deschutes storage, release, diversion, and release activities	Middle Deschutes River	year-round	AID, COID, LPID, NUID, SID, TID	NLAA	NLAA
	Implementation of DBHCP conservation measures WR-1 and DR-1	Middle Deschutes River	Nov - April	AID, COID, SID	NLAA*	NLAA*
	Upper Deschutes and Crooked subbasin storage, release, diversion, and release activities	Lake Billy Chinook	year-round	all	NLAA	NLAA
	Implementation of all DBHCP conservation measures in Upper and Middle Deschutes, Crooked subbasin, and Whychus Creek	Lake Billy Chinook	year-round	all	NLAA*	NLAA*
Lower Deschutes River	Upper Deschutes and Crooked subbasin storage, release, diversion, and release activities	Lower Deschutes River	year-round	all	NLAA	NLAA
	Implementation of all DBHCP conservation measures in Upper and Middle Deschutes, Crooked subbasin, and Whychus Creek	Lower Deschutes River	year-round	all	NLAA*	NLAA*
	Wapinitia Project	White River	year-round	BOR	NLAA	NLAA

Affected Reach	Project Element/Activity	Waterbody		Activity Season/dates	Operators	Effects Determination	
						Bull Trout	Critical Habitat
Crooked River subbasin	Release and diversion of contracted storage water from Prineville Reservoir	Crooked River	Bowman Dam to OID Diversion	irrigation season April 1 - October 15 (197 days)	BOR, OID, NUID	NLAA*	NA
			OID diversion to CAPO gauge				
			CAPO to NUID pumps				
			NUID pumps to Osborne Canyon			RM 14 - RM 7.3: LAA (PBFs 1, 2, 4, 5, 7, 8)	
			Osborne Canyon to Lake Billy Chinook			NLAA	NLAA
	Release of uncontracted storage from Prineville Reservoir and reasonably certain diversion	Crooked River	Bowman to OID	irrigation season April 1 - October 15 (197 days)	BOR, OID, NUID	NLAA*	NA
			OID to CAPO				
			CAPO to NUID				
			NUID to Osborne			RM 14 - RM 7.3: LAA [±] (PBFs 1, 2, 4, 5, 7, 8)	
			Osborne Canyon to Lake Billy Chinook			NLAA	NLAA
	Crooked River flood control	Crooked River (directly below dam for 7.5 miles)		storage season 8 days (between November 15 - April 30)	BOR	LAA	NE
	Safety of Dams Program	Upper Deschutes River, Crooked River, Ochoco Creek from dams (Crane Prairie, Wickiup,		varies, Aug - Nov	BOR	NLAA	NLAA

Affected Reach	Project Element/Activity	Waterbody	Activity Season/dates	Operators	Effects Determination	
					Bull Trout	Critical Habitat
		Bowman, and Ochoco) to confluence				
	Implementation of DBHCP conservation measures CR-1 through CR-7	Crooked River, Ochoco Creek, McKay Creek	year-round	OID, NUID, TSID	NLAA*	NLAA*
Whychus Creek	Diversion	Whychus Creek	121 days (between April 12-Oct 12)	TSID	LAA	LAA (PBFs 1, 2, 4, 5, 7, 8)
	Implementation of DBHCP conservation measures WC-1 through WC-7	Whychus Creeks	year-round	TSID	NLAA*	NLAA*

NE = No Effect

NLAA = Not Likely to Adversely Affect

LAA = Likely to Adversely Affect

* = beneficial effect

= Releases of storage water during the irrigation season have significant benefits to bull trout in two reaches of the Crooked River. These are: 1) Crooked River from OID's diversion at RM 55.9 downstream to where Ochoco Creek and McKay Creek join the Crooked at about RM 43.9 and RM 43, respectively; and, 2) Crooked River from NUID's pumps at RM 22.4 downstream to Osborne Canyon at RM 7.3. However, these benefits are negated due to the release of uncontracted storage without protection from an instream water right, as described in *Effects from Uncontracted Storage Release*, section 5.4.3.2.

5.6.2 Bull Trout Critical Habitat

The proposed Federal actions, resulting in the implementation of the DBHCP, would adversely affect 16.4 miles of bull trout critical habitat in Whychus Creek and the Crooked River. The natural hydrograph of these two waterbodies has been adversely affected by storage, release, and diversion for decades and that regime would continue under the proposed action with some changes (e.g., piping of the TSID canal; management of uncontracted water for the benefit of fish and wildlife). We anticipate adverse effects to PBFs 1, 2, 4, 5, 7 and 8 that vary in severity depending on the time of year. Critical habitat in Whychus Creek and the Crooked River is still expected to retain some function for the conservation of bull trout because flows will be large enough and cold enough for bull trout to use during some times of year, and because of the large cold water inputs from Alder Springs in Whychus Creek and Opal Springs in the Crooked River.

5.7 CONCLUSION

5.7.1 Bull Trout

After reviewing the status of the bull trout, the environmental baseline for the action area, and the effects of the proposed action, including all measures proposed to avoid and minimize adverse effects, and the cumulative effects, it is the Service's Biological Opinion that issuance of an ITP pursuant to section 10(a)(1)(B) of the Act, the implementation of the DBHCP, and Reclamation's actions to authorize and maintain the proposed action, as proposed, is not likely to jeopardize the continued existence of the bull trout.

The no jeopardy finding for bull trout is supported by the following: (1) the covered activities overlap with the Lower Deschutes River Core Area, which the Service determined has no primary habitat, demographic, or non-native threats at the metapopulation level; (2) bull trout that use habitat in the action area for foraging, migration, and overwintering have dispersed from robust local populations that rely on breeding habitat in subbasins outside of the covered lands for continued propagation; (3) connectivity between these local populations and with FMO habitat in the action area diminishes the risk of extirpation of the species in the core area that could result from habitat isolation and fragmentation; (5) increased instream flows in the Crooked River, Deschutes River, and Whychus Creek will benefit bull trout by increasing foraging opportunity from improved extent and quality of available FMO habitat; (6) spawning and rearing does not occur within the action area; and (7) the action area is used by bull trout life stages (adult and sub-adult) that have less sensitive or less restrictive habitat requirements than for successful egg survival and emergence.

5.7.2 Bull Trout Critical Habitat

After reviewing the status of the bull trout, the environmental baseline for the action area, and the effects of the proposed action, including all measures proposed to avoid and minimize adverse effects, and the cumulative effects, it is the Service's Biological Opinion that issuance of an ITP pursuant to section 10(a)(1)(B) of the Act, the implementation of the DBHCP, and Reclamation's actions to authorize and maintain the proposed action, as proposed, is not likely to result in the destruction or adverse modification of designated critical habitat for bull trout.

This finding of no destruction or adverse modification of critical habitat is supported by the following: (1) 16.4 miles of bull trout critical habitat in Whychus Creek and the Crooked River is anticipated to be adversely affected by the proposed action; however (2) the natural hydrograph of these two waterbodies has been adversely affected by storage, release, and diversion for decades and that regime would continue under the proposed action with some changes; and (3) effects to this 16.4 miles of critical habitat in the action area are not expected to appreciably diminish the value of critical habitat as a whole within the action area or across the species' range for the conservation of the species.

6 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened animal species, respectively, without special 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* is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). 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.

For Reclamation, the measures described below are non-discretionary, and must be undertaken by Reclamation so that they become binding conditions of any grant or permit issued to others conducting the work, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation: (1) fails to assume and implement the terms and conditions, or (2) fails to require Reclamation to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, 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)].

For the DBHCP Applicants, the proposed DBHCP and its associated documents clearly identify anticipated impacts to Covered Species likely to result from the proposed taking, and the measures that are necessary and appropriate to minimize those impacts. All minimization measures described in the proposed HCP, together with the terms and conditions described in the section 10(a)(1)(B) permit issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse.

To avoid duplication, this Opinion also analyzes Reclamation's actions in the Deschutes Basin project. Reclamation has been coordinating with the Service, DBHCP Applicants, and others in the development of the DBHCP. This coordination has allowed the Service to conduct one formal consultation that addresses both covered activities under the DBHCP and the Deschutes Project, and develop on biological opinion addressing these actions. As described in the Opinion above, Reclamation has activities it implements, and approval authority for a portion of the actions covered in the DBHCP, all of which have overlapping effects. The Service anticipates the activities in this Opinion to be implemented together, as described in the proposed action above. The Service acknowledges that the Applicants are wholly responsible for implementing the

conservation measures and Reclamation does not have sufficient authority or discretion to implement the entirety of the conservation measures in the HCP.

Based on the foregoing analyses and conclusions presented above, this Incidental Take Statement addresses incidental take resulting from Reclamation's proposed action as well as from the Service's issuance of a section 10 permit for the DHBCP in accordance with section 7(b)(4) of the ESA.

6.1 FORM AND AMOUNT OR EXTENT OF TAKE ANTICIPATED FOR OREGON SPOTTED FROG

6.1.1 Form of Take

Based on the analyses presented above in the *Effects of the Action* section, incidental take of the Oregon spotted frog is reasonably certain to occur in the form of lethal and sublethal harm as a result of altered habitat conditions (including increased exposure of all spotted frog life stages to predation by birds, snakes, small terrestrial mammals such as mink or raccoons, and fish) caused by the proposed action that actually injures individual spotted frogs by significantly disrupting their feeding, breeding or sheltering behavior. Lethal incidental take results in the death of individual spotted frogs, while sublethal take is more difficult to discern. Exposure to heat and cold due to insufficient cover can all result in spotted frog mortality, but may also cause sublethal injury due to damage to skin or organs, temporary dehydration, stress from the threat of predation, or even injuries sustained from unsuccessful predation attempts. In most cases we expect the anticipated incidental take will be in the form of both lethal and sublethal harm. Individual spotted frogs that experience sublethal injuries sufficient to result in harm, as defined in our regulations, may be unable to function normally, or may also survive these stresses and contribute to the subsequent year's breeding population.

6.1.2 Amount or Extent of Take

Detection of killed or injured individual eggs, tadpoles, juveniles, sub-adults, and adult Oregon spotted frogs will be very difficult due to their small size, cryptic coloration, dependence on aquatic environments, the dynamic nature of their environment (fluctuating water levels and flows due to managed river flows), and the nature of the take impact (e.g., consumption by predatory fish). For those reasons, we find it is not practical to quantify or monitor take impacts in terms of individual spotted frogs.

Pursuant to the authority of section 402.14(i)(1)(i) of the implementing regulations for section 7 of the ESA (80 FR 26832), a surrogate can be used to express the amount or extent of anticipated take if the following criteria are met: (1) the causal link between the surrogate and take is described; (2) an explanation is provided as to why it is not practical to express the amount or extent of take or to monitor take-related impacts in terms of individuals of the listed species; and (3) a clear standard is set for determining when the level of anticipated take has been exceeded.

For purposes of this incidental take statement, a combination of affected wetland acres, affected river channel acres, storage volumes, and gauge flow rates in specific geographic areas, as described in the *Effects of the Action* section, are used as surrogates for establishing the amount

or extent of Oregon spotted frog take likely to be caused by the proposed action. The causal link (criterion 1) between each of these surrogates and take of the spotted frog is described in detail for specific geographic areas in the *Environmental Baseline* section above. Each of these surrogates was specifically relied upon to determine the biological effects of the proposed action on the spotted frog. Criterion 2 is met as discussed above at the beginning of this section. The basis for compliance with regulatory criterion 3 is described below where we quantify the acres of the surrogate. For purposes of this incidental take statement, the sites for which a surrogate and a take exceedance trigger could be defined serve collectively as the standard for determining when the level of exempted take under this incidental take statement has been exceeded (see Table 48 below). NOTE: For some river reaches, it was not possible to define a take exceedance criterion due to complex groundwater hydrology, insufficient hydrological gauging in the system to measure natural/unregulated surface water inputs, and variable topography over the vast landscape where monitoring of river stage and floodplain inundation would be needed to evaluate site-specific requirements for habitat inundation that is most beneficial to spotted frogs.

In the Upper Deschutes River subbasin, the surrogates for quantifying take in the reservoir system in the area above Wickiup Dam are a combination of reservoir water storage volumes and wetland habitat acres. In the area below Wickiup Dam, the surrogates for quantifying take are a combination of river flow rates and wetland habitat acres by river reach. In the Little Deschutes River subbasin, the surrogate for quantifying take is wetland habitat acres.

Crane Prairie Reservoir

At Crane Prairie Reservoir, storage volumes and water elevations influence the level of inundation within approximately 583 acres of wetlands that provide habitat for spotted frogs. Within Crane Prairie Reservoir we know that a reservoir storage volume of 46,800 acre-feet inundates a large area of the wetlands within the reservoir. The DBHCP implements operations requiring that storage volumes in Crane Prairie Reservoir will reach at least about 46,800 acre-feet by March 15. From March 15 through July 15 the storage volume in Crane Prairie Reservoir will remain between about 46,800 acre-feet and 48,000 acre-feet (actual requirements in the DBHCP are stated in terms of water surface elevation rather than storage volume to provide more precise regulation of Oregon spotted frog habitat conditions). Beginning on July 16, reservoir storage will be drawn down until reaching about 37,870 acre-feet at the end of the irrigation season. During this period when the wetlands are draining (July 16 to October 31), some pre-metamorphic, juvenile, adult and sub-adult spotted frogs are likely to be killed or injured through desiccation and predation. Reservoir storage volumes will increase from about 37,870 acre-feet to at least about 46,800 acre-feet by March 15 the following year. While all spotted frogs overwintering in the reservoir are subject to predation pressures, the lower the storage volumes the greater likelihood spotted frogs will be killed or injured by fish that prey upon them.

Wickiup Reservoir

Downstream from Crane Prairie Reservoir, there are approximately 2,961 acres of wetlands within Wickiup Reservoir that extend into the floodplain of the Deschutes River between Crane

Prairie and Wickiup reservoirs. The floodplain wetlands along the Deschutes River are influenced by both flow releases from Crane Prairie Dam and storage volumes in Wickiup Reservoir. Wetlands within Wickiup Reservoir are influenced mainly by the storage volumes that are high (up to 200,000 acre-feet) in the spring and rapidly drain as water is released during the irrigation season. These extreme changes in hydrological condition likely preclude the establishment of a persistent spotted frog population within Wickiup Reservoir. This area currently functions as a “sink” for spotted frogs; small, incipient populations are likely established within the wetlands at Wickiup Reservoir annually from upstream source areas only to be eliminated by the rapid de-watering of these wetlands during the irrigation season. Operation of the reservoir via the proposed action will perpetuate this cycle. During the irrigation season and extending into the irrigation water storage season (April 1 through October 15), all or most of the spotted frogs in various life stages (embryos, tadpoles, juvenile, sub-adults and adults) that are present within the reservoir are likely to be stranded, desiccated and preyed upon as water drains from the wetlands as a result of the proposed action. Nearly all spotted frogs that overwinter within the residual storage volume of water within Wickiup Reservoir and the Deschutes River between the reservoirs are likely to be exposed to lethal predation by brown trout that are concentrated in the residual reservoir pool.

Below Wickiup Dam in the Deschutes River, a surrogate for the amount or extent of spotted frog take can be expressed in terms of the extent of wetland acres likely to be occupied by spotted frogs over time that are de-watered when river flows, as measured by hydrological gauges at WICO and BENO, drop below specific flow thresholds identified in Table 48 below. In general, the timing of the incidental take occurs in the fall when the river is ramped down in September and October so that storage of water may begin in the reservoirs upstream. As water drains from the wetlands, juvenile, sub-adult and adult spotted frogs are likely to be harmed by avian and terrestrial predators due to the lack of cover provided by water and emergent vegetation. Overall, spotted frogs are reasonably certain to experience a restriction in movement, a reduction in cover, and/or stranding that exposes them to lethal predation or desiccation within approximately 1,227 acres of wetlands adjacent to 57 miles of the Deschutes River downstream of Wickiup Dam.

Reaches 1 and 2 - Wickiup Dam to the Little Deschutes River

Under the proposed action, when Deschutes River flows are managed below 900 cfs as measured at the WICO gauge during the breeding and early rearing period (March 15 to June 29), most spotted frogs within 633 acres of wetlands in Deschutes River Reaches 1 and 2 are exposed to lethal and sublethal harm through habitat loss and degradation (due to a reduction in cover) that increases their exposure to avian and terrestrial predation and desiccation. Egg masses and emerging tadpoles are at increased risk of predation and exposure to freezing and overheating due to the lack of cover and to shallow water depths. As flows are reduced below 900 cfs in September, juvenile, sub-adult and adult spotted frogs are once again at increased risk of lethal and sublethal harm from predation as wetlands are dewatered and movement between rearing and overwintering habitat is restricted. The proposed action is likely to harm spotted frogs both lethally and sublethally between September 15 and June 29 of the following year when

Deschutes River flows are well below 900 cfs and there is limited habitat available to them from fall, through winter and into spring.

In Phases 2 and 3 of the DBHCP, we anticipate that wetland sloughs within Reaches 1 and 2 will be revegetated, either passively or actively through planting that is funded via the Upper Deschutes Conservation Fund. Therefore, it is likely that flows of less than the 900 cfs “threshold” will inundate emergent vegetation, thereby providing OSF tadpoles, juveniles, sub-adult and adults with cover to elude predators. For this reason, we anticipate a reduction in harm to OSF during Phases 2 and 3 of the DBHCP.

Reach 3 - Little Deschutes to Benham Falls

In Deschutes River Reach 3, when Deschutes River flows are below 1,580 cfs, as measured at the WICO gauge, some spotted frog egg masses and emerging tadpoles are likely to be taken through stranding due to the delay in inundation of 115 acres of wetlands on private land that is managed by weirs in Sunriver. In Phase 1, we anticipate this condition and take will occur at flows of <1,580 cfs for a portion of the year, and potentially for the entire year. In Phases 2 and 3, summer flows are not expected reach or exceed 1,580 cfs at any time of the year.

On approximately 171 acres outside the area managed by weirs within this reach, lethal and sublethal harm is anticipated because spotted frog movement is likely to be restricted and spotted frogs are likely to be stranded and preyed upon as water drains from wetlands as the irrigation storage season begins. The timing of this impact is likely to occur between September 16 and June 30 when flows at BENO are below 1,300 cfs.

Reach 4 - Benham to Dillon Falls

In Reach 4, some spotted frogs within approximately 198 acres of wetland habitat along three miles of river are likely to be subject to lethal and sublethal harm arising from restricted movement and exposure to an increased risk of stranding due to de-watering of habitat as flows at the BENO gauge are reduced below 1,600 cfs in September and further reduced shortly thereafter to below 1,300 cfs during the irrigation storage season. During the irrigation season when flows at BENO drop below 1,600 cfs and remain above 1,300 cfs between July 1 and September 15, spotted frogs may be exposed to lethal and sublethal take as a portion of their wetlands may be dewatered. As flows are reduced below these thresholds, most juvenile, sub-adult and adult spotted frogs using these wetlands are exposed to an increased risk of lethal predation by aquatic and terrestrial predators. The DBHCP includes conservation measures to lengthen the fall ramp down as flows are reduced, which will minimize harm to OSF as flows in the river are reduced for the storage season.

In the spring, when flows are below 1,200 cfs, most of the 198 acres of wetland habitat within Reach 4 are not inundated by the river. Until flows reach 1,600 cfs at the BENO gauge in the spring, spotted frogs within these wetlands are concentrated into small areas and egg masses and emerging tadpoles are at increased risk of mostly lethal harm from stranding and desiccation. Spotted frogs in Reach 4 are also exposed to increased predation as they utilize areas without vegetated cover for breeding.

Reach 5 - Dillon Falls to Lava Island Falls

In Reach 5, approximately 95 acres of wetlands are dewatered when flows at BENO drop below 1,500 cfs. Although spotted frogs are not currently known to occur within these acres, we anticipate that spotted frogs will utilize all these acres as winter flows improve the suitability and connectivity of riparian wetlands in Phases 2 and 3 of the DBHCP. Therefore, we anticipate those spotted frogs may experience lethal and sublethal harm from stranding, predation and desiccation at some point in Phases 2 and 3.

Reach 6 - Lava Island Falls to COID diversion

In Reach 6, all spotted frogs within seven acres of wetlands are likely to be killed when flows are reduced for the irrigation storage season during Phase 1 of the DBHCP through stranding, predation and desiccation, because this is a small or transient site with little resilience to stochastic events. The timing of this impact is likely to occur in September when the river levels decline. Increased winter flows in Phases 2 and 3 are likely to create year-round suitable habitat for OSF, and we anticipate that an OSF population is likely to become established within this reach during the later phases of the DBHCP. As this OSF population becomes established, it is likely that some individuals will be exposed to sublethal and lethal harm each year at the onset of the irrigation storage season in the fall when the wetlands begin to de-water.

Reach 7 - COID Diversion to Colorado Street Bridge

In Reach 7 in Phase 1, some spotted frogs within eight acres of the LSA Marsh in the Old Mill District in Bend, OR, are likely to experience lethal and mostly sublethal harm from a reduction in the quality and amount of available spotted frog overwintering habitat caused by lower winter flows under the proposed action. In Phases 2 and 3 we anticipate the increased minimum winter flows will result in improved overwintering conditions within the LSA marsh to the extent that there may be little to no take occurring.

Deschutes River Channel

Between Wickiup Dam and Bend, OR, Oregon spotted frogs use approximately 988 acres of the Deschutes River riverine habitats to move between seasonal habitats and for overwintering. We do not know if the entire 988 acres are currently occupied on an annual basis, but we anticipate their use over the life of the HCP as the OSF population grows due to the conservation measures in the HCP. During the irrigation storage season, overwintering spotted frogs within the river channel are concentrated into areas that are also occupied by brown trout, which are likely to prey upon juvenile, sub-adult and adult OSF. In Phases 2 and 3 of the DBHCP, winter flows will increase to 300 cfs and 400-500 cfs, respectively, and expand the area of winter habitat for OSF within the river channel, minimizing the lethal harm that occurs to OSF at winter flows of 100 cfs at the WICO gauge.

Crescent Creek and Little Deschutes River

In the Little Deschutes River subbasin, the proposed action is likely to harm some spotted frogs both lethally and sublethally as a result of de-watering up to 1,182 acres of wetland habitats

along approximately 30 miles of Crescent Creek, and within 3,322 acres of wetland habitats along approximately 60 miles of the Little Deschutes River. The timing of the impact on Crescent Creek is most likely to occur in the fall (September) as flows at the CREO gauge are reduced below 90 cfs during spotted frog movement to overwintering habitat. The fall storage season also is likely to harm some spotted frogs lethally and sublethally in the wetlands along the Little Deschutes River, but specific flow thresholds for harm could not be discerned due to a lack of hydrologic gauging in the system to measure natural/unregulated surface water inputs that would allow us to evaluate river stage and floodplain inundation levels that sufficiently inundate OSF wetland habitat. Spotted frogs in all wetland habitats that experience a drop in water levels along Crescent Creek and the Little Deschutes River are likely to be exposed to lethal and sublethal harm through increased avian, aquatic and terrestrial predation. In some areas without sufficient off-channel oxbow overwintering habitat, spotted frogs move into Crescent Creek and the Little Deschutes River where they are subject to increased predation from brown trout.

