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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF OREGON

NORTHWEST ENVIRONMENTAL DEFENSE CENTER, **WILDEARTH GUARDIANS**, and **NATIVE FISH SOCIETY**,

Plaintiffs,

v.

U.S. ARMY CORPS OF ENGINEERS and **NATIONAL MARINE FISHERIES SERVICE**,

Defendants.

CITY OF SALEM and MARION COUNTY,

Intervenors.

Case No. 3:18-cv-00437-JR

Declaration of John K. Johnson In Support of Plaintiffs' Motion for Preliminary Injunction

I, John K. Johnson, declare as follows:

1. I have personal knowledge of the facts set forth below and if called as a witness I would and could truthfully testify to these facts.

2. I was asked by the Plaintiffs in this litigation to provide my expert opinion on the impacts of the Willamette Project on threatened Upper Willamette River Chinook salmon and steelhead. I was also asked to provide my expert opinion on the feasibility and likely impacts of the interim measures that are requested in the Plaintiffs' Motion for Preliminary Injunction.

Professional Qualifications and Experience

3. I earned a Bachelor of Science in Civil Engineering from Walla Walla College in 1975.

4. I am a Professional Civil Engineer licensed in Oregon. Over the past forty years, I have worked as an engineer on behalf of private consultants, the Oregon Department of Fish and Wildlife ("ODFW"), the National Marine Fisheries Service ("NMFS"), and the U.S. Fish and Wildlife Service ("USFWS"), and since 2009 as a private fisheries engineering consultant.

5. Through those roles, I developed professional knowledge and expertise in engineering issues related to fish passage at hydroelectric dams, fish hatcheries, and irrigation projects, especially as they relate to Endangered Species Act ("ESA") compliance and Federal Energy Regulatory Commission ("FERC") relicensing. I have reviewed and witnessed multitudes of projects that both succeeded and failed at reducing negative impacts on fish species. As a fisheries agency engineer, I provided professional opinions about whether a proposed action, such as a fish passage structure, was feasible or likely to be effective, or was the appropriate technology for a particular site. As a result, I have developed professional expertise in the impacts of dams and hydroelectric facilities on fish, particularly with regard to salmon

species protected under the ESA, and how proposed fish passage facilities might contribute to or lessen that harm.

6. Since 2009, I have owned K35 Resources LLC, a one-man professional engineering consulting firm that provides fish passage engineering services. In this capacity, I have worked on projects in Oregon advising the U.S. Fish and Wildlife Service in FERC licensing proceedings at the Eugene Water and Electric Board's Carmen-Smith FERC-licensed hydroelectric project on the upper McKenzie River, Oregon; in California assessing U.S. Army Corps of Engineers dam sites for fish passage (Yuba River); in Idaho as the coordinator of a small dam removal project (Troy, Idaho); in Maine assessing ESA potential measures for providing fish protection at FERC hydroelectric projects on the Kennebec River that are without effective fish passage accommodations; and reviewing a US Forest Service proposed fish passage guideline. In 2016, I participated on a week-long Value Engineering Team review of fish passage options at the Corps' Mud Mountain Dam, reputed to the be largest fish transport scheme in the country (near Enumclaw, WA, now under construction.)

7. I worked from 2008-2009 as a Fisheries Engineer with the U.S. Fish and Wildlife Service ("FWS") in Portland, Oregon. There, I was the only FWS engineer dedicated solely to FERC and Federal hydroelectric projects on the West Coast. My role was to provide advice to USFWS Biologists—those responsible for FERC and ESA compliance—regarding feasibility of potential fish passage measures that were under consideration pursuant to either ongoing FERC re-licensing proceedings (Carmen-Smith), Federal dams subject to ESA (upper Columbia, above Grand Coulee), or an internal USFWS program (Partners for Fish and Wildlife) that sought to improve fish habitat, including, among other things, small fish passage projects (usually road crossings/culverts.)

8. Between 1997 and 2008, I worked in a similar capacity as a Fisheries Engineer in the Habitat Division of NMFS in the agency's Santa Rosa, CA Habitat Office, and in Portland, Oregon for the NMFS Hydro Division. In those offices, I was involved primarily with irrigation projects and hydroelectric and dam re-licensing projects along the West Coast (Yuba River Corps dams) and irrigation projects, Sacramento River USBR irrigation projects (Red Bluff Diversion Dam), Battle Creek PG&E relicensing (small hydro dams near Redding, CA), Klamath River FERC re-licensing, Mitchell Act small stream fish screening program (a Columbia River mitigation measure) in ID, WA, and OR—and the Corps' Willamette Valley Project. In 200,7 I presented a lecture (while working for NMFS, but as a private individual) in the "International Fish Passages in South America Symposium" in Lavras, Brasil where I presented my understanding of the current state of proposed improvements on the Corps' Willamette Project, which was near the time the NMFS 2008 Biop was completed.