Given the abundance of off-channel oxbows along Crescent Creek that maintain water (although at lower levels) through the fall drawdown and into the winter when increased precipitation results in increasing water levels in oxbows, spotted frogs are likely to persist in overwintering habitats that receive additional flows. As per conservation measure CC-1 additional winter flows from Crescent Lake and measured at the CREO gauge, are likely to increase the available water in oxbows for overwintering spotted frogs, thereby reducing the expected incidental take. The Little Deschutes River also experiences a drawdown at the onset of the irrigation storage season and spotted frogs may be concentrated into oxbow habitats with predatory bullfrogs through winter. Additional flow releases from Crescent Reservoir are not likely to influence the wetlands along the Little Deschutes River where spotted frogs must overwinter with bullfrogs, resulting in largely lethal, but also some sublethal, take. The Upper Deschutes Conservation Fund will be used to fund projects (e.g., bullfrog removal and habitat restoration) that mitigate the harm to OSF that occurs within 3,322 acres of wetlands along the Little Deschutes River through the storage season.

For Reclamation activities associated with the RO&M and SEED Programs, Oregon spotted frog are likely to be lethally and sublethally harmed when river flows are reduced at the CRAO and WICO gauges. These activities are likely to result in harm to OSF along the approximately 1-mile segment of the Deschutes River downstream of Crane Prairie Dam and 59 miles of the Deschutes River downstream of Wickiup Dam to Bend, OR periodically (i.e., every 6 – 8 years) for a short duration.

In the segment of the Deschutes River between Crane Prairie and Wickiup Reservoirs, adult spotted frogs overwintering in the Deschutes River when flows are reduced for four to 10 hours for each of up to 6 days are expected to be lethally and sublethally harmed due to increased exposure and risk of predation. If the 6-hour (10 hours with ramping) concrete conduit inspection occurs during August or September, juveniles, sub-adults, and adults will likely be lethally and sublethally harmed due to increased risk of predation as they are forced to move and locate cover as the waterline recedes.

Table 48. Amount of anticipated take of Oregon spotted frog caused annually by the Proposed Action.

Location	Surrogate Quantification of Exempted Take	Conditions that reflect take exceedance
<i>Upper Deschutes River Sub basin Above Wickiup Dam</i>		
Crane Prairie Reservoir	583 acres of dewatered wetlands between July 16 and October 31 (drawdown period); Entire reservoir pool where storage volumes are between 37,870 and 46,800 acre-feet between October 15 and March 15.	Storage volumes below 46,800 acre-feet between March 15 and July 15; Drawdown initiation before July 15; Storage volumes below 37,870 acre-feet at any time of the year, except for invasive species management actions, or for OSF conservation.
Wickiup Reservoir, including Deschutes River wetlands between reservoirs	2,961 acres of dewatered wetland acres between April 1 and October 15 as storage volumes are reduced below 200,000 acre feet (i.e., maximum storage volume); All remaining frogs in the Wickiup Reservoir pool over winter.	Since all Oregon spotted frogs within the reservoir, including the Deschutes River between Crane Prairie and Wickiup reservoirs, are anticipated to be taken annually, take in Wickiup reservoir cannot be exceeded.
<i>Upper Deschutes River Sub basin Below Wickiup Dam</i>		
1: Wickiup Dam to Fall River (includes monitored Oregon spotted frog sites at Bull Bend, Dead Slough and La Pine SP SW Slough) 2: Fall River to Little Deschutes (includes monitored spotted frog sites on private land at RM 202 and 195)	633 acres of dewatered wetlands when flows at the WICO gauge are <900 cfs between September 15 and June 29.	Flows at WICO gauge <900 cfs between June 30 and September 14.

3: Little Deschutes to Benham Falls (includes Sunriver)	115 acres breeding and rearing habitat within wetlands in Sunriver when flows at WICO gauge are <1,580 cfs year round; 171 acres of dewatered riverine wetlands (not including Sunriver) when flows at BENO are <1,300 cfs between September 16 and June 30.	N/A Flows <1,300 cfs at the BENO gauge between July 1 and September 15.
4: Benham to Dillon Falls (includes monitored Oregon spotted frog sites at East Slough Camp and S. Ryan Ranch)	198 acres of dewatered wetlands when flows at BENO drop below 1,600 cfs and are above 1,300 cfs between July 1 and September 15, and when flows drop below 1,600 cfs between September 16 and June 30.	Flows <1,300 cfs at the BENO gauge between July 1 and September 15.
5: Dillon Falls to Lava Island Falls	If and when occupied, 95 acres of dewatered wetlands when flows at BENO drop below 1,500 cfs year round.	N/A
6: Lava Island Falls to COID diversion (includes monitored spotted frog site on private land at RM 172)	7 acres of dewatered wetland from September 15 to April 30.	N/D
7: COID Diversion to Colorado Street Bridge (includes LSA Marsh in Old Mill)	8 acres of wetland from September 15 to April 30 (due to reduced water levels).	N/D
Deschutes River Channel	988 acres of riverine wetland from September 16 to March 31 at flows of ≥100 cfs at in Phase 1; ≥300 in Phase 2; ≥400 cfs in Phase 3.	As measured at the WICO gauge (September 16 to March 31), <100 cfs at in Phase 1; <300 in Phase 2; <400 cfs in Phase 3
<i>Little Deschutes River Sub basin</i>		
Crescent Creek	1,182 acres when flows at CREO gauge are <90 cfs year round.	N/D
Little Deschutes River from Crescent Creek	3,322 acres of wetlands between September 1 and June 30.	N/D

confluence to mouth at the Deschutes River		

N/D = Not defined: Based on best available information take exceedance thresholds for these reaches could not be defined due to a lack of river gauges and associated river stage-floodplain inundation information; N/A = Not Applicable as take is exempted for the entire year; WICO, BENO, CREO = flow measurement gauges on the Upper Deschutes River; COID = Central Oregon Irrigation District; RM = river mile; Cfs = cubic feet per second

In the 59-mile stretch of the Deschutes River downstream of Wickiup Dam, Oregon spotted frogs use approximately 988 acres of the Deschutes River riverine habitats to move between seasonal habitats and for overwintering. We do not know if the entire 988 acres are currently occupied on an annual basis, but we anticipate regular OSF use of the river when Reclamation's proposed activities for the RO&M and SEED Programs could occur. Within these acres, we anticipate that OSF will be lethally and sublethally harmed during activities that reduce flows at the WICO gauge below 100 cfs for a short duration. The proposed activities are likely to cause short-term disruptions to OSF that are either moving to or are already within overwintering habitat when water levels drop within the 988 acre river Deschutes River channel between Wickiup Dam and Bend, OR.

6.2 FORM AND AMOUNT OR EXTENT OF TAKE ANTICIPATED FOR BULL TROUT

6.2.1 Form of Take

Based on the analyses presented above in the *Effects of the Action* section, incidental take of the bull trout is reasonably certain to occur in the form of lethal and sublethal harm as a result of altered habitat conditions (including increased instream temperatures that result from low flows and reduced extent of foraging opportunity due to physically reduced habitat availability, also resulting from flow reductions) caused by the proposed action that actually injures individual bull trout by significantly disrupting their feeding or sheltering behavior. Lethal incidental take results in the death of individual bull trout, while sublethal take is more difficult to discern. Exposure to elevated water temperatures or high concentrations of dissolved gasses can result in bull trout mortality, but may also cause sublethal injury resulting in damage to tissues or organs, or impaired behavioral or physiological function for short periods of time so as to impair normal essential behaviors or processes (e.g., disorientation that inhibits normal foraging). In most cases we expect the anticipated incidental take will be in the form of both lethal and sublethal harm, depending on the river conditions at any given time. Individual fish that experience sublethal injuries sufficient to result in harm, as defined in our regulations, may be unable to function normally for some period of time, but may also survive these stresses and contribute to the subsequent year's breeding population. In most cases, we anticipate the incidental take will be in the form of both lethal and sublethal harm. Individual bull trout that experience sublethal harm may be unable to function normally, or may survive these stresses, but will still experience injury sufficient to result in harm, as defined in our regulations.

6.2.2 Amount or Extent of Take

Pursuant to the authority of section 402.14(i)(1)(i) of the implementing regulations for section 7 of the ESA (80 FR 26832), a surrogate can be used to express the amount or extent of anticipated

take if the following criteria are met: (1) the causal link between the surrogate and take is described; (2) an explanation is provided as to why it is not practical to express the amount or extent of take or to monitor take-related impacts in terms of individuals of the listed species; and (3) a clear standard is set for determining when the level of anticipated take has been exceeded.

For purposes of this incidental take statement, take is quantified by using surrogates, which were a combination of miles affected over a period of days as described in the *Effects of the Action* section, reasonably certain to be caused by the proposed action. The causal link (criterion 1) between each of these surrogates and take of the bull trout is described in detail for specific geographic areas in the *Environmental Baseline* section above. Each of these surrogates was specifically relied upon to determine the biological effects of the proposed action on the bull trout. Criterion 2 is met as discussed above at the beginning of this section. The basis for compliance with regulatory criterion 3 is described below where we quantify the miles of the surrogate. For purposes of this incidental take statement, the distances for which a surrogate and a take exceedance trigger could be defined serve collectively as the standard for determining when the level of exempted take under this incidental take statement has been exceeded (see Table 49 below).

The Service expects incidental take of bull trout will be difficult to detect because the presence of bull trout is difficult to determine within the action area and detecting a dead or impaired specimen is unlikely. In the Crooked River, the Service cannot clearly distinguish between the likelihood of sublethal and lethal harm of bull trout resulting from temperature-related effects from storage water releases during the irrigation season. This is due to the following factors: 1) flow management in the Crooked River is highly variable in terms of both the timing and volume of water releases from Bowman Dam and in terms of diversions for irrigation, which results in unpredictable temperature fluctuations throughout the 48.6 miles of river from Bowman Dam to Osborne Canyon; and 2) bull trout distribution in specific affected reaches of the Crooked River is not currently known and is likely to change because this portion of the river has only recently been accessible to and re-colonized by bull trout (with Opal Dam fish passage in November 2019); thus 3) injurious temperatures could occur at any point in the 48.6 miles of the Crooked River between OID Diversion (RM 55.9) and Osborne Canyon (RM 7.3) annually; and 4) bull trout are reasonably certain to come into contact with those temperatures in some locations within that stretch. Because of these factors, the effects to bull trout can vary unpredictably between sublethal and lethal.

Table 49. Amount of anticipated take of bull trout annually caused by the Proposed Action.

Affected Reach	Project Element/Activity resulting in temperatures >16°C (sublethal) and >23°C (lethal)	Waterbody		Activity Season/dates	Operators	Incidental Take (river miles affected)	
						Sublethal	Lethal
Crooked River subbasin	Release and diversion of contracted storage water from Prineville Reservoir	Crooked River	OID diversion to CAPO gauge	irrigation season April 1 - October 15 (197 days)	BOR, OID, NUID	9.2 miles for 197 days	
			CAPO to NUID pumps			24.3 miles for 197 days	
			NUID pumps to Osborne Canyon			15.1 miles for 197 days	
	Release of uncontracted storage from Prineville Reservoir and reasonably certain diversion	Crooked River	OID to CAPO	irrigation season April 1 - October 15 (197 days)	BOR	9.2 miles for 197 days	
			CAPO to NUID			24.3 miles for 197 days	
			NUID to Osborne			15.1 miles for 197 days	
	Crooked River flood control*	Crooked River (directly below Bowman Dam)		30 days (within the storage and irrigation seasons)	BOR	7.5 miles for 30 days	
Whychus Creek	Diversion	Whychus Creek		April 12 - Oct 12 (121 days sublethal, 33 days lethal)	TSID	20 miles for 121 days	4.5 miles for 33 days

* For Crooked River flood control operations, incidental take is anticipated to occur from high flow releases that result in TDG (total dissolved gas) and GBD (gas bubble disease) effects, and not temperature threshold exceedances.

6.3 EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of designated critical habitat.

6.4 REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the impacts of incidental take on the Oregon spotted frog and bull trout as described in this incidental take statement, which is based on the analysis of the *Effects of the Action* for each species in the accompanying Biological Opinion.

1. Reclamation shall continue to provide funding and/or other support to ongoing interagency efforts to conduct annual spotted frog breeding counts within the action area.
2. Reclamation shall prepare an annual report summarizing all Project-related monitoring activities specified under this incidental take statement. The report shall be submitted to the Service by March 1 of each calendar year.
3. Reclamation, consistent with the language in its final assessment, the DBHCP, and pursuant to the 2014 Crooked River Act, shall on each water year's Day of Allocation, set aside specific volumes (in acre-feet) from Prineville Reservoir's groundwater mitigation account and from the Reclamation's uncontracted storage account. This storage will be used to maintain Crooked River instream flows during the October to April non-irrigation season.
4. Reclamation shall, within 90 days of the Service's issuance of an Incidental Take Statement for the Deschutes River Basin Project (the Service can extend if needed) apply to the Oregon Water Resources Department for a secondary water right for no less than 62,527 acre-feet of uncontracted storage in Prineville Reservoir. The Service must be included in all communications with the OWRD.
5. Reclamation shall annually request that the Oregon Water Resources Department protect all instream flow releases made pursuant to any secondary water right issued for flow releases from Prineville Reservoir. This includes but is not limited to releases from the City of Prineville's groundwater mitigation account and releases from uncontracted storage. The Service must be included in all communications with the OWRD.
6. Reclamation shall monitor TDG levels in the Crooked River when flow releases from Bowman Dam exceed 1,500 cfs at the PRVO gauge.
7. Reclamation shall annually report the number of days that water temperature reaches or exceeds 16 °C in the Crooked River.
8. Reclamation shall work with the Service and other interagency partners to improve instream flow monitoring, irrigation diversion monitoring, and instream flow compliance in the Crooked River.

9. Reclamation shall, within 60 days of the Service's issuance of an Incidental Take Statement for Operation and Maintenance of Bowman Dam and Prineville Reservoir, apply for a TDG waiver for flow releases from Bowman Dam and Prineville Reservoir.
10. Reclamation shall inform the Service when RO&M and SEED activities will be implemented at Crane Prairie and Wickiup Dams.

6.4 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions are necessary to implement RPM 1:

1. Reclamation shall fund a qualified party (e.g., USGS, as in 2018 and 2019), approved by the Service, to conduct annual breeding surveys for spotted frogs in the action area. The survey plan shall be developed in coordination with and with the approval of the Service by Feb 1 of each year.
2. Reclamation shall participate in and provide resources to interagency efforts to conduct spotted frog breeding surveys that begin in mid-March. Coordination meetings will be initiated by the Service in February, prior to the breeding season.

The following term and condition is necessary to implement RPM 2:

3. The format of the report shall be consistent with the annual reports submitted in 2018 through 2020.

The following terms and conditions are necessary to implement RPM 3:

4. Reclamation shall hold up to 5,100 AF of first-fill Groundwater Mitigation Account Storage for release during December and January of each water year. This storage shall be released at a daily rate of 41 cfs, or at a daily rate specified by the Service (unless the OWRD provides new direction pursuant to Oregon Water Law).
5. Reclamation shall hold up to 13,000 AF of uncontracted Prineville Reservoir storage for release during the approximately October 15 to April 1 storage season of each water year. This storage shall be released at a daily rate of 50 cfs, or at a daily rate specified by the Service.

The following term and condition is necessary to implement RPM 4:

6. Reclamation must apply for and use its best efforts to secure (including defense of the application during any protest or hearing) a secondary water right for no less than 62,527 AF of storage in Prineville Reservoir, which results in the protection and use of the

uncontracted water releases for fish and wildlife (the uncontracted storage releases). The result of this application, subsequent secondary water right issued by OWRD, and Reclamation's subsequent operations after receipt of the secondary water right shall be that:

- a) the purpose of use of the uncontracted storage releases must result in the flow augmentation for fish and wildlife,
- b) Reclamation does not make the uncontracted storage releases for any other purposes than fish and wildlife,
- c) the uncontracted storage releases are enforceable and protectable under State law by OWRD.
- d) the uncontracted storage releases can be made year-round,
- e) the uncontracted storage releases' place of use is in (and enforceable in) the Crooked River from Bowman Dam downstream to Lake Billy Chinook, and
- f) the storage and release of the uncontracted storage releases will be based on the Day of Allocation (DOA) accounting system.

The following term and condition is necessary to implement RPM 5:

7. Reclamation will, on or before each water year's DOA, annually request that the OWRD protect all instream flow releases made pursuant to any secondary water rights issued for flow releases from Prineville Reservoir. This includes but is not limited to releases from the City of Prineville's groundwater mitigation account and releases from uncontracted storage. The request shall
 - a) include the Service in all communications with the OWRD, and
 - b) specify that all the flows from the account are to be protected from diversion to the maximum extent allowed in their secondary instream water rights.

The following terms and conditions are necessary to implement RPM 6:

8. Reclamation shall conduct or contract with the appropriate Federal or State agency to monitor TDG levels in the Crooked River whenever flows from Bowman Dam exceed 1,500 cfs.
 - a) TDG will be monitored at least once per week when flows exceed 1,500 cfs; monitoring will continue weekly until flows decline to 600 cfs.
 - b) TDG will be monitored at three locations between Bowman Dam at RM 70.5 and RM 60.5. Specific monitoring locations will to be determined by Reclamation and the Service.
 - c) TDG monitoring equipment will be maintained and calibrated to ensure accurate measurements
 - d) Reclamation or contracted staff will be fully trained on use of TDG equipment.

The following term and condition is necessary to implement RPM 7:

9. Reclamation shall report on the number of days Crooked River water temperatures exceed 16 °C at two locations on the Crooked River. These are 1) CAPO gauge and 2) Smith Rock gauge. If operations and temperature monitoring are not currently available or discontinued at either of these gauges, Reclamation will (directly or through another Federal or State agency) install and operate suitable water temperature devices.

The following term and condition is necessary to implement RPM 8:

10. Reclamation will, in cooperation with the OWRD and other interagency parties, implement the instream flow and irrigation diversion monitoring actions specified in its Assessment. Reclamation will include in their annual report their efforts to optimize water delivery and ensure protection of instream flow releases. The report should include information on the following:
 - a) Efforts to facilitate cooperation between Reclamation, OWRD, and the three diversions to be gauged by Reclamation.
 - b) Progress in improving water management as specified in section 4.4 of Reclamation's Assessment.
 - c) Improvements in compliance monitoring of instream flow released from uncontracted storage.
 - d) Document compliance with certified water rights at the three diversions gauged by the Reclamation.

The following term and condition is necessary to implement RPM 9:

11. Reclamation will apply to the Oregon Department of Environmental Quality, or the appropriate State or Federal authority, for a TDG waiver for flow releases from Bowman Dam and Prineville Reservoir.

The following term and condition is necessary to implement RPM 10:

12. Habitat monitoring shall be conducted in coordination with the Service during activities that cause take.

Reporting Requirements

If a dead, injured, or sick endangered or threatened species is located, initial notification must be made to the Service's Division of Law Enforcement in Oregon at (503) 682-6131. Instruction for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Care must be taken in handling sick or injured Oregon spotted frogs to ensure effective treatment and care must be taken in handling dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured Oregon spotted frogs, or the preservation of biological materials from a dead Oregon spotted frogs, Reclamation has the responsibility to ensure that information relative to the date, time, and location of the frog when found, and possible cause of injury or death of each Oregon spotted frogs be recorded and provided to the Service Law Enforcement.

6.5 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends that Reclamation implement the following conservation measures:

1. Continue the close coordination with the Service in monitoring the status of the spotted frog in the area affected by the Deschutes Project.
2. Support on-farm water conservation to reduce demands on the Deschutes River flows.
3. Given that there is no means of calculating the acres of wetland habitat that remain inundated through winter (during the irrigation storage season), the Service recommends that Reclamation fund LiDAR imagery for the Basin at low flows (i.e., October flights before the snow) or “green” (bathymetric) LiDAR. Currently available LiDAR spatial layers for the Basin have been flown during high flows (irrigation season) and cannot be used for assessing winter conditions. Furthermore, the currently available LiDAR that has been flown during the summer irrigation season limits the ability to develop hydraulic modeling products that can assess the change in spatial inundation on the landscape over the changing hydrograph that occurs through storage and release operations.
4. Treat reed canarygrass within the project area and re-establish a diversity of native wetland vegetation in treated areas.
5. Assist with bullfrog control within lands occupied by spotted frogs.
6. In concert with ODFW establish two intern positions to control bullfrogs within lands occupied by spotted frogs.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

6.6 REINITIATION NOTICE

This concludes formal consultation on the proposed action. As provided in 50 CFR 402.16, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the Biological Opinion; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action. If you have any questions about this consultation, please contact Bridget Moran of my staff at (541) 383-7146.

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APPENDIX A

OREGON SPOTTED FROG STATUS OF THE SPECIES

1 Listing Status

The Oregon spotted frog was listed as threatened under the Endangered Species Act (ESA) on August 29, 2014 (79 FR 51658).

2 Taxonomy

The scientific name *Rana pretiosa* (order Anura; family Ranidae) was first applied to a series of five specimens collected in 1841 by Baird and Girard (1853, p. 378) from the vicinity of Puget Sound. Subsequently, the “spotted frog” was separated into two species, *Rana pretiosa* (Oregon spotted frog) and *Rana luteiventris* (Columbia spotted frog) based on genetic analyses (Green *et al.* 1996, 1997).

Phylogenetic analyses conducted on samples of Oregon spotted frogs collected from 3 locations in Washington and 13 locations in Oregon indicate that there are two well-supported clades (a group of biological taxa, as species, that includes all descendants of one common ancestor) nested within the Oregon spotted frog: the Columbia clade (Trout Lake Natural Area Preserve (NAP) and Camas Prairie) and the southern Oregon clade (Wood River and Buck Lake in the Klamath River basin) (Funk *et al.* 2008, p. 202).

Blouin *et al.* (2010) performed genetic analyses on Oregon spotted frogs from 23 locations in British Columbia, Washington, and Oregon for variation at 13 microsatellite loci and 298 base pairs of mitochondrial DNA. Their results indicate that *Rana pretiosa* is comprised of six major genetic groups: (1) British Columbia; (2) the Chehalis River drainage in Washington; (3) the Columbia River drainage in Washington; (4) Camas Prairie in northern Oregon; (5) the central Cascades of Oregon; and (6) the Klamath River basin (Blouin *et al.* 2010, pp. 2184–2185). Within the northern genetic groups, the British Columbia (Lower Fraser River) and Chehalis (Black River) populations form the next natural grouping (Blouin *et al.* 2010, p. 2189). Recently discovered locales in the Sumas, South Fork Nooksack, and Samish Rivers occur in-between these two groups. While no genetic testing has been done on these newly found populations, it is reasonable to assume that they are likely to be closely related to either the British Columbia or Chehalis group, or both, given their proximity and use of similar lowland marsh habitats (79 FR 51659).

3 Physical Description

The Oregon spotted frog is named for the black spots that cover the head, back, sides, and legs. The dark spots are characterized by ragged edges and light centers that grow and darken with age (Hayes 1994, p. 14). Body color also varies with age. Juveniles are usually brown or, occasionally, olive green on the back and white, cream, or flesh-colored with reddish pigments on the underlegs and abdomen developing with age (McAllister and Leonard 1997, pp. 1–2). Adults range from brown to reddish brown but tend to become redder with age. The Oregon spotted frog is a medium-sized frog, ranging from 44 to 100 millimeters (mm; 1.74 to 4 inches (in)) in body length. Females are typically larger than males and can reach up to 100 mm or more (4 in) (Rombough *et al.* 2006, p. 210).

4 Life History

Adult Oregon spotted frogs begin to breed by one to three years of age, depending on sex, elevation, and latitude. Male Oregon spotted frogs are not territorial and often gather in large groups of 25 or more individuals at specific locations (Leonard *et al.* 1993, p. 132). Breeding occurs in February or March at lower elevations and between early April and early June at higher elevations (Leonard *et al.* 1993, p. 132). The majority of egg masses are laid communally in groups of a few to several hundred (Licht 1971, p. 119; Nussbaum *et al.* 1983, p. 186; Cook 1984, p. 87; Hayes *et al.* 1997 p. 3; Engler and Friesz 1998, p. 3). Females may deposit their egg masses at the same locations in successive years, in shallow, often temporary, pools of water; gradually receding shorelines; on benches of seasonal lakes and marshes; and in wet meadows. These sites are usually associated with the previous year's emergent vegetation, are generally no more than 14 inches (35 centimeters (cm)) deep (Pearl and Hayes 2004, pp. 19–20). Breeding micro-environments are often located in seasonally inundated shallows, and are usually hydrologically connected to permanently-wetted areas, such as creeks, wetlands, and springs (Licht 1971, p. Licht, 1974, p. 614). Shallow water is easily warmed by the sun, and warmth hastens egg development (McAllister and Leonard 1997, p. 8). However, laying eggs in shallow water can result in high mortality rates for eggs and hatchling larvae due to desiccation or freezing (Licht 1971, p.112, Licht1974, p 618).

Eggs usually hatch within three weeks after oviposition. Tadpoles metamorphose into froglets during their first summer. Tadpoles are grazers, having rough tooth rows for scraping plant surfaces and ingesting plant tissue and bacteria. They also consume algae, detritus, and probably carrion. Post-metamorphic spotted frogs feed on live animals, primarily insects.

Similar to many North American pond-breeding anurans (belonging to the Order Anura, which contains all frogs), predators can strongly affect the abundance of larval and post-metamorphic spotted frogs. The heaviest losses to predation are thought to occur shortly after tadpoles emerge from eggs, when they are relatively exposed and poor swimmers (Licht 1974, p. 624). However, the odds of survival appear to increase as tadpoles grow in size and aquatic vegetation matures, thus affording cover (Licht 1974, p. 624).

Licht (1974, pp. 617–625) documented the highly variable mortality rates for spotted frog life-history stages in marsh areas in the lower Fraser Valley, BC: embryos (30 percent), tadpoles (99 percent), and post-metamorphic (after the change from tadpole to adult, or “metamorphosis”) frogs (95 percent). Licht (1974, p. 625) estimated mortality of each life stage and predicted only a 1 percent chance of survival of eggs to metamorphosis, a 67 percent chance of juvenile survival for the first year, and a 64 percent adult annual survival with males having a higher mortality rate than females. An average adult between-year survival of 37 percent was estimated by a mark-recapture study at Dempsey Creek in Washington between 1997 and 1999 (Watson *et al.* 2000, p. 19).

5 Habitat

The Oregon spotted frog is highly aquatic; it is almost always found in or near a perennial body of water that includes zones of shallow water and abundant emergent or floating aquatic plants,

which the frogs use for basking and cover. Watson *et al.* (2003, p. 298) summarized the conditions required for completion of the Oregon spotted frog life cycle as shallow water areas for egg and tadpole survival, perennially deep, moderately vegetated pools for adult and juvenile survival in the dry season, and perennial water for protecting all age classes during cold wet weather. Characteristic vegetation includes grasses, sedges, and rushes, although eggs are laid where the vegetation is low or sparse, such that vegetation structure does not shade the eggs (McAllister and Leonard 1997, p. 17). While native vegetation is the preferred substrate, the frog may also use short, manipulated reed canarygrass/native vegetation mix (J. Engler, pers. comm. 1999) a high level of insolation, or solar exposure, seems to be a significant factor in breeding habitat selection (McAllister and White 2001, p. 12; Pearl and Hayes 2004, p. 18). The availability of the unique characteristics of traditional egg-laying sites is limited at many sites, and adults may have limited flexibility to switch sites (Hayes 1994, p. 19). This may make the spotted frog particularly vulnerable to modification of egg-laying sites (Hayes 1994, p. 19).

After breeding, during the dry season, spotted frogs move to deeper, permanent pools or creeks (Watson *et al.* 2003, p. 295). They are often observed near the water surface basking and feeding in beds of floating and submerged vegetation (Watson *et al.* 2003, pp. 292–298; Pearl *et al.* 2005, pp. 36–37).

Known overwintering sites are associated with flowing systems, such as springs and creeks, that provide well-oxygenated water (Hallock and Pearson 2001, p. 15; Hayes *et al.* 2001, pp. 20–23, Tattersall and Ultsch 2008, pp. 123, 129, 136) and sheltering locations protected from predators and freezing (Risenhoover *et al.* 2001; Watson *et al.* 2003, p. 295). Oregon spotted frogs burrow in mud, silty substrate, clumps of emergent vegetation, woody accumulations within the creek, and holes in creek banks when inactive during periods of prolonged or severe cold (Watson *et al.* 2003, p. 295; Hallock and Pearson 2001, p. 16; McAllister and Leonard 1997, p. 17); however, they are intolerant of anoxic (absence of dissolved oxygen) conditions and are unlikely to burrow into the mud for more than a day or two (Tattersall and Ultsch 2008, p. 136) because survival under anoxic conditions is only a matter of 4–7 days (Tattersall and Ultsch 2008, p. 126). This species can remain active during the winter and selects microhabitats that can support aerobic metabolism and minimize exposure to predators (Hallock and Pearson 2001, p. 15; Hayes *et al.* 2001, pp. 20–23; Tattersall and Ultsch 2008, p. 136). In central Oregon, where winters generally result in ice cover over ponds, spotted frogs follow a fairly reliable routine of considerable activity and movement beneath the ice during the first month following freeze-up. Little movement is observed under the ice in January and February, but activity steadily increases in mid-March, even when ice cover persists (Bowerman 2006, pers. comm.; Hallock 2009, pers. comm.; Hayes *et al.* 2001, pp. 16–19). Oregon spotted frogs have been observed using “semi-terrestrial” overwintering habitats such as interstices in lava rock, beaver channels, and flooded beaver lodges along the Deschutes River in central Oregon (Pearl *et al.* 2018, p 545). Overwintering sites may contain multiple frogs, underscoring the importance of these habitat features for spotted frogs (Pearl *et al.* 2018, p 548).

Movement studies specific to Oregon spotted frogs are limited in number and scope. Results of a habitat utilization and movement study at Dempsey Creek in Washington indicate that adult frogs made infrequent movements between widely separated pools and more frequent movements between pools in closer proximity (Watson *et al.* 2003, p. 294), but remained within

the study area throughout the year. Home ranges averaged 5.4 ac (2.2 ha), and daily movement was 16–23 ft (5–7 m) throughout the year (Watson *et al.* 2003, p. 295). During the breeding season (February–May), frogs used about half the area used during the rest of the year. During the dry season (June–August), frogs moved to deeper, permanent pools, and occupied the smallest range of any season, then moved back toward their former breeding range during the wet season (September–January) (Watson *et al.* 2003, p. 295). Individuals equipped with radio transmitters stayed within 2,600 ft (800 m) of capture locations at the Dempsey Creek site (Watson *et al.* 1998, p. 10) and within about 1,312 ft (400 m) at the Trout Lake NAP (Hallock and Pearson 2001, p. 16). A late season movement and habitat use study of four spotted frog populations in the upper Willamette (1 population), Klamath River basin (1 population) and upper Deschutes (2 populations) showed that 84.5% (49/58) of frogs moved less than 250 m between late summer and winter tracking locations (Pearl *et al.* 2018, p. 543). The Pearl *et al.* (2018, p. 543) study also showed that frogs associated with ditches in the Klamath Marsh National Wildlife Refuge, traveled significantly longer distances (i.e., ranging up to 1145 m) than frogs not utilizing ditches. Whether ditches facilitate movement of spotted frogs or frogs are moving longer distances to locate more suitable overwintering habitat is unknown (Pearl *et al.* 2018 p. 548).

Long travel distances, while infrequent, have been observed between years and within a single year between seasons. Recaptures of spotted frogs at breeding locations in the Buck Lake population in Oregon indicated that adults often move less than 300 ft (100 m) between years (Hayes 1998, p. 9). Three adult spotted frogs (one male and two females) marked in a study at Dempsey Creek and the Black River in Washington moved a distance of 1.5 mi (2.4 km) between seasons along lower Dempsey Creek to the creek's mouth from the point where they were marked (McAllister and Walker 2003, p. 6). An adult female spotted frog traveled 1,434 ft (437 m) between seasons from its original capture location at the Trout Lake Wetland NAP (Hallock and Pearson 2001, p. 8). Two juvenile frogs at the Jack Creek site in Oregon were recaptured the next summer 4,084 ft (1,245 m) and 4,511 ft (1,375 m) downstream from where they were initially marked, and one adult female moved 1.7 miles (2.7 km) downstream (Cushman and Pearl 2007, p. 13). Spotted frogs at a Sunriver site routinely make annual migrations of 1,640 to 4,265 ft (500 to 1,300 m) between the major egg-laying complex and an overwintering site (Bowerman 2006, pers. comm.).

Although these movement studies are specific to Oregon spotted frogs, the number of studies and size of the study areas are limited. Few studies have been conducted over multiple seasons or years. In addition, the ability to detect frogs is challenging because of the difficult terrain and the need for the receiver and transmitter to be in close proximity. Hammerson (2005) recommends that a 3.1-mile (5-km) dispersal distance be applied to all ranid frog species, because the movement data for ranids are consistent. The preponderance of data indicates that a separation distance of several kilometers may be appropriate and practical for delineation of occupancy, despite occasional movements that are longer or that may allow some genetic interchange between distant populations (for example, the 6.2-mi (10-km) distance noted by Blouin *et al.* 2010, pp. 2186, 2188). Based on the best available scientific information, the Service considers that spotted frog habitats are connected for purposes of genetic exchange when occupied/suitable habitats fall within a maximum movement distance of 3.1 mi (5 km) (79 FR 51663, p. 51662).

6 Distribution

Historically, the Oregon spotted frog ranged from British Columbia to the Pit River basin in northeastern California (Hayes 1997; p. 40; McAllister and Leonard 1997, p. 7). Oregon spotted frogs have been documented at 61 historical localities in 48 watersheds (3 in British Columbia, 13 in Washington, 29 in Oregon, and 3 in California) in 31 sub-basins (McAllister *et al.* 1993, pp. 11–12; Hayes 1997, p. 41; McAllister and Leonard 1997, pp. 18–20; COSEWIC 2011, pp. 12–13).

Currently, the spotted frog is found within 16 sub-basins ranging from extreme southwestern British Columbia south through the Puget Trough, and the Cascades Range from south-central Washington at least to the Klamath River basin in southern Oregon (Table 1 79 FR 51662–51663)(Figure 1). Oregon spotted frogs occur in lower elevations in British Columbia and Washington and are restricted to high elevations in Oregon (Pearl *et al.* 2010 p. 7). In addition, spotted frogs currently have a very limited distribution west of the Cascade crest in Oregon, are considered to be extirpated from the Willamette Valley in Oregon (Cushman and Pearl 2007, p. 14), and may be extirpated in the Klamath and Pit River basins of California (Hayes 1997, p. 1; Service (Klamath Falls Fish and Wildlife Office), unpublished data).

In British Columbia, spotted frogs no longer occupy the locations documented historically, but they currently are known to occupy six locations in a single sub-basin and 3 unconfirmed eDNA detections in, the Lower Fraser River (Canadian Oregon Spotted Frog Recovery Team 2012, p. 6, Kendra Morgan, BC Ministry of Environment, pers. comm., 2018).

In Washington, spotted frogs are known to occur only within seven sub-basins/watersheds: the Sumas River, a tributary to the Lower Chilliwack River watershed and Fraser River sub-basin; the lower South Fork Nooksack River, a tributary of the Nooksack River; Samish River; Chambers Creek, which drains to the Puget Sounds, Black River, a tributary of the Chehalis River; Outlet Creek (Conboy Lake), a tributary to the Middle Klickitat River; and Trout Lake Creek, a tributary of the White Salmon River. The Klickitat and White Salmon Rivers are tributaries to the Columbia River. The spotted frogs in each of these sub-basins/watersheds, with the exception of perhaps the South Fork Nooksack and Samish, are isolated from frogs in other sub-basins (79 FR 51663).

In Oregon, Oregon spotted frogs are known to occur only within eight sub-basins (scale equivalent to Hydrologic Unit Code 8): (1) Lower Deschutes River; (2) Upper Deschutes River; (3) Little Deschutes River; (4) McKenzie River; (5) Middle Fork Willamette; (6) Upper Klamath; (7) Upper Klamath Lake; and (8) the Williamson River. Oregon spotted frogs in most of these sub-basins are isolated from spotted frogs in other sub-basins. However, Oregon spotted frogs in the lower Little Deschutes River are aquatically connected with those in the Deschutes River downstream of the confluence of the rivers in the Upper Deschutes River sub-basin. Oregon spotted frog distribution west of the Cascade Mountains in Oregon is restricted to a few lakes in the upper watersheds of the McKenzie River and Middle Fork Willamette River sub-

basins, which represent the remaining 2 out of 12 historically occupied sub-basins west of the Cascades in Oregon (79 FR 51663).

In California, this species has not been detected since 1918 (California Academy of Science Museum Record 44291) at historical sites and may be extirpated (Hayes 1997 pp. 135). However, there has been little survey effort of potential habitat since 1996, so this species may still occur in California (79 FR 51663).

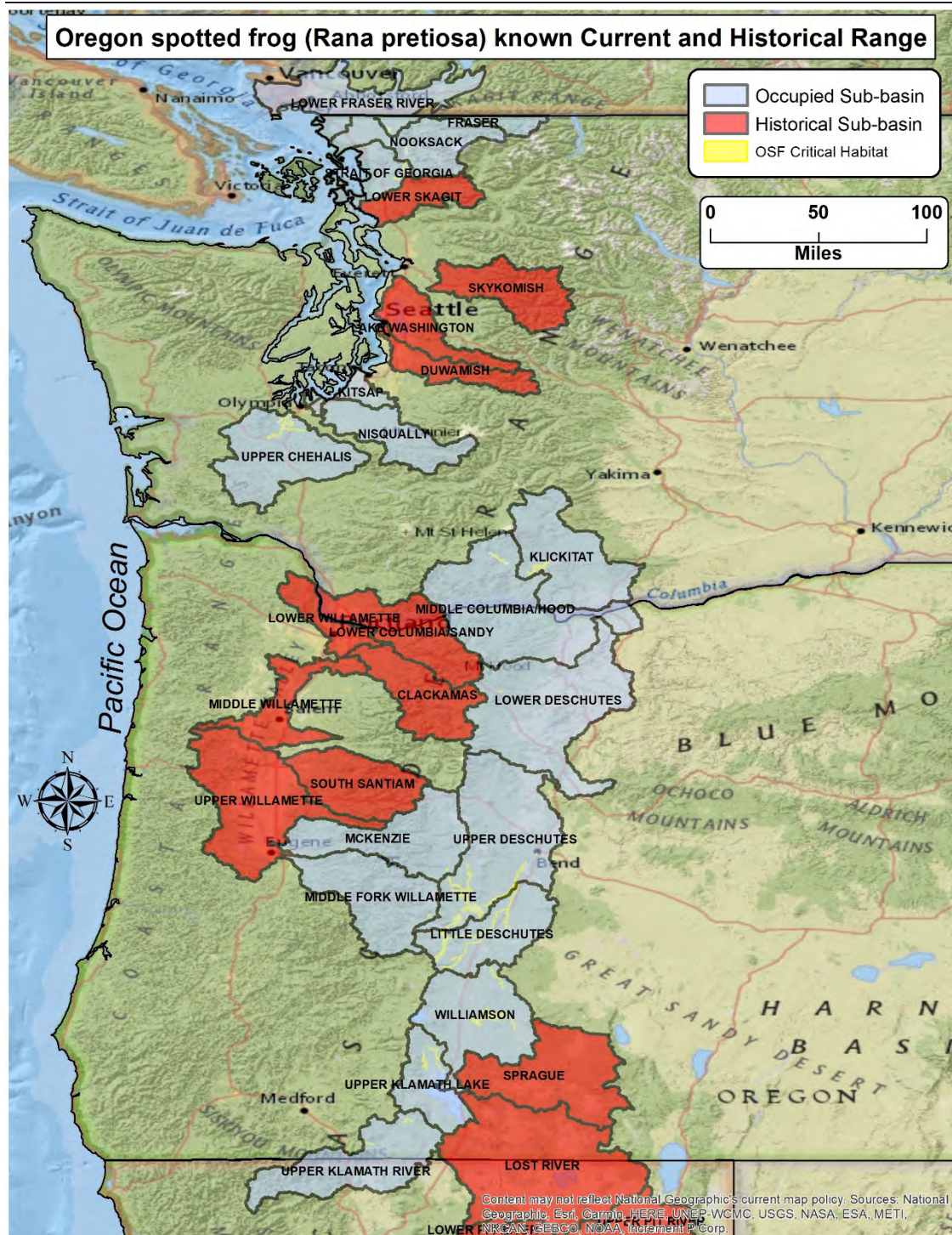


Figure 1: Historic and current occupation of sub-basins (HUC level 4) by the Oregon spotted frog (Table 1 79 FR 51662 -51663, with addition of a single extant population in Chamber Creek found in 2018)

7 Population Dynamics

The Services' final rule to list the Oregon spotted frog estimated the total minimum breeding adult populations within each of the 15 occupied sub-basins using egg mass counts from known breeding locations (79 FR 51663-51667). Although there are limitations with using egg mass data to evaluate population size and status at the site level and sub-basin scale, egg mass counts do indicate that many breeding locations within sub-basins have small numbers of breeding adults. Adams *et al.* (2013, p. 1 and 4 and 2014 p. 1 - 2) recommends assessing trends in amphibian populations by documenting the change in the number of populations using occupancy modeling rather than a change in abundance at individual sites. However, long-term spotted frog population trends using occupancy modeling are not yet available.

Modeling across a variety of amphibian taxa suggests that pond-breeding frogs have high temporal variances of population abundances and high local extinction rates relative to other groups of amphibians, with smaller frog populations undergoing disproportionately large fluctuations in abundance (Green 2003, pp. 339–341). The vulnerability of spotted frog egg masses to fluctuating water levels (Hayes *et al.* 2000, pp. 10–12; Pearl and Bury 2000, p. 10), the vulnerability of post-metamorphic stages to predation (Hayes 1994, p. 25), and low overwintering survival (Hallock and Pearson 2001, p. 8) can contribute to relatively rapid population turnovers, suggesting spotted frogs are particularly vulnerable to local extirpations from stochastic events and chronic sources of mortality (Pearl and Hayes 2004, p. 11). The term “rapid population turnovers” refers to disproportionately large fluctuations in abundance.

Oregon spotted frogs concentrate breeding efforts in relatively few locations (Hayes *et al.* 2000, pp. 5–6; McAllister and White 2001, p. 11). For example, Hayes *et al.* (2000, pp. 5–6) found that 2 percent of breeding sites accounted for 19 percent of the egg masses at the Conboy Lake NWR. Similar breeding concentrations have been found elsewhere in Washington and in Oregon. Moreover, spotted frogs exhibit relatively high fidelity to breeding locations, using the same seasonal pools every year and often using the same egg-laying sites. In years of extremely high or low water, the frogs may use alternative sites. For example, the Trout Lake Creek and Conboy Lake frogs return to traditional breeding areas every year, but the egg-laying sites change based on water depth at the time of breeding. A stochastic event that impacts any one of these breeding locations could significantly reduce the Oregon spotted frog population associated with that sub-basin.

Egg mass count data suggests a positive correlation and significant link between site size and spotted frog breeding population size (Pearl and Hayes 2004, p. 12). Larger sites are more likely to provide the seasonal microhabitats required by spotted frogs, have a more reliable prey base, and include overwintering habitat. The observation that extant spotted frog populations tend to occur in larger wetlands led Hayes (1994, Part II pp. 5, 7) to hypothesize that a minimum size of 9 acres (ac) (4 hectares (ha)) may be necessary to reach suitably warm temperatures and support a large enough population to persist despite high predation rates. However, spotted frogs also occupy smaller sites and are known to occur at sites as small as 2.5 ac (1 ha) and as large as 4,915 ac (1,989 ha) (Pearl and Hayes 2004, p. 11). Smaller sites generally have a small number of frogs and, as described above, are more vulnerable to extirpation. Pearl and Hayes (2004, p. 14) believe that these smaller sites were historically subpopulations within a larger breeding

complex and spotted frogs may only be persisting in these small sites because the sites exchange migrants or seasonal habitat needs are provided nearby.

Egg mass counts are believed to be the best available metric of adult reproductive population size and are the most time-efficient way to estimate population size (Phillipsen *et al.* 2010, p. 743). Adult females are believed to lay one egg mass per year (Phillipsen *et al.* 2010, p. 743), and the breeding period occurs within a reliable and predictable timeframe each year (McAllister 2006, pers. comm.). If egg mass numbers are collected in a single survey timed to coincide with the end of the breeding season, when egg laying should be complete, then the egg mass count should represent a reliable estimate of total egg masses. Because one egg mass is approximately equivalent to one breeding female plus one to two adult males, a rough estimate of adult population size can be made if a thorough egg mass census is completed (Phillipsen *et al.* 2010, p. 743). A minimum adult population estimate can be derived from the total egg mass count multiplied by two (one egg mass equals two adult frogs). However, using egg mass counts to estimate population size has some weaknesses. For example, researchers have uncertainties about whether adult females breed every year, only lay one egg mass per year, and find difficulty in distinguishing individual egg masses in large communal clusters. Furthermore, access to high elevation or remotely located sites during the breeding period can be difficult or unsafe due to snow and other hazards.

Egg mass counts, as currently conducted at most sites, do not allow for evaluation of trends within a site nor between sites because surveys are not standardized. Survey effort, area coverage, and timing can differ between years at individual sites. In addition, method of survey can differ between years at individual sites and differ between sites. Because of the weaknesses associated with the egg mass counts, site estimates derived from egg mass counts are considered to be a minimum estimate and generally should not be compared across years or with other sites. However, some breeding locations have been surveyed in a consistent manner (in some cases by the same researcher) and for enough years that trend data are available and considered to be reliable (e.g., Big Marsh or Sunriver).

Most species' populations fluctuate naturally in response to weather events, disease, predation, or other factors. However, these factors have less impact on a species with a wide and continuous distribution. Small, isolated populations are generally more likely to be extirpated by stochastic events and genetic drift (Lande 1988, pp. 1456–1458).

Funk *et al.* (2008, p. 205) found low genetic variation in Oregon spotted frogs, which likely reflects small effective population sizes, historical or current genetic bottlenecks, and/or low gene flow among populations. Genetic work by Blouin *et al.* (2010) indicates low genetic diversity within and high genetic differentiation among each of the six Oregon spotted frog groups (British Columbia, Chehalis and Columbia drainages, Camas Prairie, central Oregon Cascades, and the Klamath River basin). This pattern of genetic fragmentation is likely caused by low connectivity between sites and naturally small populations sizes. Gene flow is very limited between locations, especially if separated by 6 mi (10 km) or more, and at the larger scale, genetic groups have the signature of complete isolation (Blouin *et al.* 2010, p. 2187). At least two of the locations sampled by Blouin *et al.* (2010) (Camas Prairie and Trout Lake) show indications of recent genetic drift.

Movement studies suggest spotted frogs are limited in their overland dispersal and potential to recolonize sites. Oregon spotted frog movements are associated with aquatic connections (Watson *et al.* 2003, p. 295; Pearl and Hayes 2004, p. 15). Oregon spotted frogs rely on an aquatic connection between breeding sites to maintain population viability.

8 Rangewide Threats

Large historical losses of wetland habitat have occurred across the range of the Oregon spotted frog. Wetland losses are estimated from between 30 to 85 percent across the species range with the greatest percentage lost having occurred in British Columbia. These wetland losses have directly influenced the current fragmentation and isolation of remaining spotted frog populations. Loss of natural wetland and riverine disturbance processes as a result of human activities has and continues to result in degradation of spotted frog habitat. Historically, a number of disturbance processes created early successional wetlands favorable to spotted frogs throughout the Pacific Northwest: (1) Rivers freely meandered over their floodplains, removing trees and shrubs and baring patches of mineral soil; (2) beavers created a complex mosaic of aquatic habitat types for year-round use; and (3) summer fires burned areas that would be shallow water wetlands during the spotted frog breeding season the following spring. Today, all of these natural processes are greatly reduced, impaired, or have been permanently altered as a result of human activities, including stream bank, channel, and wetland modifications; operation of water control structures (e.g., dams and diversions); beaver removal; and fire suppression.

The historical loss of Oregon spotted frog habitats and lasting anthropogenic changes in natural disturbance processes are exacerbated by the introduction of reed canarygrass, nonnative predators, and potentially climate change. In addition, current regulatory mechanisms and voluntary incentive programs designed to benefit fish species have inadvertently led to the continuing decline in quality of Oregon spotted frog habitats in some locations in Washington. The current wetland and stream vegetation management paradigm is generally a no-management or restoration approach that often results in succession to a tree- and shrub-dominated community that unintentionally degrades or eliminates remaining or potential suitable habitat for Oregon spotted frog breeding. Furthermore, incremental wetland loss or degradation continues under the current regulatory mechanisms. If left unmanaged, these factors are anticipated to result in the eventual elimination of remaining suitable Oregon spotted frog habitats or populations. The persistence of habitats required by the species is now largely management dependent.

In the Final Rule to list the frog as threatened (79 FR 51658), the Service determined that the Oregon spotted frog is impacted by one or more of the following factors to the extent that the species meets the definition of a threatened species under the ESA:

- Habitat necessary to support all life stages is continuing to be impacted and/or destroyed by human activities that result in the loss of wetlands to land conversions; hydrologic changes resulting from operation of existing water diversions/manipulation structures, new and existing residential and road developments, drought, and removal of beavers; changes in water temperature and vegetation structure resulting from reed canarygrass

invasions, plant succession, and restoration plantings; and increased sedimentation, increased water temperatures, reduced water quality, and vegetation changes resulting from the timing and intensity of livestock grazing (or in some instances, removal of livestock grazing at locations where it maintains early seral stage habitat essential for breeding);

- Predation by nonnative species, including nonnative trout and bullfrogs;
- Inadequate existing regulatory mechanisms that result in significant negative impacts such as habitat loss and modification; and
- Other natural or manmade factors including small and isolated breeding locations, low connectivity, low genetic diversity within occupied sub-basins, and genetic differentiation between sub-basins.

Also, there are cumulative effects of the several threats that the Oregon spotted frog faces. All occupied sub-basins are subjected to multiple threats, which cumulatively pose a risk to individual populations. Many of these threats are intermingled, and the magnitude of the combined threats to the species is greater than the individual threats (79 FR 51658).

9 Consulted-on Effects

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.

Formal Consultations have been completed for Oregon spotted frog habitat restoration activities in the Middle Klickitat River sub-basin in Washington and within the Little Deschutes and Upper Deschutes River sub-basins in Oregon (Table 1). These restoration activities, described briefly below, were designed to improve habitat for Oregon spotted frog and will have short-term adverse but long term beneficial effects to spotted frog habitat.

Conboy Lake National Wildlife Refuge (NWR), located within the Middle Klickitat River sub-basin in Klickitat County, WA, will improve habitat conditions for Oregon spotted frogs through decommissioning and cleaning approximately 0.75 miles of ditches and other management actions. Ditch decommissioning reduces the amount of habitat used by non-native predatory and competitive species (ex: bullfrogs and brown bullhead). Ditch cleaning is essential for maintaining water flow into the wetlands that are used by Oregon spotted frogs for breeding and rearing. These conservation actions paired with continued removal of predatory and competitive species and reed canarygrass management support recovery of this large and isolated population of spotted frogs.

The Ryan Ranch Restoration Project, located downstream of Wickiup Dam within the Upper Deschutes River sub-basin on the Deschutes National Forest, has restored approximately 65 acres of emergent marsh habitat and reconnects the Deschutes River with its floodplain. The wetland restoration area had been historically (circa 1949) occupied by Oregon spotted frog prior to the construction of a berm that disconnected the wetland from the Deschutes River. Restoration work was completed in the spring of 2019.

The Marsh Project, located within the Little Deschutes River sub-basin on the Deschutes National Forest in Klamath County, OR, implemented in 2018, improves habitat conditions for Oregon spotted frog through hydrological restoration and lodgepole pine removal. The Big Marsh project area represents approximately 80 percent of the adult breeding population in the Little Deschutes River sub-basin at the time of the ESA Listing. The Big Marsh Oregon spotted frog population is essential to the conservation of the spotted frog because it is the source population for downstream habitats within Big Marsh Crescent, Crescent Creek, and the Little Deschutes River. Therefore, the Big Marsh Restoration Project supports the recovery of Oregon spotted frogs within the Little Deschutes River sub-basin.

The Deschutes Project consultation with the Bureau of Reclamation analyzed impacts to spotted frogs as a result of water management and the implementation of early conservation measures within the Deschutes Basin Habitat Conservation Plan (OSF Proposal) within the Upper and Little Deschutes River sub-basins within an approximate xx acres of spotted frog habitat.

The current condition of the Oregon spotted frog and its critical habitat within the Deschutes Project action area is highly degraded due to the impacts of past and ongoing irrigation water storage and delivery activities conducted by the Districts, in coordination with Reclamation, that have radically altered the natural hydrology of this portion of the Deschutes River Basin. Synchronizing and modifying, as needed, water management activities within the action area to ensure the proper function of habitats that support all spotted frog life stages and to ensure connectivity within suitable habitat areas and between spotted frog populations are vital to the survival and recovery of this species. Implementation of the OSF Proposal over a two-year period is a first step in that direction, and should help inform the development of the Deschutes River Basin HCP by the Districts. That HCP effort represents a highly significant opportunity to conserve the Oregon spotted frog by aligning irrigation water management in the Basin to closely conform to and support the life history requirements of the spotted frog and the proper function of its critical habitat.

The Thurston County Beaver Creek Culvert Replacement Project installed a bridge that allowed better connectivity between two known Oregon spotted frog sites on Beaver Creek. Most of the construction activities occurred outside the wetted channel and incorporated several conservation measures such as having experience frog biologist on site to oversee seining the dewater area and minimize effects to Oregon spotted frogs if found in the area. Take in the form of harm is estimated at two adult spotted frogs along 50 feet of Beaver Creek.

The overall goal of the Chehalis-Olympia No. 1 Transmission Line Right-of-Way Maintenance project is to establish low-growing plant communities along the ROW and control the development of trees that could interfere with transmission lines. The right-of-way easement is 75 to 615 feet in width through the project area and approximately 80 miles long. The action area contains known occupied sites and contains habitat for the full life history of the Oregon spotted frog. The vegetation maintenance includes conservation measures to avoid or minimize effects of the activities to Oregon spotted frogs and suitable habitat. Although there may be short-term impacts to frogs, maintaining the right-of-way and avoiding activities in wetted areas at known occupied sites and in areas with suitable habitat will benefit Oregon spotted frogs in the

long term. The action area may also act as a dispersal corridor that is necessary for gene flow and demographic support of populations within the Black River watershed.

The Preserve Habitat Conservation Plan includes managing 25 acres of wetland habitat to benefit Oregon spotted frog by reducing the occurrence of invasive or non-native plants. The mitigation site is degraded due to reed canarygrass and other invasive plant species. Reed canarygrass mechanical control, mowing, management of livestock access in wetted areas of OSF suitable habitat will improve the suitability of the habitat at the mitigation site. Conservation measures include avoiding mechanical management activities in the water or immediately next to the water's edge on the mitigation site, and no in-water vegetation management work in OSF suitable habitat during OSF breeding season. Take in the form of harm is estimated as one adult spotted frog and one egg mass annually for 10 years

The WFWO Monroe-Custer No. 2 Transmission Right-of-Way Vegetation Management Project includes maintaining vegetation and performing routine inspections on the existing right-of-way under the transmission lines. The right-of-way easement is 150 to 575 feet in width and crosses approximately 20 miles of potentially suitable habitat for Oregon spotted frogs. Within that area, the right-of-way crosses 16 to 18 acres of designated critical habitat for the Oregon spotted frog. Vegetation control methods include hand cutting, mowing, and managed herbicidal treatments to remove tall-growing trees and shrubs and to maintain low-growing vegetation. The proposed vegetation maintenance may affect a small number of individual spotted frogs on a total of 210 acres suitable habitat spread over a period of 15 years. In the long term, maintaining the vegetation in the right-of-way and avoiding activities in wetted areas at known occupied sites and in areas with potentially suitable habitat will benefit Oregon spotted frogs.

The Gifford Pinchot National Forest Beaver Pond restoration project will restore 12 acres of Oregon spotted frog wetland habitat through removal of invasive plant species via manual and herbicide treatment over a five-year period (2018-2023). Annual Oregon spotted frog egg mass surveys will occur to complement the restoration activities. Reed canarygrass and Canada thistle will be treated through mowing beginning in June and application of aquatic-labeled imazapyr beginning August 1. Take associated with activities conducted in suitable occupied habitat will include a small proportion of the total number of individuals in all life stages of Oregon spotted frogs within 12 acres.

Each year WDFW staff conducts surveys for Oregon spotted frogs in Washington State under the WDFW Section 6 Cooperative Agreement. When new breeding sites are located 1 to 3 eggs are collected for genetic confirmation to ensure species identification as they can easily be confused with red-legged frog (*Rana aurora*).

Table 1. Completed formal consultations or conferences involving effects of Federal actions on the Oregon spotted frog.

Project/Consultation/Conference Name	Sub-basin Affected	Type of Take (Harm or Harass)	Amount of Take (eggs, tadpoles, frogs, or habitat surrogate)
Colorado Avenue Dam Paddle Trail Improvements Project Biological Opinion	Upper Deschutes	Harm	2.72 acres overwintering habitat permanent loss
		Harass	3.44 acres of disturbance
Ryan Ranch Restoration Conference Opinion and Amended Biological Opinion (2018)	Upper Deschutes	Harm	2,940 tadpoles
		Harass	14 adults, 7 egg masses (avg. of 600 eggs per mass) and 7 juveniles
Old Mill CCAA 20-year Permit Conference Opinion	Upper Deschutes	Harm	12 adult/juvenile spotted frogs and 20 egg masses or up to 8,400 tadpoles
Antelope Grazing Allotments Project Biological Opinion	Williamson River	Harm	2 adults, 4 juveniles, 2 metamorphs, and 237 tadpoles
Marsh Biological Opinion	Little Deschutes	Harm	29 adults, 29 sub adults and 216 juveniles – mortality within 0.10 acre
		Harass	adults, sub-adults, and juveniles with 153 acres
		Harass	294 adult spotted frogs, 294 sub-adult and 2,157 juveniles via capture and handling
Conboy Lake NWR Habitat Management Activities Opinion	Middle Klickitat River	Harm	13 tadpoles
		Harass	109 adults
Wickiup Hydro Opinion	Upper Deschutes	Harm	≤ 5% increase in brown trout
Deschutes Project	Upper Deschutes	Harm and harass	All life stages within 4,661 acres of wetlands.
		Harm	All spotted frogs within 7 acres of wetlands.
		Harass	All spotted frogs within 8 acres of wetlands.
	Little Deschutes	Harm and harass	All spotted frogs within 1,182 acres of wetlands.
Thurston Country PW Beaver Creek Culvert Replacement	Black River	Harm	2 adult spotted frogs along 50 ft of Beaver Creek
Nationwide Aerial Application of Fire Retardant on National Forest System Land	All sub-basins on USFS lands		No take
Chehalis-Olympia No. 1 Transmission Line Right-of-Way Maintenance	Black River	Harm and harass	All spotted frogs occurring on a total of

			268 acres of suitable habitat
The Preserve Habitat Conservation Plan	Black River	Harm and harass	A total of 47 acres over ten years
		Harm	1 adult spotted frog and 1 egg mass annually for 10 years
Monroe-Custer No. 2 Transmission Right-of-Way Vegetation Management Project	South Fork Nooksack & Samish Rivers	Harm and harass	All spotted frogs on a total of 210 acres suitable habitat spread over a period of 15 yrs,
GPNF Beaver Pond	White Salmon River	Harm and harass	Oregon spotted frogs, all life stages, on 12 acres
Section 6	All sub-basins in Washington	Harm and harass	1 to 3 eggs at newly found sites

3.10 Rangewide Conservation Needs

The overall reproductive success of the Oregon spotted frog is directly influenced by the timing and availability of water in habitats that support all life stages and maintaining aquatic connectivity within suitable habitat areas and between populations. Synchronizing and modifying, as needed, water management activities within Oregon spotted frog habitat to ensure the proper function of habitats that support all spotted frog life stages and to ensure connectivity within suitable habitat areas and between spotted frog populations are vital to the survival and recovery of this species. Of equal importance is maintaining low emergent wetland vegetative structure with a high level of solar exposure (low canopy closure) during breeding and the early stages of rearing. Maintaining and restoring complex wetland habitats of variable water depths and native vegetation structure and diversity will provide quality habitat that is suitable for all life stage of spotted frogs. These habitats should be without non-native predators such as bull frogs.

Currently, Oregon spotted frogs are mostly found in small isolated sites occupied by a small number of individuals in a very small portion of its historic range. Therefore, re-establishing and maintaining adequate areas of high quality, connected wetland and aquatic habitat for the spotted frog is a vital conservation need. Conservation efforts focused on improving water management to create habitats that are suitable for all life stages and reducing or removing non-native plant and animal species that reduce the suitability of habitat or result in direct predation of spotted frog are necessary.

In most watersheds across the range of the Oregon spotted frog there is some level of population resilience in the form of multiple occupied sites or sufficient extent of suitable habitat for the species. However in three watersheds, the Lower Chilliwack River, the White River, and Keene Creek the entire reproductive population of Oregon spotted frogs is likely represented by less than 10 females or its status is completely unknown and the habitat is only marginally functional for species life history needs. Immediate, planned and coordinated conservation and recovery

actions are needed for the species in those watersheds of they are likely to become locally extinct in the near future.

General criteria for Oregon spotted frog recovery (delisting) are currently being developed by the Service. A draft recovery plan is anticipated to be completed in 2020. Recovery will require removing and reducing threats to the species coupled with building self-sustaining populations of spotted frogs across their current and possibly historical range by maintaining, restoring, and expanding the habitat on which they depend. Portions of the historical range, including the Pit River Basin of California, Willamette Valley lowlands of Oregon and Central Puget Lowlands of Washington, will require further evaluation to determine if populations can be re-established within the current highly modified habitat condition. Development of recovery metrics may vary geographically in order to create discrete recovery goals across the range of the species. The Service does not have an estimated recovery time for this species.

Long and short-term spotted frog conservation and recovery needs include managing hydrology, reducing or removing invasive animals and plants, and improving connectivity among sites and populations. Conservation efforts will focus on maintaining and increasing population numbers and expanding distribution into suitable habitat within the current and historical range to allow for adequate genetic interchange and re-population of areas following stochastic events.

APPENDIX B

OREGON SPOTTED FROG STATUS OF CRITICAL HABITAT

STATUS OF OREGON SPOTTED FROG CRITICAL HABITAT

The Fish and Wildlife Service designated critical habitat for Oregon spotted frog on 65,038 acres and 20.3 stream miles in Washington and Oregon on May 11, 2016 (81 FR 29336). Critical habitat for Oregon spotted frog was designated within 14 units, delineated by river sub-basins where spotted frogs are extant: (1) Lower Chilliwack River; (2) South Fork Nooksack River; (3) Samish River; (4) Black River; (5) White Salmon River; (6) Middle Klickitat River; (7) Lower Deschutes River; (8) Upper Deschutes River; (9) Little Deschutes River; (10) McKenzie River; (11) Middle Fork Willamette River; (12) Williamson River; (13) Upper Klamath Lake; and (14) Upper Klamath. The final rule for critical habitat provides descriptions of ownership, acreages and threats for each Unit (pp. 29356 – 29360). A summary of area or length and ownership can be found in Tables 7 and 8 below.

Table 1. Approximate area and landownership in designated critical habitat units for the Oregon spotted frog in Oregon and Washington.

	Critical Habitat Unit	Federal Ac (Ha)	State Ac (Ha)	County Ac (Ha)	Private/local municipalities Ac (Ha)	Total
Washington	1. Lower Chilliwack River	0	0	0	143 (58)	143 (58)
	2. South Fork Nooksack River	0	0	0	111 (45)	111 (45)
	3. Samish River	0	1 (<1)	7 (3)	976 (395)	984 (398)
	4. Black River	877 (355)	375 (152)	485 (196)	3,143 (1,272)	4,880 (1,975)
	5. White Salmon River	108 (44)	1,084	0	33 (13)	1,225 (496)
	6. Middle Klickitat River	4,069 (1,647)	0	0	151 (61)	4,220 (1,708)
Oregon	7. Lower Deschutes River	90 (36)	0	0	0	90 (36)
	8. Upper Deschutes River	23,213	185 (75)	45 (18)	589 (238)	24,032 (9,726)
	8A. Upper Deschutes River, Below Wickiup Dam	1,182 (479)	185 (75)	45 (18)	589 (238)	2,001 (810)
	8B. Upper Deschutes River, Above Wickiup Dam	22,031	0	0	0 (<1)	22,031 (8,916)
	9. Little Deschutes River	5,288 (2,140)	14 (6)	80 (32)	5,651 (2,287)	11,033 (4,465)
	10. McKenzie River	98 (40)	0	0	0	98 (40)
	11. Middle Fork Willamette River ...	292 (118)	0	0	0	292 (118)
	12. Williamson River	10,418	0	0	4,913 (1,988)	15,331 (6,204)
	13. Upper Klamath Lake	1,259 (510)	9 (4)	1 (<1)	1,068 (432)	2,337 (946)
	14. Upper Klamath	103 (42)	0	0	159 (64)	262 (106)
	Total	45,815	1,668	618 (250)	16,937 (6,854)	65,038 (26,320)

Note: Area sizes may not sum due to rounding. Area estimates reflect all land and stream miles within critical habitat unit boundaries.

Table 2. Approximate river mileage and ownership within proposed critical habitat units for the Oregon spotted frog in Washington State only. No river miles were designated in Oregon.

Critical habitat unit	Federal river mile (km)	Federal/ private * river mile (km)	State river mile (km)	State/private river mile (km)	County river mile (km)	County/ private river mile (km)	Private/local municipalities river mile (km)	Total
1. Lower Chilliwack River	0	0	0	0	0	0	4.38 (7.05)	4.38 (7.05)
2. South Fork Nooksack River	0	0	0	0	0	0	3.56 (5.73)	3.56 (5.73)
3. Samish River	0	0	0	0	0	0	1.73 (2.78)	1.73 (2.78)
4. Black River	0.06 (0.10)	0.06 (0.10)	0.49 (0.79)	0.05 (0.07)	0.64 (1.02)	0.26 (0.42)	5.90 (9.49)	7.46 (11.98)
5. White Salmon River	0.91 (1.46)	0	0	0	0	0	2.30 (3.70)	3.21 (5.16)
Total	0.97 (1.56)	0.06 (0.09)	0.49 (0.79)	0.05 (0.07)	0.64 (1.02)	0.26 (0.42)	17.87 (28.75)	20.34 (32.7)

* Ownership—multi-ownership (such as Federal/Private) indicates different ownership on each side of the river/stream/creek.

Note: River miles (km) may not sum due to rounding. Mileage estimates reflect stream miles within critical habitat unit boundaries that are not included in area estimates in Table 8.

1 Physical or Biological Features and Primary Constituent Elements

When designating critical habitat, the Service identifies “the physical or biological features [PBFs] essential to the conservation of the species and which may require special management considerations or protection” (50 CFR §424.12; 81 FR 29351). “These include, but are not limited to: 1) space for individual and population growth and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing (or development) of offspring; and 5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species” (81 FR 29351). The final rule for critical habitat identifies the physical or biological features that are essential to the conservation of Oregon spotted frog (USDI FWS 2016, pp. 29351 – 29354). Primary Constituent Elements (PCEs) are those specific elements of the physical and biological features that provide for a species’ life history processes and are essential to the conservation of the species.

The following PCEs of critical habitat were identified for the Oregon spotted frog:

1. Nonbreeding (N), Breeding (B), Rearing (R), and Overwintering Habitat (O) - Ephemeral or permanent bodies of fresh water, including, but not limited to natural or manmade ponds, springs, lakes, slow-moving streams, or pools within oxbows adjacent to streams, canals, and ditches that have one of more of the following characteristics:
 - Inundated for a minimum of 4 months per year (B, R) – timing varies by elevation but may begin as early as February and last as long as September. Inundated from October through March (O).
 - If ephemeral, areas are hydrologically connected by surface water flow to a permanent water body (e.g., pools, springs, ponds, lakes, streams, canals, or ditches) (B, R).
 - Shallow water areas (less than or equal to 30 cm (12 inches), or water of this depth over vegetation in deeper water (B, R).
 - Total surface area with less than 50% vegetative cover (N).
 - Gradual topographic gradient (<3% slope) from shallow water toward deeper, permanent water (B, R).
 - Herbaceous wetland vegetation (i.e. emergent, submergent, and floating-leaved aquatic plants), or vegetation that can structurally mimic emergent wetland vegetation through manipulation (B, R).
 - Shallow water areas with high solar exposure or low (short) canopy cover (B, R)
 - An absence or low density of nonnative predators (B, R, N).
2. Aquatic movement corridors - Ephemeral or permanent bodies of fresh water that have one or more of the following characteristics:
 - Less than or equal to 5 km (3.1 miles) linear distance from breeding areas;

- Impediment free (including, but not limited to, hard barriers such as dams, impassable culverts, lack of water, or biological barriers such as abundant predators, or lack of refugia from predators).
3. Refugia habitat – Nonbreeding, breeding, rearing, or overwintering habitat or aquatic movement corridors with habitat characteristics (e.g., dense vegetation and/or an abundance of woody debris) that provide refugia from predators (e.g., nonnative fish or bullfrogs).

2 Special Management Considerations

Threats to the physical or biological features that are essential to the conservation of this species and that may warrant special management considerations or protection include, but are not limited to: 1) habitat modifications brought on by nonnative plant invasions or native vegetation encroachment (trees and shrubs); 2) loss of habitat from conversion to other uses; 3) hydrologic manipulation; 4) removal of beavers and features created by beavers; 5) livestock grazing; and 6) predation by invasive fish and bullfrogs. These threats also have the potential to affect the PCEs if conducted within or adjacent to designated units.

3 Consulted-on Effects to Oregon Spotted Frog Critical Habitat

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 Critical Habitat designated for Oregon spotted frog.

Formal Consultations have been completed for Oregon spotted frog habitat restoration activities in Critical Habitat Units 6, 8 (subunit 8A) and 9. All actions have had short-term adverse but long term beneficial effects to critical habitat. All consulted on activities to date, briefly described below, are designed to improve habitat conditions within Oregon spotted frog designated critical habitat.

Conboy Lake National Wildlife Refuge (NWR) in Klickitat County, WA, comprises the majority of the critical habitat in Unit 6. The Service determined that actions at Conboy NWR long-term beneficial effects to PCEs of the critical habitat, but in improving overall conditions there would be some loss of PCEs 1 and 2 through the decommissioning of 0.75 miles of ditches and a short term loss of PCE 3 through 0.75 miles of ditch cleaning.

The Ryan Ranch Restoration Project, located within CHU 8 (subunit 8A) on the Deschutes National Forest, in Deschutes County, OR, plans to restore approximately 65 acres of critical habitat for the Oregon spotted frog. PCE 1 will be improved by increasing the extent and duration of inundation within a floodplain wetland that was historically occupied by spotted frogs. PCE 2 will be improved by re-establishing an aquatic movement corridor between this wetland and the Deschutes River.

The Marsh Project, located within CHU 9 on the Deschutes National Forest in Klamath County, OR, will improve all PCEs through hydrological restoration and lodgepole pine removal. The Big Marsh project area represents approximately 25% or 2,847 acres of critical habitat in CHU 9. Implementation of the Marsh Project is likely to enhance the recovery support function of CHU 9 by improving the physical and biological features of critical habitat that will support life history processes that are essential for the conservation of the spotted frog.

APPENDIX C

Wickiup Ram Down 2014 Deschutes River and Wetland Monitoring

Wickiup Ramp Down 2014

Deschutes River and Wetland Monitoring

Jennifer O'Reilly, U.S. Fish and Wildlife Service, Fish and Wildlife Biologist
 Jason Gritzner, U.S. Forest Service, Deschutes and Ochoco National Forest Watershed Program Manager

In October 2014, a monitoring opportunity provided insight into how specific flows affect riverine and wetland habitats along the Deschutes River between Wickiup Dam and Lava Island Falls (approximately 53 miles). A staged ramp down of the Deschutes River was conducted by Oregon Water Resources Department in cooperation with the Deschutes Board of Basin Control and partners within the community (Trout Unlimited, Oregon Department of Fish and Wildlife, Deschutes River Conservancy) to allow stranded fish to be salvaged from a side channel at Lava Island Falls (RM 174.5). The USFWS and Forest Service, as part of the collaborative effort, selected 20 locations (photo below) along the river between Wickiup Dam and Lava Island Falls to conduct a photo monitoring study over the staged ramp down to determine how the system, including wetlands, responded to various flows. The following photos represent a subset of this effort and correspond to the map and index below.

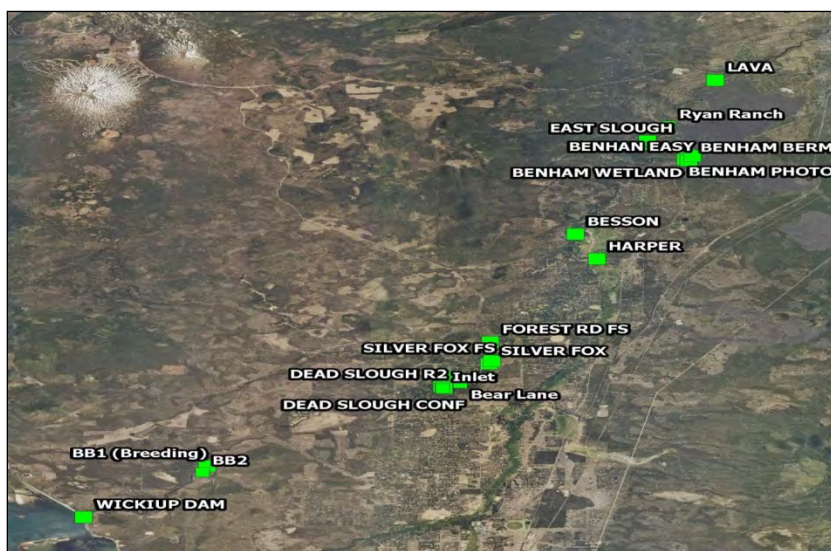


Figure xx: Photo monitoring locations along 53 miles of river between Wickiup Dam and Lava Island Falls.

River Reach	Site location	WICO	BENO
Wickiup to Fall River	Bull Bend	1168-47	
	Bull Bend breeding	1168-47	
	Dead Slough River	886-47	
	Dead Slough Inlet	886-47	
	La Pine State Park SW Slough	1168-47	
	La Pine State Park SW Slough (panoramic)	47	
Fall River to Little Deschutes	Silver Fox oxbow	975-47	1445-790
Little Deschutes to Benham Falls	Benham Wetland	886-229	
Benham to Dillon Falls	East Slough Camp pond	936-47	
	East Slough Camp revisit 12/9/14	50	
	East Slough Camp revisit 2/11/15	127	941

Site location: Bull Bend



WICO: 1168



WICO: 683

Site location: Bull Bend



WICO: 528



WICO: 315



WICO: 229

Site location: Bull Bend



WICO: 102



WICO: 47

WICO: 47



- 683 cfs – Mudflat are becoming evident; side channel with 0.5 feet of water; water line about 0.5 feet below sedge root zone.
- 528 cfs – water drop approximately 0.4 feet; lateral movement of water from edge of bank is approximately 10 feet; 0.25 feet of water remaining over river substrate; wetted side channel inundation retreated ~40 feet toward river.
- 315 cfs – Significant lateral movement of water towards river and riverbed exposure. No riverine water in wetlands. Instream wood is no longer in the water.
- 229 cfs – Entire mudflat exposed. Slumping banks and water level below root zone of

Site location: Bull Bend breeding



WICO: 1168



WICO: 683

Site location: Bull Bend breeding



WICO: 528



WICO: 315

Site location: Bull Bend breeding



WICO: 229



WICO: 102

Site location: Bull Bend breeding



WICO: 47

- 683 cfs – Mudflats are exposed; water no longer within wetland where spotted frogs had been observed in 2013. No potential overwintering habitat off channel. Beaver channel on far bank is connected.
- 528 cfs – water level drop of ~0.5 feet; 40 percent of mudflat exposed. Mid-channel depositional feature becoming exposed. Banks that are not dominated by sedge have roots totally exposed and are greater than 1 foot from water surface. Beaver channel on far bank is disconnected from river.
- 315 cfs – Significant lateral movement of water's edge away from bank and riverbed exposure. Remaining water is within river channel only. Most of the instream wood is partially out of the water.
- 229 cfs – Entire mudflat exposed. Submerged aquatic vegetation is out of the water. Bank erosion is evident. Greater than 50 percent of the riverbed is exposed. Majority of instream wood is out of the water.
- 102 cfs – Increased exposure of riverbed and banks.
- 47 cfs – Riverbed is largely exposed (80 percent), including fish spawning gravels.

Site location: Dead Slough River



WICO: 886



WICO: 683

Site location: Dead Slough River



Site location: Dead Slough River



Site location: Dead Slough River



WICO: 47

- 683 cfs – Mudflat 75 percent exposed. Riverbed, including gravels and wood, becoming exposed. North channel from Dead Slough barely connected and draining to river. South channel to Dead Slough flowing towards river.
- 528 cfs – North channel to Dead Slough cut off from river. Residual pools with small fish are isolated. Increased gradient towards river observed in south channel. No vegetation connected to water. Exposed submerged aquatic vegetation.
- 315 cfs – Continued lateral movement of water toward river and riverbed exposure. Wood increasingly exposed with a drop in flows. South channel to Dead Slough becoming incised.
- 229 cfs – Riverbed exposure increases to ~ 50 percent.
- 102 cfs – Increased incision of south channel flowing (~2 cfs) from Dead Slough.
- 47 cfs – Continued exposure of riverbed and habitat features as described above.

Site location: Dead Slough Inlet



WICO: 886



WICO: 683

Site location: Dead Slough Inlet



WICO: 528



WICO: 315

Site location: Dead Slough Inlet



WICO: 229



WICO: 102

Site location: Dead Slough Inlet



WICO: 47

- 683 cfs – Water outside of sedge vegetation and draining towards the slough.
- 528 cfs – Increased lateral movement of water away from the edge of sedge vegetation. Water extremely shallow.
- 315 cfs – Large increase in exposed mudflat. Residual channel flowing toward river.
- 229 cfs – Remaining pool within Dead Slough does not drop with decrease in flows below ~300 cfs.
- 102 cfs – No change
- 47 cfs – No change

Site location: La Pine State Park SW Slough



Site location: La Pine State Park SW Slough



WICO: 528



WICO: 315

Site location: La Pine State Park SW Slough



Site location: La Pine State Park SW Slough



WICO: 47



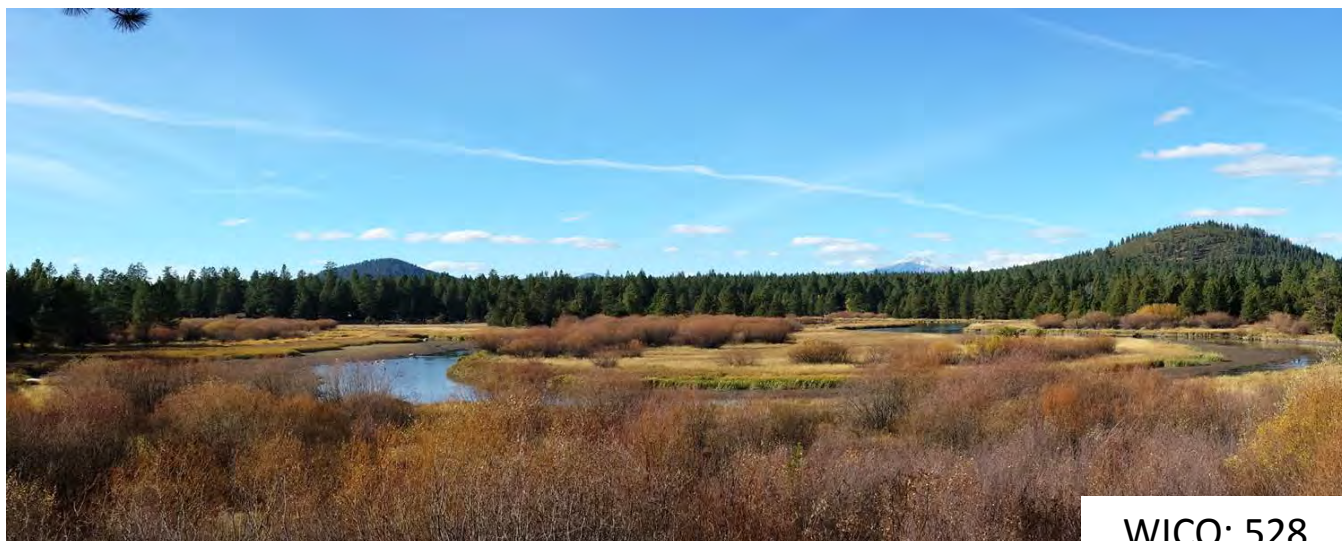
WICO: 47

- 683 cfs – Upstream inlet no longer connected. Some residual pools remain in upstream arm of the slough. Still connected on the downstream outlet arm of the slough.
- 528 cfs – Still connected at the outlet. Water levels down. Large lateral retreat of water's edge on inlet arm toward the apex of the slough.
- 315 cfs – Further lateral retreat of water's edge toward apex of slough. Downstream outlet arm of slough is disconnected. Remaining pool is isolated from the river.
- 229 cfs – 180 meter lateral retreat of water's edge at the outlet compared to when it was connected at 528 cfs. Most residual water on mudflats is gone.
- 102 cfs – No change.
- 47 cfs – No change

Site location: Silver Fox oxbow



Site location: Silver Fox oxbow



WICO: 528



WICO: 315

Site location: Silver Fox oxbow



WICO: 229



WICO: 102

Site location: Silver Fox oxbow



WICO: 47

- 683 cfs – Approximately 50% of river bed exposed on south bend (left). Some water accessing off-channel wetland. No eroding banks. Water surface ~ 0.75-1.0 feet below sedge line.
- 528 cfs – Approximately 65% of river bed exposed on south bend and 50% on north bend. Side channel is cut off.
- 315 cfs – Major lateral recession of active channel with some residual pools remaining on exposed river bed.
- 229 cfs – Further recession of active channel and bed exposure.
- 102 cfs – Flow to channel largely cut off.
- 47 cfs – Mostly residual water on exposed bed surface. Unclear if there is minor connection to main stem river or release of bank storage providing negligible flow.

Site location: East Slough Camp pond



Site location: East Slough Camp pond

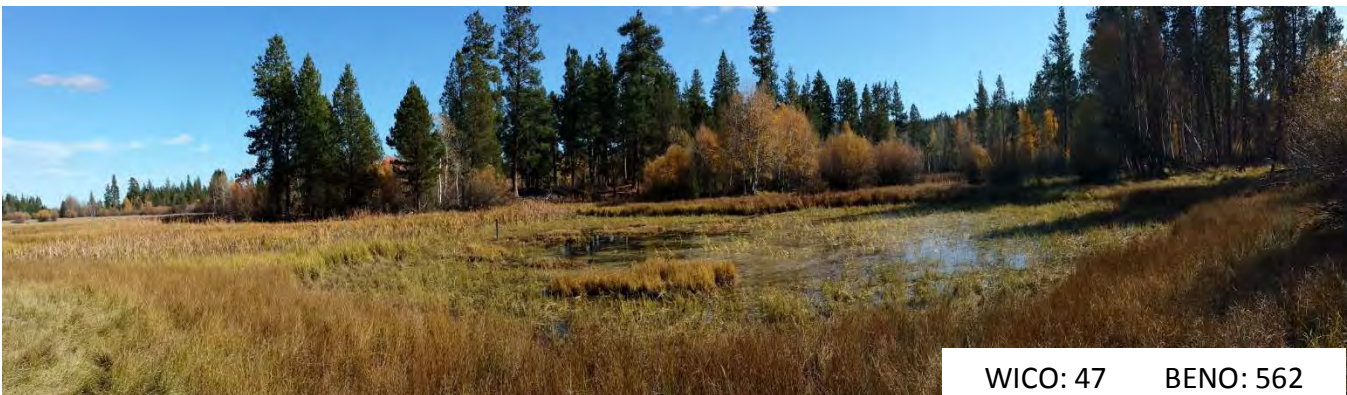


- 683/1445 cfs (WICO/BENO discharge) – Water levels decreased. Water's at the edge of vegetation. Wetland still connected to the river.
- 528/1260 cfs – Further decrease of water surface elevation. Exposure of mud flat near river and at base of butte.
- 315/901 cfs – Significant increase in exposed mudflat. Wetland is disconnected from river.
- 229/790 cfs – Wetland is entirely drained. Some residual water on mud flats.
- 102 cfs – No change
- 47 cfs – No change

Site location: East Slough Camp pond



Site location: East Slough Camp pond



- 683/1445 cfs– Water levels decreased. Pond is isolated from surrounding wetland complex.
- 528/1260 cfs – No visible change.
- 315/901 cfs – Possible slight decrease in water surface elevation.
- 229/790 cfs – No visible change.
- 102/665 cfs – Rains may have increased water surface elevations slightly.
- 47/562 cfs – No visible change
- 50/664 cfs December visit – Vegetation has died back. Pond still retaining water
- ??/??? cfs February visit – Significant decrease in water levels. Pond almost dry.

Site location: East Slough Camp pond



WICO: 50 BENO: 664

East Slough pond re-visited in December 2014. Photo shows that there is a residual pool of water remaining in the pond after the fall ramp down.



WICO: 127 BENO: 941

East Slough pond was re-visited on February 11, 2015, prior to the spring breeding period. There was little water remaining in the pond at the following flows: WICO: 127 and BENO: 941 cfs. The winter of 2014/2015 was dry compared to other years.

APPENDIX D

Upper Deschutes Conservation Fund Implementation



December 2020

Implementation of UD-1: Oregon Spotted Frog Conservation Fund

The U.S. Fish and Wildlife Service (USFWS) is drafting a Recovery Plan and Recovery Implementation Strategy for the Oregon spotted frog and a final plan is anticipated in August 2022. The Recovery Plan will aim to improve the viability of OSF within each of the 15 sub-basins where the species occurs in Oregon and Washington.

Oregon spotted frogs in all subbasins across the range are subject to more than one stressor (i.e., threats). Many OSF breeding sites are small and isolated from each other. Because of OSF's fidelity to breeding locations, fluctuating water levels in the embryonic and tadpole life stages, combined with risk of predation and low overwinter survival, may result in the species being vulnerable to rapid population declines. Changing climate has the potential to exacerbate these stressors through changes in timing and availability of snow and rain events that sustain wetland habitat or creating temperature more favorable to non-native predators, competitors, or disease.

Oregon spotted frogs occur throughout the Upper Deschutes River Basin and within the area affected by water management covered by the Deschutes Basin HCP (HCP). Covered lands within the HCP include approximately 35 percent of the geographic area designated as OSF critical habitat within the species' range that are deemed essential for the conservation of the species. Threats to OSF within the geographic area covered by the HCP, identified in the 2014 ESA listing (79 FR 51658) and USFWS's Deschutes Project Biological Opinions (USFWS 2017, 2019), include not only hydrological changes due to water management, but continued wetland habitat loss due to a lack of natural disturbance processes (e.g., floods, fire, beaver activity). Open water areas within wetlands are being encroached upon by lodgepole pine, cattails, and shrubs. Reed canarygrass is present within a number of OSF sites and renders these habitats less suitable for OSF as it spreads. Introduced predators, such as bullfrogs and nonnative fish, are also present within a number of OSF sites and active management is necessary to reduce predation on spotted frogs.

In general, a conservation strategy for OSF in the Upper Deschutes River Basin will include the following biological goals:

- Expand the overall distribution of populations and increase population viability and abundance of OSF to contribute to the regional recovery of the species.
- Reduce threats to existing populations of OSF.
- Increase the number of individuals in all age classes at known sites.
- Increase connectivity between disjunct populations.

Oregon spotted frog conservation measures outlined in the HCP have aimed to adjust the timing and volume of water storage and release to improve hydrological conditions within OSF habitat at key times during the species' lifecycle. The improvements to habitat via implementation of these conservation measures vary geographically. The proposed conservation measures in the HCP will occur over time as the HCP permit is expected to span 30 years. Therefore, the anticipated benefits to OSF habitat from hydrological changes will vary spatially and temporally within the Upper Deschutes River Basin.

In the Deschutes River downstream of Wickiup Dam, the HCP conservation measures that increase winter flows are not sufficient to independently improve hydrological conditions that support OSF habitat for a number of years post implementation. Even at full implementation (i.e., 400–500 cfs), restoration actions will be necessary to enhance the function and condition of the river and wetland sloughs adjacent to it that support OSF. Furthermore, passive and active habitat restoration of the river and OSF habitat is not feasible in some areas until hydrological improvements are achieved (e.g., winter flow increases in the Deschutes River and summer flow decreases). Habitat maintenance work at OSF sites will be necessary to reduce existing threats to OSF and maintain population viability currently and into the future as flows are restored to the Deschutes River. HCP Conservation Measure UD-1 provides funding to implement site specific actions to improve habitat conditions for OSF that complement enhanced flows in the Deschutes River.

Restoring Spotted Frog Habitat in the Upper Deschutes River Basin

This document outlines some of the OSF conservation actions proposed to be implemented spatially and temporally within the Upper Deschutes River Basin for OSF within the context of the HCP. Some of these conservation actions could be implemented in the short-term, prior to and concurrent with hydrological adjustments to storage and release from reservoirs as identified in the HCP. As USFWS develops a Recovery Plan for OSF, actions that promote recovery will be further identified in an Implementation Strategy for the Upper Deschutes River Basin. However, USFWS knows enough at this time to identify the types of conservation actions that will benefit OSF in the Upper Deschutes River Basin and which can be funded in whole or in part through the conservation fund. Continued monitoring of riverine and wetland habitats that support OSF will inform studies and projects to be conducted and funded in the future.

Crane Prairie Reservoir

Early conservation measures developed for the HCP have modified storage and release operations at Crane Prairie that appear, in the short-term, to be improving survival of OSF. However, invasive species are among the existing threats to OSF at Crane Prairie Reservoir that must be managed to sustain the high-quality wetland habitats in Crane Prairie Reservoir that support OSF and reduce predation of OSF. Efforts are underway by the U.S. Forest Service to inventory and control invasive aquatic weeds in Crane Prairie. However, resources are needed to treat reed canarygrass to prevent spread into OSF breeding sites. Another invasive species, the brown bullhead, may pose a long-term threat to OSF. The Oregon Department of Fish and Wildlife has conducted some management to assess and reduce the abundance of brown

bullheads within Crane Prairie. Funds provided through the Conservation Measure UD-1 may be used to continue these invasive species control efforts now and into the future.

Wickiup Reservoir

The feasibility of habitat enhancement for OSF within Wickiup Reservoir will likely be dependent upon future management of the reservoir and the fluctuation of water storage volumes. Given that springs feed the reservoir, there may be opportunities for site-specific enhancements that create habitat for OSF. However, habitat work that supports OSF in Wickiup Reservoir is not a current conservation priority given the highly degraded OSF habitat condition.

Deschutes River and Adjacent Wetlands Below Wickiup Reservoir

Restoration of the functioning condition of the Deschutes River is a key path to restoring OSF habitat and improving connectivity between OSF populations between Wickiup Dam and Bend, Oregon. Restoration in this segment of the Deschutes River is primarily dependent upon improvement of flows (increased winter flows and reduced summer flows), coupled with some site-specific physical river channel habitat improvements that convey water into oxbows and wetland habitats where OSF occur.

Within the regulated water management regime on the Deschutes River, two factors influence the ecological function of the river and wetlands inhabited by OSF: (1) the physical configuration of the river and (2) the variation in the timing and duration of flow volumes within the river's channel (described in terms of cubic feet per second [cfs]). In its current condition, the Deschutes River channel is wider by approximately 20 percent than it was historically, as a result of storage and release operations from Wickiup Dam (USFS 1996). The widened river channel affects the way water is distributed spatially onto the floodplain and into wetlands. Essentially, higher than historical flows are currently (and in the short-term) needed to reach and support the ecological function of floodplain wetland habitats where OSF occur.

Wetland habitats have shifted in distribution, due to the high summer flows for irrigation, and the hydroperiod (i.e., seasonal timing and duration of water) within wetlands has also changed under the regulated water management regime. The vegetative characteristics of wetland and riparian areas are influenced by duration that water is present and the volume of water. High irrigation season flows result in deep inundation of riverine slough habitats, inhibiting the growth of emergent wetland vegetation in many areas. During the irrigation storage season when flows in the Deschutes River are lowest, large unvegetated areas within the wetlands are without water. Although wetland habitat may extend further onto the Deschutes River floodplain due to high summer flows, the existing condition of wetlands is degraded due to water storage and release operations such that OSF may not successfully complete its lifecycle (USFWS 2017, 2019).

In this regulated system, hydrograph modification with the purpose of restoring physical and ecological function to the Deschutes River and wetlands should trend toward a more natural flow regime. In a hypothetically restored condition, flows from Wickiup Dam could range from

approximately 500 cfs in winter to approximately 1,200 cfs during the summer season.¹ However, improving the ecological function of the river and wetland habitat for OSF will require both passive and active restoration.

The HCP will increase winter flows in the Deschutes River up to 300 cfs by year 8 and 400 to 500 cfs by year 13 of the permit term, respectively. The effect of increases in winter flows results in lower summer flows. Prior to and concurrent with increases in winter flows that are anticipated via HCP implementation, OSF conservation actions that improve habitat function and reduce threats to OSF at the site scale are needed. Examples of potential conservation and restoration actions for OSF and its habitat are bulleted below. We anticipate that continued monitoring of OSF sites will inform additional actions necessary to support OSF conservation and recovery.

Deschutes River winter flows between 100 and 300

Winter flows between 100 and 300 cfs will allow for localized and site-specific restoration activities to mitigate risk to existing OSF populations. When these flows are being achieved, the types of restoration and conservation actions that provide benefits to OSF and its habitat include, but are not limited to:

- Reed canary grass treatment at existing OSF sites and within critical habitat.
- Bull frog removal in Sunriver and wherever they are detected.
- Treatment of encroaching vegetation (cattails, lodgepole, etc.) in Sunriver, Slough Camp, and LSA Marsh and other habitats that support OSF.
- Potential beaver dam analog at Dead Slough to mitigate headcut formation and maintain winter water at higher elevations.

Deschutes River Winter Flows at 400 and 500 Cubic Feet per Second

Winter flows of 400 to 500 cfs will result in lower summer flows in the Deschutes River and passive restoration of the river channel is likely to occur. Active restoration activities to improve habitat and channel function and mitigate risk to existing OSF populations will be localized and site-specific at these winter flows. In general, higher winter flows in the range of 400 to 500 cfs are likely to improve connectivity between seasonal habitats (i.e., overwintering and breeding) for OSF.

Based on observations of flows and corresponding floodplain inundation in past studies (USFS 1996; USFWS 2017, 2019), winter flows of at least 500 cfs in the Deschutes River downstream of Wickiup Dam will support riparian vegetation. Inundation of the root systems of riparian plants through winter along the river corridor will facilitate bank stabilization and lessen the impact of erosion and sedimentation to the river as flow releases from the Wickiup Dam increase during spring and summer. Therefore, winter flows of 500 cfs are likely maximize the potential for passive and active, physical habitat restoration of the Deschutes River channel that influences

¹ This is a hypothetical flow scenario to illustrate a range in flows that could support physical and ecological function of the river while providing optimum passive and active restoration opportunities.

the ecological function of the river and adjacent wetlands for OSF. Improved base flow in the winter increases the opportunity to intercept groundwater within floodplain wetlands.

Winter flows of 400 cfs will provide similar opportunities for restoration but channel restoration activities may be more limited and spatially explicit at these winter flows.

The types of restoration and conservation actions that provide benefits to OSF and its habitat at winter flows of 400 cfs include, but are not limited to:

- Site-specific riparian planting as passive restoration occurs.
- Reed canarygrass treatment at existing OSF sites.
- Bull frog removal in Sunriver and anywhere that bullfrogs are detected in proximity to OSF sites.
- Treatment of encroaching vegetation (cattails, lodgepole pine, etc.) in Sunriver, Slough Camp, and LSA Marsh.
- Potential beaver dam analog at Dead Slough to mitigate headcut formation and maintain winter water at higher elevations.

Winter flows of 500 cfs could support the following types of restoration and conservation actions, in addition to those stated above for winter flows of 400 cfs, in order to provide benefits to OSF and its habitat:

- Bank restoration and planting riparian vegetation.
- Wood placement within the river channel to improve depositional aggradation, which will reduce the cross-sectional area of the channel and thus improving floodplain/wetland connectivity to the channel.
- Beaver dam analogs in oxbows, side channels, and wetlands to moderate the effects of flow fluctuations.
- Excavation of existing wetlands within the river channel to intercept base flow to provide new habitats for OSF.
- Excavation of oxbows on floodplain to intercept groundwater.
- Physical habitat modifications at site scale to benefit specific life stages of OSF.

Little Deschutes River Basin (including Crescent)

Within the Little Deschutes River and Crescent Creek there are potential opportunities to conduct conservation actions for OSF on Federal and private lands under the current and future flow regime. Approximately 5,204 acres of critical habitat for OSF are within the area influenced by storage and release operations at Crescent Dam. Approximately 70 percent of the lands adjacent to the Little Deschutes River and Crescent Creek are in private ownership. Therefore, private lands are important to conservation and recovery of OSF.

Addressing the ongoing threats to OSF from habitat loss and predation are essential for conservation and recovery. The following types of conservation and restoration activities may be conducted within the Little Deschutes River sub-basin to support OSF conservation:

- Installation of beaver dam analogs and wood structures within channel to increase duration and spatial extent of water on the floodplain and within oxbow habitats to support OSF life cycles and habitat connectivity.
- Riverbank restoration.
- Reed canary grass treatment along the river and at OSF sites.
- Bull frog removal to reduce predation on OSF.
- Excavation of oxbows on floodplain to intercept groundwater.

Bullfrogs occur throughout the Little Deschutes River between the confluence with Crescent Creek and the outlet near Sunriver. Current plans are underway to implement bullfrog control within OSF habitat on private lands in the lower reaches of the Little Deschutes River. A team of volunteers and consultants, with help from federal and state agencies, are developing a strategy to control bullfrogs and reduce threats to OSF. The Conservation Fund could be used to support these efforts now and into the future.

Conservation of Oregon Spotted Frog outside of HCP Covered Lands

Approximately half of all known OSF sites and 55 percent of the acres of designated critical habitat in the Upper Deschutes River Basin occur outside of the area influenced by the HCP. Improving the function of these sites and critical habitat, via the conservation actions described above, is essential to OSF conservation. Conservation funds provided through Conservation Measure UD-1 will be used to conduct maintenance and restoration of OSF habitat within all areas that currently support OSF to maintain and improve connectivity between seasonal habitats and reduce threats to OSF.

In some cases, OSF populations outside of the area influenced by storage and release operations covered by the HCP provide demographic support to populations affected by water management. For example, OSF occur in several drainages upstream of Crane Prairie Reservoir. These populations of OSF are important in maintaining the geographic distribution of the species and sustaining genetic diversity of OSF in Crane Prairie. The Dilman population of OSF may provide a source for future establishment of OSF directly downstream of Wickiup Dam (e.g., Bull Bend area). The Dilman site needs periodic maintenance that reduces encroachment of vegetation into open water areas needed to support OSF breeding, rearing and dispersal. Habitat maintenance and enhancement of these populations are important in a recovery strategy for the areas that are anticipated to become functional OSF habitat in the long-term implementation of the HCP.

The upper reaches of the Little Deschutes River that are outside of the area affected by water management provide similar demographic support for OSF. Habitat enhancement work in these areas is important to the broad recovery strategy for OSF. Currently, bullfrogs are not known to occur in these areas but channel function has been impacted by historical ditching and diversion structures. The recent implementation of the Upper Little Deschutes River Restoration Project provides an example of how hydrological restoration may be conducted to increase the duration that water remains on the floodplain. The removal of ditches and installation of beaver dam analogs can greatly improve the function of critical habitat for OSF.

OSF habitat in other areas such as Long Prairie slough within the Little Deschutes River sub- basin have been impacted by ditching and diversions. OSF currently inhabit several areas throughout Long Prairie and there may be opportunities to enhance these habitats and connectivity between these sites. Conservation actions in this area fit into the broad context of maintaining the distribution and genetic diversity of OSF.

As USFWS develops the Recovery Plan and Implementation strategy for OSF, key actions to improve population resiliency and manage site specific threats in the Upper Deschutes River Basin will be identified. We anticipate the Conservation Fund established through the Deschutes Basin HCP will be implemented strategically to enhance survival and recovery of OSF.'

Estimated Project Costs

To estimate the number and type of projects that could be completed annually using the Upper Deschutes Conservation Fund, the USFWS compiled current costs for projects proposed for funding with the Upper Deschutes Conservation Fund. USFWS interviewed entities currently conducting projects outlined above, including the U.S. Forest Service and local non-governmental entities and tabulated the costs in Table 1 (Attachment 1). Based on the cost of each activity, a calculation was made to demonstrate how many acres or projects of each type could be conducted if the full amount of the annual \$150,000 was dedicated to that project type alone. USFWS does not anticipate using the fund in this manner, but calculated these values to demonstrate how much of each project type the full \$150,000 could fund each year. USFWS then developed multiple example scenarios aligned with in the different phases of the DBHCP, see Table 2 (Attachment 1). Specific funding proposals will be developed consistent with the *Deschutes Basin Habitat Conservation Fund - Advisory Committee Standard Operating Procedure* (Attachment 2).

Citations

- U.S. Forest Service (USFS). 1996. *Upper Deschutes Wild and Scenic River: Record of Decision and Final Environmental Impact Statement*. U.S. Forest Service, Deschutes National Forest, Bend, Oregon. 15 pp.
- U.S. Fish and Wildlife Service (USFWS). 2014. “Endangered and Threatened Wildlife and Plants: Threatened Status for Oregon spotted frog Final Rule.” *Federal Register* 79 (168): 51658–51710.
- U.S. Fish and Wildlife Service (USFWS). 2017. *Biological Opinion for Formal Consultation on the Approval of Contract Changes to the 1938 Inter-District Agreement for the Operation of Crane Prairie and Wickiup Dams, and Implementation of Review of Operations and Maintenance and Safety Evaluation of Existing Dams Programs at Crane Prairie and Wickiup Dams, Deschutes Project, Oregon (2017–2019)*. U.S. Fish and Wildlife Service Reference: 01EOFW00-2017-F-0528. Dated September 27, 2017. 270 pp.
- U.S. Fish and Wildlife Service (USFWS). 2019. *Reinitiation of Formal Consultation on Bureau of Reclamation Approval of Contract Changes to the 1938 Inter-District Agreement for the Operation of Crane Prairie and Wickiup Dams, and Implementation of the Review of Operations and Maintenance (ROM) and Safety Evaluation of Existing Dams (SEED) Programs at Crane Prairie and Wickiup Dams, Deschutes Project, Oregon (2017–2019)*. Dated July 26, 2019. 32 pp.

Attachment 1

Table 1. Conservation Fund activity costs and scenarios.

Conservation Fund Activities				
Activity	Cost/Unit	Qty	Unit	Total
Reed Canary Grass Treatments (acre)	\$600.00	250.00	Acres	\$150,000.00
Bull Frog Treatment Costs:				
Control Open Water Habitats (clean edges)	\$343.43	436.77	Acres	\$150,000.00
Maintenance of Open Water Habitats	\$240.40	623.95	Acres	\$150,000.00
Cpntrol Oxbows and Other Vegetated Habitats	\$517.52	289.84	Acres	\$150,000.00
Maintenance of Oxbows and Other Vegetated Habitats	\$362.27	414.06	Acres	\$150,000.00
Site Specific Riparian Planting	\$500.00	300.00	Acres	\$150,000.00
Treatment of Encroaching Vegetation - Cattails (acre)	\$2,500.00	60.00	Acres	\$150,000.00
Treatment of Encroaching Vegetation - Lodgepole (acre)	\$250.00	600.00	Acres	\$150,000.00
Beaver Dam Analogs (each)	\$2,750.00	54.55	Each	\$150,000.00
Large in-channel wood complex (each)	\$10,000.00	15.00	Each	\$150,000.00
Oxbow Excavation (each)	\$50,000.00	3.00	Each	\$150,000.00
Site Scale Habitat Modifications (each)	\$3,000.00	50.00	Each	\$150,000.00
Bank Restoration (mile)	\$500,000.00	0.30	Mile	\$150,000.00
Restoration NEPA Categorical Exclusion	\$35,000.00		Each	N/A
Restoration NEPA Environmental Assessment	\$125,000.00		Each	N/A
Restoration NEPA Environmental Impact Statement	\$250,000.00		Each	N/A

<i>Sample early year scenario (years 1-3)</i>	<i>Location/Priority</i>	<i>Cost/Unit</i>	<i>Qty</i>	<i>Total</i>
Bull Frog Treatments:				
Control Open Water Habitats (clean edges)	Sunriver & Little D	\$343.43	100.00	\$34,343.34
Control Oxbows and Other Vegetated Habitats	Sunriver & Little D	\$517.52	75.00	\$38,814.18
Reed Canary Grass Treatments (acre)	tbd	\$600.00	25.00	\$15,000.00
Treatment of Encroaching Vegetation - Cattails (acre)	Sunriver, Slough Camp, and LSA Marsh	\$2,500.00	12.00	\$30,000.00
Beaver Dam Analog	Dead Slough	\$2,750.00	1.00	\$2,750.00
Total Early Year Scenario 1				\$120,907.52

<i>Sample early year scenario (years 4-7)</i>		<i>Cost/Unit</i>	<i>Qty</i>	<i>Total</i>
Bull Frog Treatments:	<i>tbd</i>			
Maintenance of Open Water Habitats	tbd	\$240.40	100.00	\$24,040.34
Maintenance of Oxbows and Other Vegetated Habitats	tbd	\$362.27	75.00	\$27,169.93
Control Open Water Habitats (clean edges)	tbd	\$343.43	50.00	\$17,171.67
Control Oxbows and Other Vegetated Habitats	tbd	\$517.52	35.00	\$18,113.29
Reed Canary Grass Treatments (acre)	tbd	\$600.00	10.00	\$6,000.00
Treatment of Encroaching Vegetation - Cattails (acre)	tbd	\$2,500.00	12.00	\$30,000.00
Total Early Year Scenario 2				\$122,495.22

<i>Sample mid-year scenario (years 8-12)</i>		<i>Cost/Unit</i>	<i>Qty</i>	<i>Total</i>
Bull Frog Treatments:	tbd			
Maintenance of Open Water Habitats	tbd	\$240.40	50.00	\$12,020.17
Maintenance of Oxbows and Other Vegetated Habitats	tbd	\$362.27	20.00	\$7,245.31
Control Open Water Habitats (clean edges)	tbd	\$343.43	100.00	\$34,343.34
Control Oxbows and Other Vegetated Habitats	tbd	\$517.52	50.00	\$25,876.12
Reed Canary Grass Treatments (acre)	tbd	\$600.00	25.00	\$15,000.00
Treatment of Encroaching Vegetation - Cattails (acre)	tbd	\$2,500.00	12.00	\$30,000.00
Beaver Dam Analog	tbd	\$2,750.00	1.00	\$2,750.00
Total Mid Year Scenario				\$127,234.95

Sample late-year scenario 1 (years 13-30) (1 year projects)		Cost/Unit	Qty	Total
Bull Frog Treatments:	tbd			
Maintenance of Open Water Habitats	tbd	\$240.40	50.00	\$12,020.17
Maintenance of Oxbows and Other Vegetated Habitats	tbd	\$362.27	20.00	\$7,245.31
Reed Canary Grass Treatments (acre)	tbd	\$600.00	10.00	\$6,000.00
Treatment of Encroaching Vegetation - Cattails (acre)	tbd	\$2,500.00	5.00	\$12,500.00
Treatment of Encroaching Vegetation - Lodgepole (acre)	tbd	\$250.00	25.00	\$6,250.00
Site Specific Riparian Planting	tbd	\$500.00	10.00	\$5,000.00
Site Scale Habitat Modifications (each)	tbd	\$3,000.00	3.00	\$9,000.00
Oxbow Excavation (each)	tbd	\$50,000.00	2.00	\$100,000.00
Total Late Year Scenario 1				\$158,015.48

Sample late-year scenario 2 (years 13-30) (3 year projects)		Cost/Unit	Qty	Total	Annual Treatment Qty
Bull Frog Treatments:	tbd				
Maintenance of Open Water Habitats	tbd	\$240.40	20.00	\$4,808.07	6.67
Maintenance of Oxbows and Other Vegetated Habitats	tbd	\$362.27	10.00	\$3,622.66	3.33
Large in-channel wood complex (each)	tbd	\$10,000.00	6.00	\$60,000.00	2.00
Bank Restoration (mile)	tbd	\$500,000.00	0.85	\$425,000.00	0.28
Total Late Year Scenario 2 (3 year cost)				\$493,430.72	
Total Late Year Scenario 2 (annual cost)				\$164,476.91	

Sample late-year scenario 3 (years 13-30) (3 year projects)		Cost/Unit	Qty	Total	Annual Treatment Qty
Bull Frog Treatments:					
Maintenance of Open Water Habitats		\$240.40	20.00	\$4,808.07	6.67
Maintenance of Oxbows and Other Vegetated Habitats		\$362.27	10.00	\$3,622.66	3.33
Bank Restoration (mile)		\$500,000.00	0.75	\$375,000.00	0.25
Oxbow Excavation (each)		\$50,000.00	4.00	\$200,000.00	1.33
Site Scale Habitat Modifications (each)		\$3,000.00	6.00	\$18,000.00	2.00
Total Late Year Scenario 3 (3 year cost)				\$601,430.72	
Total Late Year Scenario 3 (annual cost)				\$200,476.91	

Table 2. Example Fund Balances

Example Fund Balances with Annual Contributions and Estimated Expenditures

Year	Calendar Year	Running Balance	Annual Deposit	Scenario	Withdrawal	Balance	Interest Earned 3%	Balance Forward
1	2021	\$0.00	\$150,000.00	Sample early year scenario (years 1-3)	-\$120,907.52	\$29,092.48	\$872.77	\$29,965.25
2	2022	\$29,965.25	\$150,000.00	Sample early year scenario (years 1-3)	-\$120,907.52	\$59,057.73	\$1,771.73	\$60,829.46
3	2023	\$60,829.46	\$150,000.00	Sample early year scenario (years 1-3)	-\$120,907.52	\$89,921.93	\$2,697.66	\$92,619.59
4	2024	\$92,619.59	\$150,000.00	Sample early year scenario (years 4-7)	-\$122,495.22	\$120,124.37	\$3,603.73	\$123,728.10
5	2025	\$123,728.10	\$150,000.00	Sample early year scenario (years 4-7)	-\$122,495.22	\$151,232.88	\$4,536.99	\$155,769.86
6	2026	\$155,769.86	\$150,000.00	Sample early year scenario (years 4-7)	-\$122,495.22	\$183,274.64	\$5,498.24	\$188,772.88
7	2027	\$188,772.88	\$150,000.00	Sample early year scenario (years 4-7)	-\$122,495.22	\$216,277.65	\$6,488.33	\$222,765.98
8	2028	\$222,765.98	\$150,000.00	Sample mid-year scenario (years 8-12)	-\$127,234.95	\$245,531.04	\$7,365.93	\$252,896.97
9	2029	\$252,896.97	\$150,000.00	Sample mid-year scenario (years 8-12)	-\$127,234.95	\$275,662.02	\$8,269.86	\$283,931.88
10	2030	\$283,931.88	\$150,000.00	Sample mid-year scenario (years 8-12)	-\$127,234.95	\$306,696.93	\$9,200.91	\$315,897.84
11	2031	\$315,897.84	\$150,000.00	Sample mid-year scenario (years 8-12)	-\$127,234.95	\$338,662.90	\$10,159.89	\$348,822.78
12	2032	\$348,822.78	\$150,000.00	Sample mid-year scenario (years 8-12)	-\$127,234.95	\$371,587.83	\$11,147.64	\$382,735.47
13	2033	\$382,735.47	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$374,719.99	\$11,241.60	\$385,961.59
14	2034	\$385,961.59	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$377,946.10	\$11,338.38	\$389,284.49
15	2035	\$389,284.49	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$381,269.00	\$11,438.07	\$392,707.07
16	2036	\$392,707.07	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$384,691.59	\$11,540.75	\$396,232.34
17	2037	\$396,232.34	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$388,216.85	\$11,646.51	\$399,863.36
18	2038	\$399,863.36	\$150,000.00	Sample late-year scenario 1 (years 13-30) (1 year projects)	-\$158,015.48	\$391,847.87	\$11,755.44	\$403,603.31
19	2039	\$403,603.31	\$150,000.00	Sample late-year scenario 2 (years 13-30) (3 year projects)	-\$164,476.91	\$389,126.40	\$11,673.79	\$400,800.19
20	2040	\$400,800.19	\$150,000.00	Sample late-year scenario 2 (years 13-30) (3 year projects)	-\$164,476.91	\$386,323.29	\$11,589.70	\$397,912.98
21	2041	\$397,912.98	\$150,000.00	Sample late-year scenario 2 (years 13-30) (3 year projects)	-\$164,476.91	\$383,436.08	\$11,503.08	\$394,939.16
22	2042	\$394,939.16	\$150,000.00	Sample late-year scenario 2 (years 13-30) (3 year projects)	-\$164,476.91	\$380,462.25	\$11,413.87	\$391,876.12
23	2043	\$391,876.12	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$341,399.21	\$10,241.98	\$351,641.19
24	2044	\$351,641.19	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$301,164.28	\$9,034.93	\$310,199.21
25	2045	\$310,199.21	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$259,722.30	\$7,791.67	\$267,513.97
26	2046	\$267,513.97	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$217,037.06	\$6,511.11	\$223,548.17
27	2047	\$223,548.17	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$173,071.26	\$5,192.14	\$178,263.40
28	2048	\$178,263.40	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$127,786.49	\$3,833.59	\$131,620.09
29	2049	\$131,620.09	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$81,143.18	\$2,434.30	\$83,577.47
30	2050	\$83,577.47	\$150,000.00	Sample late-year scenario 3 (years 13-30) (3 year projects)	-\$200,476.91	\$33,100.56	\$993.02	\$34,093.58

Deschutes Basin Habitat Conservation Fund - Advisory Committee

Standard Operating Procedure

Background

The Upper Deschutes Basin Conservation Fund (Conservation Fund) is one of the conservation commitments contained within the Deschutes Basin Habitat Conservation Plan (Deschutes HCP). The Conservation Fund requires the Districts (Arnold, Central Oregon, Lone Pine, North Unit and Tumalo Irrigation Districts) to contribute \$150,000 to the Deschutes Basin Conservation Fund each year for the term (of the Deschutes HCP, which is 30 years after the date of permit issuance). The fund is being managed by the Oregon Community Foundation with the Advisory Committee providing annual funding recommendations.

The fund will be used to support a wide variety of activities, all with the common objective of improving conditions for Oregon spotted frogs in the Upper Deschutes Basin. These activities can include, but will not be limited to, river/stream restoration, wetland creation/enhancement/revegetation, invasive plant control and invasive predator control. In addition to the anticipated benefits to Oregon spotted frogs from the substantial flow improvements required under the Deschutes HCP, the Conservation Fund will enable USFWS and others to enhance the overall benefits of the Deschutes HCP (e.g., through restoration of river channels to more effectively accommodate new flow regimes) and address myriad threats to Oregon spotted frogs unrelated to the covered activities (e.g., reed canarygrass and bullfrogs).

Role and Structure of the Advisory Committee

The Advisory Committee for the Conservation Fund shall serve to do the following:

- Meet at least bi-annually to develop and review request for proposals (RFPs) identifying the types of projects the fund will be funding in the current funding cycle. RFPs will contain the following information (at a minimum):
 - The types of projects being funded in the current grant period.
 - The applicable deadlines and review and funding timelines.
 - Ranking criteria.
- The Advisory Committee will rely on recommendations and input from a team of technical experts, hereafter referred to as the “Technical Committee” (described further below), to develop the RFPs as well as ranking and funding decisions.
- Provide recommendations to **Oregon Community Foundation** for recipients consistent with the specifications outlined in Section 5 of the “Fund Agreement for the Deschutes Basin Habitat Conservation Fund” (Appendix 1).

The advisory board shall be comprised of three members, a representative of the US Fish and Wildlife Service – Bend Field Office, the Deschutes Watershed District of the Oregon Department of Fish and Wildlife, and the Deschutes National Forest. Outlined below are the list of initial Advisory Committee members, each agency has discretion over who the appropriate staff person is to represent their agencies interest on the Advisory Committee.

This SOP will be finalized within the first 3 months after completion of the Deschutes HCP, as well as selection of additional members to the “Technical Committee”

As the permitting agency for the Deschutes HCP the Fish and Wildlife Service member of the Advisory Committee shall serve as the lead and will be responsible for scheduling the meetings and ensuring that the other members have materials necessary to make funding recommendations.

Grant funding decisions will be made by a vote of the Advisory Committee members; projects with a majority vote in favor will move forward to funding, commensurate with sufficient funds available.

Initial Advisory Committee Members

Bridget Moran, Bend Field Supervisor, U.S. Fish and Wildlife Service
63095 Deschutes Market Rd, Bend, OR 97701
541-312-6428, bridget_moran@fws.gov

Michael Harrington, Deschutes Watershed District Manager, Oregon Department of Fish and Wildlife
61374 Parrell Road, Bend, OR 97702
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Shanda Fallau Dekome, Deputy Forest Supervisor, Deschutes National Forest
63095 Deschutes Market Road, Bend, OR 97701
541-383-5709, shanda.dekome@usda.gov

Technical Committee Members and Roles

The Technical Committee will be comprised of one representative from each of the following agencies/entities: U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Service, Oregon Department of Fish and Wildlife, Upper Deschutes Watershed Council, Deschutes River Conservancy and other technical experts by invitation.

Initial membership will be as follows:

Jennifer O'Reilly, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Bend Field Office

Jason Gritzner, Hydrologist, U.S. Forest Service, Deschutes National Forest

TBD, U.S. Geological Service

TBD, Oregon Department of Fish and Wildlife

TBD, Upper Deschutes Watershed Council

TBD, Deschutes River Conservancy

The technical committee will communicate regularly among members regarding ongoing efforts to address threats to the Oregon Spotted Frog in the Upper Deschutes Watershed, they will also communicate priority funding needs to address ongoing threats to the advisory committee. The following graphic outlines the communication structure of the three entities outlined in this document:

Advisory Committee, Technical Committee and Oregon Community Foundation.

This SOP will be finalized within the first 3 months after completion of the Deschutes HCP, as well as selection of additional members to the "Technical Committee"



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APPENDIX E

Bull Trout Status of the Species

Bull Trout

This section provides information about the bull trout's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This includes description of the effects of past human activities and natural events that have led to the current status of the bull trout. This information provides the background for analyses in later sections of the biological opinion. The proposed and final listing rules contain a physical species description (63 FR 31647, June 10, 1998; 64 FR 58910, November 1, 1999). Additional information can be found at <https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=E065>.

Listing Status and Current Range

The coterminous United States population of the bull trout (*Salvelinus confluentus*) 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; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, pg. 2; Brewin and Brewin 1997, pg. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719; 63 FR 31647; 64 FR 58910; 75 FR 2269, January 14, 2010; USFWS 2015a, pg. 1).

The final listing rule for the United States coterminous population of the bull trout discusses the consolidation of five DPSs into one listed taxon and the application of the jeopardy standard in accordance with the requirements of section 7 of the ESA of 1973, as amended (Act; 16 U.S.C. 1531 et seq.), relative to this species, and established five interim recovery units for each of these DPSs for the purposes of Consultation and Recovery (64 FR 58910).

Six draft recovery units were identified based on new information (75 FR 63898, October 18, 2010) that confirmed they were needed to ensure a resilient, redundant, and representative distribution of bull trout populations throughout the range of the listed entity. The final Recovery Plan for the Coterminous Bull Trout Population (bull trout recovery plan) formalized these six recovery units (USFWS 2015a, pg. 36-43) (see Figure BT-1). The final recovery units replace the previous five interim recovery units and will be used in the application of the jeopardy standard for Section 7 consultation procedures.

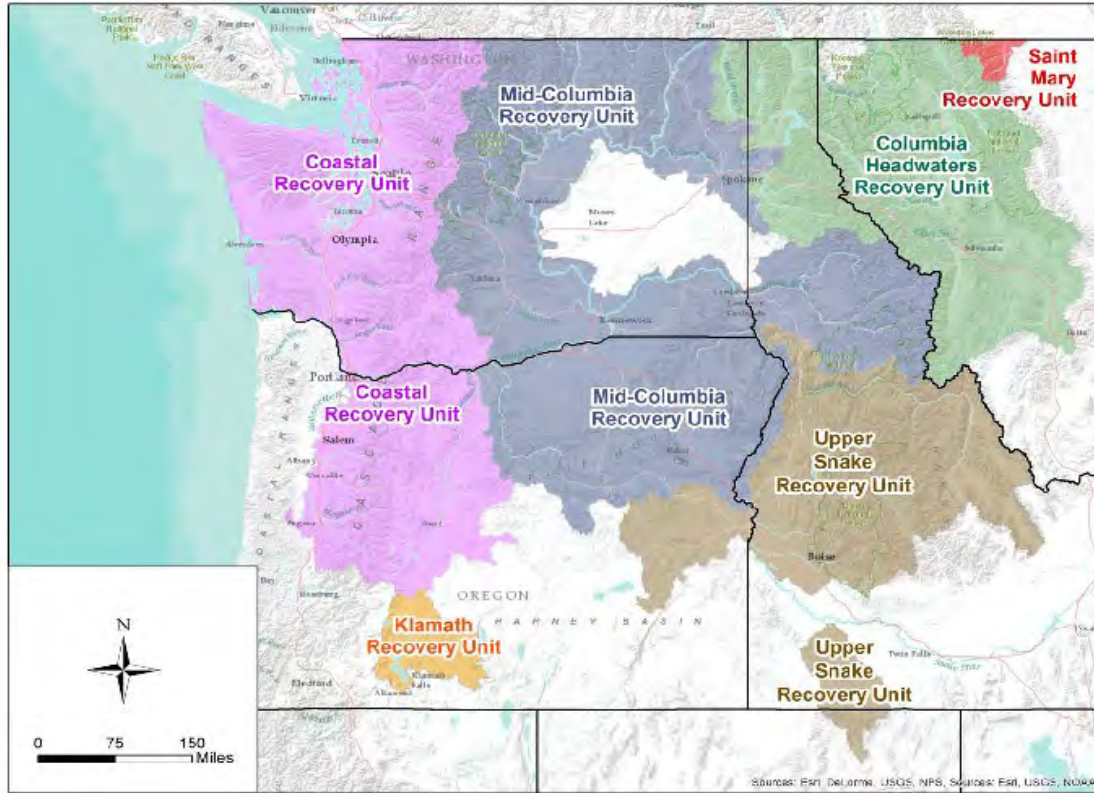


Figure BT-1. Locations of the six bull trout recovery units in the coterminous United States.

Reasons for Listing, Rangewide Trends and Threats

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels; and introduced non-native species (63 FR 31647; 64 FR 58910). Poaching and incidental mortality of bull trout during other targeted fisheries are identified described in the bull trout recovery plan (see Threat Factors B and D) as additional threats (USFWS 2015a, pg. 150). Since the time of coterminous listing the species (64 FR 58910) and designation of its critical habitat (69 FR 59996, October 6, 2004; 70 FR 56212, September 26, 2005; 75 FR 63898) a great deal of new information has been collected on the status of bull trout. The USFWS's Science Team Report (Whitesel et al 2004, entire), the bull trout core areas templates (USFWS 2005b, entire; USFWS 2009, entire), Conservation Status Assessment (USFWS 2005a), and 5-year Reviews (USFWS 2008, entire; USFWS 2015h, entire) have provided additional information about threats and status. The final recovery plan lists other documents and meetings that compiled information about the status of bull trout (USFWS 2015a, pg. 3). As well, 2015 5-year review maintained the listing status as

threatened based on the information compiled in the final bull trout recovery plan (USFWS 2015h, pg.3) and the recovery unit implementation plans (RUIPs) (USFWS 2015b-g, entire).

When first listed, the status of bull trout and its threats were reported by the USFWS at subpopulation scales. In 2002 and 2004, the draft recovery plans (USFWS 2002, entire; USFWS 2004a, entire; USFWS 2004b, entire) included detailed information on threats at the recovery unit scale (i.e. similar to subbasin or regional watersheds), thus incorporating the metapopulation concept with core areas and local populations. In the 2008, 5-year Review, the USFWS established threats categories (i.e. dams, forest management, grazing, agricultural practices, transportation networks, mining, development and urbanization, fisheries management, small populations, limited habitat, and wild fire.) (USFWS 2008, entire). In the final recovery plan, threats and recovery actions are described for 109 core areas, forage/migration and overwintering areas, historical core areas, and research needs areas in each of the six recovery units (USFWS 2015a, p 10-11). Primary threats are described in three broad categories: Habitat, Demographic, and Nonnative Fish for all recovery areas described in the listed range of the species. The 2015 5-year status review (USFWS 2015h, entire) references the final recovery plan and the recovery unit implementation plans and incorporates by reference the threats described therein. Although significant recovery actions have been implemented since the time of listing, the 5-year review concluded that bull trout still meets the definition of a “threatened” species (USFWS 2015h, entire).

New or Emerging Threats

The final Recovery Plan for the Coterminous Bull Trout Population (USFWS 2015a, pg. 17) describes new or emerging threats, climate change, and other threats. Climate change was not addressed as a known threat when bull trout was listed. The 2015 bull trout recovery plan and RUIPs (USFWS 2015b-g, entire) summarize the threat of climate change and acknowledge that some bull trout local populations and core areas may not persist into the future due to small populations, isolation, and effects of climate change (USFWS 2015a, pg. 48). The recovery plan further states that use of best available information will ensure future conservation efforts that offer the greatest long-term benefit to sustain bull trout and their required coldwater habitats (USFWS 2015a, pg. vii, and pp. 17-20). Mote et al. (2014, entire) summarized climate change effects to include rising air temperature, changes in the timing of streamflow related to changing snowmelt, increases in extreme precipitation events, lower summer stream flows, and other changes. A warming trend in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, reduce summer stream flows, and increase summer water temperatures (Poff et al. 2002, entire; Koopman et al. 2009, entire; PRBO Conservation Science 2011, entire). Lower flows as a result of smaller snowpack could reduce habitat, which might adversely affect bull trout reproduction and survival. Warmer water temperatures could lead to physiological stress and could also benefit nonnative fishes that prey on or compete with bull trout. Increases in the number and size of forest fires could also result from climate change (Westerling et al. 2006, entire) and could adversely affect watershed function by resulting in faster runoff, lower base flows during the summer and fall, and increased sedimentation rates. Lower flows also may result in increased groundwater withdrawal for agricultural purposes and resultant reduced water availability in certain stream reaches occupied by bull trout (USFWS 2015c, pg. B-10). Although all salmonids are likely to be affected by climate change, bull trout

are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, pp. 6672-6673; Rieman et al. 2007, pg. 1552). Climate change is expected to reduce the extent of cold water habitat (Isaak et al. 2015, entire), and increase competition with other fish species (lake trout (*Salvelinus namaycush*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and northern pike (*Esox Lucius*)) for resources in remaining suitable habitat. Brook trout, a fish species that competes for resources with and predated on the bull trout, will continue increasing their range in several areas (an elevation shift in distribution) due to the effects from climate change (Ficke et al. 2009, pg. 1; Peterson et al. 2013, pg. 117; Howell 2017, pg. 2).

Life History and Population Dynamics

Distribution

The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, pp. 165-166; Bond 1992, pg. 2). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992, pg. 2). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, pp. 165-166; Brewin and Brewin 1997, entire).

Reproductive Biology

The iteroparous reproductive strategy (fishes that spawn multiple times, and therefore require safe two-way passage upstream and downstream) of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). 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 safe downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, pg. 30; Pratt 1985, pp. 28-34). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982, pg. 95).

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, pg. 141). Redds are often

constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, pp. 15-16; Pratt 1992, pp. 6-7; Rieman and McIntyre 1996, pg. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, pg. 1). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 220 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, pg. 1; Ratliff and Howell 1992, pg. 10).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002, pg. 9) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007, pg. 10). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995, Ch. 2 pp. 23-24). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Population Structure

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, pg. 2). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Goetz 1989, pg. 15). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, pg. 138; Goetz 1989, pg. 24), or saltwater (anadromous form) to rear as subadults and to live as adults (Brenkman and Corbett 2005, entire; McPhail and Baxter 1996, pg. i; WDFW et al. 1997, pg. 16). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, pg. 135; Leathe and Graham 1982, pg. 95; Pratt 1992, pg. 8; Rieman and McIntyre 1996, pg. 133).

Bull trout are naturally migratory, which allows them to capitalize on temporally abundant food resources and larger downstream, and resident forms may develop where barriers (either natural or manmade) occur or where foraging, migrating, or overwintering habitats for migratory fish are minimized (Swanberg, 1997, entire; Brenkman and Corbett 2005, pp. 1075-1076; Goetz et al. 2004, pg. 105, Starcevich et al 2012, entire; USFWS 2016, pg. 170). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002, pp. 96, 98-106). Some river systems have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem

Rivers. In these areas with connectivity bull trout can migrate between large rivers lakes, and spawning tributaries. Other migrations in Central Washington have shown that fluvial and adfluvial life forms travel long distances, migrate between core areas, and mix together in many locations where there is connectivity (Ringel et al 2014, entire; Nelson and Nelle 2008, entire). Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits of connected habitat for migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 861-863; MBTSG 1998, pg. 13; Rieman and McIntyre 1993, pp. 2-3). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993, pg. 2).

Whitesel et al. (2004, pg. 2) noted that although there are multiple resources that contribute to the subject, Spruell et al. (2003, entire) best summarized genetic information on bull trout population structure. Spruell et al. (2003, entire) analyzed 1,847 bull trout from 65 sampling locations, four located in three coastal drainages (Klamath, Queets, and Skagit Rivers), one in the Saskatchewan River drainage (Belly River), and 60 scattered throughout the Columbia River Basin. They concluded that there is a consistent pattern among genetic studies of bull trout, regardless of whether examining allozymes, mitochondrial DNA, or most recently microsatellite loci. Typically, the genetic pattern shows relatively little genetic variation within populations, but substantial divergence among populations. Microsatellite loci analysis supports the existence of at least three major genetically differentiated groups (or evolutionary lineages) of bull trout (Spruell et al. 2003, pg. 17). They were characterized as:

- “Coastal”, including the Deschutes River and all of the Columbia River drainage downstream, as well as most coastal streams in Washington, Oregon, and British Columbia. A compelling case also exists that the Klamath Basin represents a unique evolutionary lineage within the coastal group.
- “Snake River”, which also included the John Day, Umatilla, and Walla Walla rivers. Despite close proximity of the John Day and Deschutes Rivers, a striking level of divergence between bull trout in these two systems was observed.
- “Upper Columbia River” which includes the entire basin in Montana and northern Idaho. A tentative assignment was made by Spruell et al. (2003, pg. 25) of the Saskatchewan River drainage populations (east of the continental divide), grouping them with the upper Columbia River group.
- Spruell et al. (2003, pg. 17) noted that within the major assemblages, populations were further subdivided, primarily at the level of major river basins. Taylor et al. (1999, entire) surveyed bull trout populations, primarily from Canada, and found a major divergence between inland and

coastal populations. Costello et al. (2003, pg. 328) suggested the patterns reflected the existence of two glacial refugia, consistent with the conclusions of Taylor and Costello (2006, pg. 1165-1170), Spruell et al. (2003, pg. 26) and the biogeographic analysis of Haas and McPhail (2001, entire). Both Taylor et al. (1999, pg. 1166) and Spruell et al. (2003, pg. 21) concluded that the Deschutes River represented the most upstream limit of the coastal lineage in the Columbia River Basin.

More recently, the USFWS identified additional genetic units within the coastal and interior lineages (Ardren et al. 2011, pg. 18). Based on a recommendation in the USFWS's 5-year review of the species' status (USFWS 2008, pg. 45), the USFWS reanalyzed the 27 recovery units identified in the 2002 draft bull trout recovery plan (USFWS 2002, pg. 48) by utilizing, in part, information from previous genetic studies and new information from additional analysis (Ardren et al. 2011, entire). In this examination, the USFWS applied relevant factors from the joint USFWS and NMFS Distinct Population Segment (DPS) policy (61 FR 4722, February 7, 1996) and subsequently identified six draft recovery units that contain assemblages of core areas that retain genetic and ecological integrity across the range of bull trout in the coterminous United States. These six draft recovery units were used to inform designation of critical habitat for bull trout by providing a context for deciding what habitats are essential for recovery (75 FR 63898). These six recovery units, adopted in the final bull trout recovery plan (USFWS 2015a, entire) and described further in the RUIPs (USFWS 2015b-g, entire) include: Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Saint Mary, and Upper Snake. A number of additional genetic analyses within core areas have been completed to understand uniqueness of local populations (Hawkins and Von Bargen 2006, entire; 2007, entire; Small et al. 2009, entire; DeHaan and Neibauer 2012, entire).

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, pg. 4). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991, entire). Burkey (1989, entire) 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 for local populations may be low and probability of extinction high (Burkey 1989, entire; Burkey 1995, entire).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, pg. 15; Dunham and Rieman 1999, entire; Rieman and Dunham 2000, entire). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994, pp. 189-190). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000, entire). Ideally, multiple local populations distributed throughout a watershed provide a

mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman and Clayton 1997, pp. 10-12; Dunham and Rieman 1999, pg. 645; Spruell et al. 1999, pp. 118-120; Rieman and Dunham 2000, pg. 55).

Human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999, entire). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of the bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999, entire) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000, pp. 56-57). Research does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho (Whiteley et al. 2003, entire), while Whitesel et al. identifies that bull trout fit the metapopulation theory in several ways (Whitesel et al, 2004, pg. 18-21).

Habitat Characteristics

The habitat requirements of bull trout are often generally expressed as the four “Cs”: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout throughout all hierarchical levels.

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, pg. 4). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, entire; Goetz 1989, pp. 23, 25; Hoelscher and Bjornn 1989, pp. 19, 25; Howell and Buchanan 1992, pp. 30, 32; Pratt 1992, entire; Rich 1996, pg. 17; Rieman and McIntyre 1993, pp. 4-6; Rieman and McIntyre 1995, entire; Sedell and Everest 1991, entire; Watson and Hillman 1997, entire). Watson and Hillman (1997, pp. 247-250) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, pp. 4-6), bull trout should not be expected to simultaneously occupy all available habitats.

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, pg. 2). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note

that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, pg. 2; Spruell et al. 1999, entire). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams, and spawning habitats are generally characterized by temperatures that drop below 9 °C in the fall (Fraley and Shepard 1989, pg. 137; Pratt 1992, pg. 5; Rieman and McIntyre 1993, pg. 2).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, pp 7-8; Rieman and McIntyre 1993, pg. 7). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (Buchanan and Gregory 1997, pg. 4; Goetz 1989, pg. 22). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996, entire) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C, within a temperature gradient of 8 °C to 15 °C. In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003, pg. 900) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, pg. 2; Fraley and Shepard 1989, pp. 133, 135; Rieman and McIntyre 1993, pp. 3-4; Rieman and McIntyre 1995, pg. 287). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick 2002, pp. 6 and 13).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, pg. 137; Goetz 1989, pg. 19; Hoelscher and Bjornn 1989, pg. 38; Pratt 1992, entire; Rich 1996, pp. 4-5; Sedell and Everest 1991, entire; Sexauer and James 1997, entire; Thomas 1992, pp. 4-6; Watson and Hillman 1997, pg. 238). Maintaining bull trout habitat requires stable and complex stream channels and stable stream flows (Rieman and McIntyre 1993, pp. 5-6). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pg. 364). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, pg. 141; Pratt 1992, pg. 6; Pratt and Huston 1993, pg. 70). Pratt (1992, pg. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Fish growth depends on the quantity and quality of food that is eaten, and as fish grow

their foraging strategy changes as their food changes, in quantity, size, or other characteristics (Quinn 2005, pp. 195-200). Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, pg. 58; Donald and Alger 1993, pp. 242-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout generally feed on various fish species (Donald and Alger 1993, pp. 241-243; Fraley and Shepard 1989, pp. 135, 138; Leathe and Graham 1982, pp. 13, 50-56). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 2001, pg. 204). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, pg. 105; WDFW et al. 1997, pg. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies and their environment. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources both within and between core areas. Connectivity between the spawning, rearing, overwintering, and forage areas maintains this diversity. There have been recent studies documenting movement patterns in the Columbia River basin that document long distance migrations (Borrows et al 2016, entire; Schaller et al 2014, entire; USFWS 2016, entire). For example, a data report documented a juvenile bull trout from the Entiat made over a 200-mile migration between spawning grounds in the Entiat River to foraging and overwintering areas in Columbia and Yakima River near Prosser Dam (PTAGIS 2015, Tag Code 3D9.1C2CCD42DD). As well, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997, pg. 25). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, pp. 1078-1079; Goetz et al. 2004, entire).

Conservation Needs

The 2015 recovery plan for bull trout established the primary strategy for recovery of bull trout in the coterminous United States: (1) conserve bull trout so that they are geographically widespread across representative habitats and demographically stable in six recovery units; (2) effectively manage and ameliorate the primary threats in each of six recovery units at the core area scale such that bull trout are not likely to become endangered in the foreseeable future; (3) build upon the numerous and ongoing conservation actions implemented on behalf of bull trout since their listing in 1999, and improve our understanding of how various threat factors potentially affect the species; (4) use that information to work cooperatively with our partners to design, fund, prioritize, and implement effective conservation actions in those areas that offer the greatest long-term benefit to sustain bull trout and where recovery can be achieved; and (5) apply adaptive management principles to implementing the bull trout recovery program to account for new information (USFWS 2015a, pg. 24.) .

Information presented in prior draft recovery plans published in 2002 and 2004 (USFWS 2002, entire; 2004a, entire; 2004b, entire) provided information that identified the original list of threats and recovery actions across the range of the species and provided a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation. Many recovery actions were completed prior to finalizing the recovery plan in 2015.

The 2015 recovery plan (USFWS 2015a, entire) integrates new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and integrates and updates previous bull trout recovery planning efforts across the range of the coterminous bull trout listing

The USFWS has developed a recovery approach that: (1) focuses on the identification of and effective management of known and remaining threat factors to bull trout in each core area; (2) acknowledges that some extant bull trout core area habitats will likely change (and may be lost) over time; and (3) identifies and focuses recovery actions in those areas where success is likely to meet our goal of ensuring the certainty of conservation of genetic diversity, life history features, and broad geographical representation of remaining bull trout populations so that the protections of the ESA are no longer necessary (USFWS 2015a, pg. 45-46).

To implement the recovery strategy, the 2015 recovery plan establishes the recovery of bull trout will entail effectively managing threats to ensure the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat conditions and access to them that allow for the expression of various life history forms within each of six recovery units (USFWS 2015a, pg. 50-51).” The recovery plan defines four categories of recovery actions that, when implemented and effective, should:

1. Protect, restore, and maintain suitable habitat conditions for bull trout;
2. Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity;
3. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout;
4. and result in actively working with partners to 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, and considering the effects of climate change (USFWS 2015a, pg. 50-51).

Bull trout recovery is based on a geographical hierarchical approach. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. The single DPS is subdivided into six biological-based recovery units: (1) Coastal Recovery Unit; (2) Klamath Recovery Unit; (3) Mid-Columbia Recovery Unit; (4) Upper Snake Recovery Unit; (5) Columbia Headwaters Recovery Unit; and (6) Saint Mary Recovery Unit (USFWS 2015a, pg. 23). A viable recovery unit should demonstrate that the three primary principles of biodiversity have been met: representation (conserving the genetic makeup of the species); resiliency (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to withstand catastrophic events) (USFWS 2015a, pg. 33).

Each of the six recovery units contain multiple bull trout recovery areas which are non-overlapping watershed-based polygons, and each core area includes one or more local population. Currently there are 109 occupied core areas, which comprise 611 local populations (USFWS 2015a, pg. 3, Appendix F). There are also six core areas where bull trout historically occurred but are now extirpated, and one research needs area where bull trout were known to occur historically, but their current presence and use of the area are uncertain (USFWS 2015a,

pg. 3, Appendix F). Core areas can be further described as complex or simple (USFWS 2015a, pg. 3-4). Complex core areas contain multiple local bull trout populations, are found in large watersheds, have multiple life history forms, and have migratory connectivity between spawning and rearing habitat and foraging, migration, and overwintering habitats (FMO). Simple core areas are those that contain one bull trout local population. Simple core areas are small in scope, isolated from other core areas by natural barriers, and may contain unique genetic or life history adaptations.

A core area is a combination of core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) and constitutes the basic unit on which to gauge recovery within a recovery unit. Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. A core area represents the closest approximation of a biologically functioning unit for bull trout. Core areas are presumed to reflect the metapopulation structure of bull trout.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system (USFWS 2015a, pg. 73). A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (e.g., those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

Population Units

The final recovery plan (USFWS 2015a, entire) designates six bull trout recovery units as described above. These units replace the 5 interim recovery units previously identified (USFWS 1999, entire). The USFWS will address the conservation of these final recovery units in our section 7(a)(2) analysis for proposed Federal actions. The recovery plan (USFWS 2015a, entire), identified threats and factors affecting the bull trout within these units. A detailed description of recovery implementation for each recovery unit is provided in separate recovery unit implementation plans (RUIPs)(USFWS 2015b-g, entire), which identify recovery actions and conservation recommendations needed for each core area, forage/ migration/ overwinter (FMO) areas, historical core areas, and research needs areas. Each of the following recovery units (below) is necessary to maintain the bull trout's numbers and distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. For more details on Federal, State, and tribal conservation actions in this unit see the actions since listing, contemporaneous actions, and environmental baseline discussions below.

Coastal Recovery Unit

The Coastal RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015b, entire). The Coastal Recovery Unit is divided into three Geographic Regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River regions. This recovery unit contains 20 core areas comprising 84

local populations and a single potential local population in the historic Clackamas River core area where bull trout had been extirpated and were reintroduced in 2011. This recovery unit also has four historically occupied core areas that could be re-established (USFWS 2015a, pg. 47; USFWS 2015b, pg. A-2).

Although population strongholds do exist across the three regions, populations in the Puget Sound region generally have better demographic status while the Lower Columbia River region exhibits the least robust demography (USFWS 2015b, pg. A-6). Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This recovery unit also contains ten shared FMO habitats which allow for the continued natural population dynamics in which the core areas have evolved (USFWS 2015b, pg. A-5). There are four core areas within the Coastal Recovery Unit that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River (USFWS 2015a, pg. 79; USFWS 2015b, pg. A-3). These are the most stable and abundant bull trout populations in the recovery unit. The Puget Sound region supports at least two core areas containing a natural adfluvial life history.

The demographic status of the Puget Sound populations is better in northern areas. Barriers to migration in the Puget Sound region are few, and significant amounts of headwater habitat occur in protected areas (USFWS 2015b, pg. A-7). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, loss of functioning estuarine and nearshore marine habitats, development and related impacts (e.g., flood control, floodplain disconnection, bank armoring, channel straightening, loss of instream habitat complexity), agriculture (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation, livestock grazing), fish passage (e.g., dams, culverts, instream flows) residential development, urbanization, forest management practices (e.g., timber harvest and associated road building activities), connectivity impairment, mining, and the introduction of non-native species (USFWS 2015b, pg. A-1 – A-25). Conservation measures or recovery actions implemented or ongoing include relicensing of major hydropower facilities that have provided upstream and downstream fish passage or complete removal of dams, land acquisition to conserve bull trout habitat, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, road removal, and projects to protect and restore important nearshore marine habitats (USFWS 2015b, pg. A-33 – A-34).

Klamath Recovery Unit

The Klamath recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015c, entire). The Klamath Recovery Unit is located in southern Oregon and northwestern California. The Klamath Recovery Unit is the most significantly imperiled recovery unit, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout (USFWS 2015a, pg. 39). This recovery unit currently contains three core areas and eight local populations (USFWS 2015a, pg. 47; USFWS 2015c, pg. B-1). Nine historic local populations of bull trout have become extirpated (USFWS 2015c, pg. B-1). All three core areas have been isolated from other bull trout populations for the past 10,000 years (USFWS 2015c, pg. B-3). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, habitat degradation and fragmentation,

past and present land use practices, agricultural water diversions, nonnative species, and past fisheries management practices (USFWS 2015c, pg. B-13 – B-14). Conservation measures or recovery actions implemented or ongoing include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for instream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culver replacement, and habitat restoration (USFWS 2015c, pg. B-10 – B-11).

Mid-Columbia Recovery Unit

The Mid-Columbia RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015d, entire). The Mid-Columbia Recovery Unit is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia Recovery Unit is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, Lower Snake, and Mid-Snake Geographic regions. This recovery unit contains 24 occupied core areas comprising 142 local populations, two historically occupied core areas, one research needs area, and 7 FMO habitats (USFWS 2015a, pg. 47; USFWS 2015d, pg. C-1 – C-4). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, agricultural practices (e.g. irrigation, water withdrawals, livestock grazing), fish passage (e.g. dams, culverts), nonnative species, forest management practices, and mining (USFWS 2015d, pg. C-9 – C-34). Conservation measures or recovery actions implemented or ongoing include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and instream flow requirements (USFWS 2015d, C-37 – C-40).

Columbia Headwaters Recovery Unit

The Columbia headwaters RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015e, entire). The Columbia Headwaters Recovery Unit is located in western Montana, northern Idaho, and the northeastern corner of Washington. The Columbia Headwaters Recovery Unit is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene geographic regions (USFWS 2015e, pg. D-2 – D-4). This recovery unit contains 35 bull trout core areas; 15 of which are complex core areas as they represent larger interconnected habitats and 20 simple core areas as they are isolated headwater lakes with single local populations. The 20 simple core areas are each represented by a single local population, many of which may have persisted for thousands of years despite small populations and isolated existence (USFWS 2015e, pg. D-1). Fish passage improvements within the recovery unit have reconnected some previously fragmented habitats (USFWS 2015e, pg. D-42), while others remain fragmented. Unlike other recovery units in Washington, Idaho and Oregon, the Columbia Headwaters Recovery Unit does not have any anadromous fish overlap (USFWS 2015e, pg. D-42). Therefore, bull trout within the Columbia Headwaters Recovery Unit do not benefit from the recovery actions for salmon (USFWS 2015e, pg. D-42). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, mostly historical mining and contamination by heavy metals, expanding populations of nonnative fish predators and competitors, modified instream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e.g., logging, roads), agriculture practices (e.g. irrigation, livestock grazing), and residential development (USFWS 2015e, pg. D-10 – D-25).

Conservation measures or recovery actions implemented or ongoing include habitat improvement, fish passage, and removal of nonnative species (USFWS 2015e, pg. D-42 – D-43).

Upper Snake Recovery Unit

The Upper Snake RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015f, entire). The Upper Snake Recovery Unit is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake Recovery Unit is divided into seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This recovery unit contains 22 core areas and 207 local populations, with over 70 percent being present in the Salmon River Region (USFWS 2015a, pg. 47; USFWS 2015f, pg. E-1 – E-2). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing) (USFWS 2015f, pg. E-15 – E-18). Conservation measures or recovery actions implemented or ongoing include instream habitat restoration, instream flow requirements, screening of irrigation diversions, and riparian restoration (USFWS 2015f, pg. E-19 – E-20).

St. Mary Recovery Unit

The St. Mary RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015g, entire). The Saint Mary Recovery Unit is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada. Most of the Saskatchewan River watershed which the St. Mary flows into is located in Canada. The United States portion includes headwater spawning and rearing habitat and the upper reaches of FMO habitat. This recovery unit contains four core areas, and seven local populations (USFWS 2015g, pg. F-1) in the U.S. Headwaters. The current condition of the bull trout in this recovery unit is attributed primarily to the outdated design and operations of the Saint Mary Diversion operated by the Bureau of Reclamation (e.g., entrainment, fish passage, instream flows), and, to a lesser extent habitat impacts from development and nonnative species (USFWS 2015g, pg. F-7 – F-8). The primary issue precluding bull trout recovery in this recovery unit relates to impacts of water diversions, specifically at the Bureau of Reclamations Milk River Project (USFWS 2015g, pg. F-5). Conservation measures or recovery actions implemented or ongoing are not identified in the St. Mary RUIP; however, the USFWS is conducting interagency and tribal coordination to accomplish conservation goals for the bull trout (USFWS 2015g, pg. F-9)

Federal, State and Tribal Actions Since Listing

Since our listing of bull trout in 1999, numerous conservation measures that contribute to the conservation and recovery of bull trout have been and continue to be implemented across its range in the coterminous United States. These measures are being undertaken by a wide variety of local and regional partnerships, including State fish and game agencies, State and Federal land management and water resource agencies, Tribal governments, power companies, watershed working groups, water users, ranchers, and landowners.

In many cases, these bull trout conservation measures incorporate or are closely interrelated with work being done for recovery of salmon and steelhead, which are limited by many of the same threats. These include removal of migration barriers (culvert removal or redesign at stream crossings, fish ladder construction, dam removal, etc.) to allow access to spawning or FMO habitat; screening of water diversions to prevent entrainment into unsuitable habitat in irrigation systems; habitat improvement (riparian revegetation or fencing, placement of coarse woody debris in streams) to improve spawning suitability, habitat complexity, and water temperature; instream flow enhancement to allow effective passage at appropriate seasonal times and prevent channel dewatering; and water quality improvement (decommissioning roads, implementing best management practices for grazing or logging, setting pesticide use guidelines) to minimize impacts from sedimentation, agricultural chemicals, or warm temperatures.

At sites that are vulnerable to development, protection of land through fee title acquisition or conservation easements is important to prevent adverse impacts or allow conservation actions to be implemented. In several bull trout core areas, it is necessary to continue ongoing fisheries management efforts to suppress the effects of non-native fish competition, predation, or hybridization; particularly brown trout, brook trout, lake trout, and northern pike (DeHaan et al. 2010, entire; DeHaan and Godfrey 2009, entire; Rosenthal and Fredenberg 2017, pg. 2). A more comprehensive overview of conservation successes from 1999-2013, described for each recovery unit, is found in the Summary of Bull Trout Conservation Successes and Actions since 1999 (Available at: http://www.fws.gov/pacific/ecoservices/endangered/recovery/documents/Service_2013_summary_of_conservation_successes.pdf).

Projects that have undergone ESA section 7 consultation have occurred throughout the range of bull trout. Singly or in aggregate, these projects could affect the species' status. The USFWS has conducted periodic reviews of prior Federal "consulted-on" actions. A detailed discussion of consulted-on effects in the proposed action area is provided in the environmental baseline section below.

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APPENDIX F

Bull Trout Status of Critical Habitat

Status of Critical Habitat - Bull Trout

Legal Status

Current Designation

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. Critical habitat is defined as the specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. Designated critical CHUs for the bull trout are described in Figure 1. A justification document describes occupancy and the rationale for why these habitat areas are essential for the conservation of bull trout was developed to support the rule and is available on our website (<https://www.fws.gov/pacific/bulltrout/crithab/Jusitfication%20Docs.html>).

The scope of the designation involved the species' coterminous range. Rangelwide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table B-1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table B-1. 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

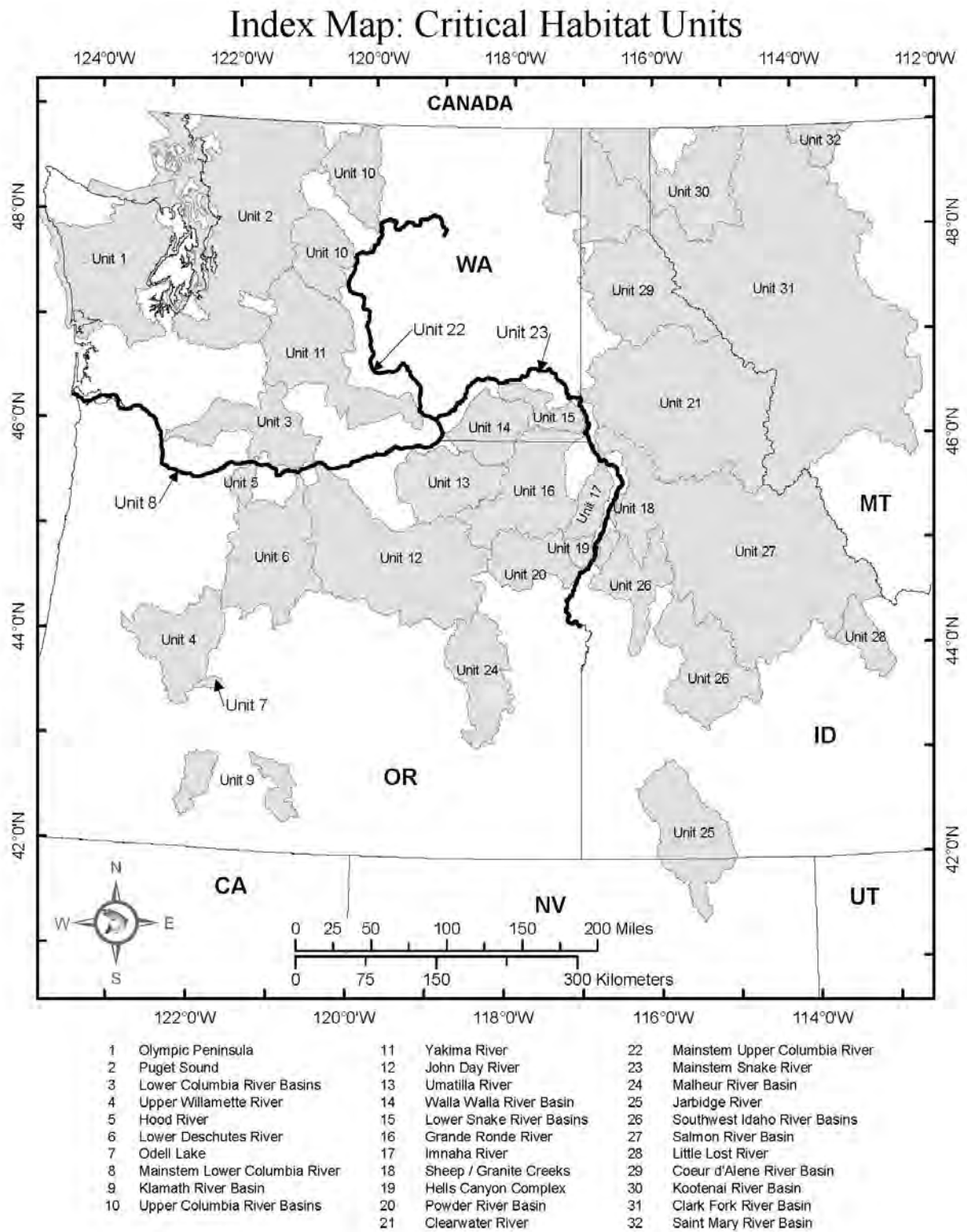


Figure 1. Index map of bull trout designated critical habitat units.

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. 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 main stem 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 habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), 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. Fewer than 2,000 stream miles and 20,000 acres of lake and reservoir surface area were excluded from the designation of critical habitat. 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, nor reduce authorities that protect the species under the ESA. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). 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 shown in Figure 1, thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the final critical habitat 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 biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

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 (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; 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 (Hard 1995, pp. 321-322; 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 anadromous 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, overwintering, and migration.

Primary Constituent Elements for Bull Trout Critical Habitat

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of the bull trout and the characteristics of the habitat necessary to sustain its essential life-history functions, we determined in our final designation that the following PCEs are essential for the conservation of bull trout.

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 °C to 15 °C (36 °F 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 departure 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 non-native 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.

PCE 9 addresses the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat designated within each CHU includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the

waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean low low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands within CHUs are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat within the CHUs can have significant effects on physical and biological features of the aquatic environment.

Activities that are likely to cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat such that the critical habitat will no longer serve the intended conservation role for the species or retain those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943). The Service’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (Service and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

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 decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor

water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout habitat function, 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; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was 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 non-native fishes). For more discussion regarding impacts of climate change, see the status of the species and environmental baseline sections.

Consulted on Effects to Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts are also proposed and have been implemented, which provides some stability or improvement in the existing functions within some of the critical habitat units. For about a detailed analysis of prior consulted-on effects in the action area, see the environmental baseline section.

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