9. During my tenure at NMFS, I spent about a quarter of my time on the ESA consultation for the Willamette Project from 2001 to 2008. I was the only engineer at NMFS working on this consultation and the resulting Biological Opinion that NMFS issued in 2008. In that role, I reviewed and provided comments on all sections of the 2008 BiOp, with a focus on fish passage. I helped formulate the Reasonable and Prudent Alternatives ("RPAs") that were designed to improve fish passage at dams on the North and South Santiam Rivers, the McKenzie River, and the Middle Fork Willamette River and its tributaries. This work required an understanding of the physical structures of these dams and how they affect fish. I participated in multiple site visits to the various Willamette basins and dams, and participated in numerous meetings with representatives from the Corps and NMFS (along with other stakeholders) to develop ideas for the 2008 BiOp. Since leaving NMFS, I have continued to follow the progress

of Willamette Project issues by attending the annual Willamette Science Reviews that showcases scientific papers and studies related to Project impacts conducted by scientists at federal, state, and local governments, universities, and private consultants.

10. In addition to working on the ESA consultation for the Willamette Project, I spent about half of my time with NMFS on ESA consultations regarding irrigation diversions, culverts, and other projects for the NMFS Habitat Division. I worked on the FERC relicensing of the Hells Canyon dam complex in Idaho, the Pacificorp's Klamath FERC Project in Southern Oregon, and the Lebanon Dam on the South Santiam River. My role in these relicensing projects was either reviewing project proponents' initial concepts for appropriate fish protection measures, or working with them as a team to consider and develop appropriate fish protection measures.

11. For example, I briefly worked on fish passage for the Hells Canyon Hydro project until NMFS made the decision that volitional upstream passage for salmon was infeasible there because downstream migrating juveniles could not survive the upstream reservoirs. During the Klamath relicensing process, I participated in a FERC "Trial-Type" hearing the first such hearing pursuant to the Energy Policy Act of 2005 (Pub.L. 109–58) in 2006 and provided written testimony on passage of lamprey, which was cited in the Administrative Law Judge's decision. I was involved as the NMFS engineer on the U.S. Bureau of Reclamation Red Bluff Diversion Dam project for which I observed testing and reviewed juvenile injuries at Red Bluff Diversion dam's Archimedes screw pumps, and participated in a team to improve passage there. In addition, I was the NMFS engineer on the nearby Battle Creek projects which included a large USFWS fish hatchery intended as partial mitigation for Shasta Dam's adverse fish impacts, as well as reconfiguration of number of PG&E's adjacent small hydro projects to meet fisheries

concerns. My principal role on a FERC relicensing project for these Pacific Gas & Electric hydroelectric dams in California was to participate in meetings with PG&E and assist in developing acceptable fish protection schemes (upstream and downstream protection) and render professional opinions for biologists drafting the NMFS Biological Opinion about whether fish passage measures were adequate and appropriate. As with my work on the Willamette Project, these tasks required me to analyze the impacts of dams and other structures on fish, primarily with regard to passage, and provide professional opinions about how to reduce those impacts to a level consistent with an ESA Biop's incidental take authorization. I received a Department of Commerce Bronze award in 1999 as part of a team effort to restore habitat on 41 miles of this stream formerly blocked by dams.

12. I also worked for ODFW from 1988-1997 as a Fisheries Engineer. In that role, I designed and oversaw construction of small fish screens and ladders (that is, developed plans and specifications, put the jobs out for bid, and then monitored contractor construction and compliance), habitat restoration projects, and fish hatchery repairs. For instance, I prepared plans for three Catherine Creek (near La Grande, OR) fish ladders near Union, Oregon, and small fish screens near The Dalles, and renovation of hatchery ponds near Alsea, Oregon.

13. I started my engineering career working for private consulting firms in Washington State between 1975-1980, and worked on a variety of projects such as small fish hatcheries for Puget Sound Indian Tribes, was a construction engineer on a large bridge in across the Columbia River Kennewick, WA and also several water (Port Gamble, WA) and large sewer projects (Kennewick, WA and Olympia, WA.)

Willamette Project Impacts

14. The Willamette Valley Project ("WVP") includes Detroit and Big Cliff Dams on the North Santiam River; Green Peter and Foster Dams on the South Santiam River; Cougar Dam on the South Fork of the McKenzie River; and Lookout Point, Dexter, Hills Creek, and Fall Creek Dams on the Middle Fork Willamette River and its tributaries. Many of these dams are "high-head" dams, which are, to me, dams greater than around 120 feet high. The Corps built the Willamette Project dams primarily during the 1950s and 1960s. The WVP did not, despite some notable failed attempts, provide adequate facilities for upstream adult or downstream juvenile fish passage. Thus, when the dams were constructed, they had a profound effect on fish species that relied on the mainstem Willamette River and access to its key tributaries upstream of these dams.

15. Unlike the reservoirs on the Columbia River, many of the WVP dams are operated for flood control and have water surface elevations in their reservoirs that vary greatly over the year, complicating upstream and downstream fish passage. Many WVP dams include turbines that produce hydroelectric power, but some—Detroit, Green Peter, and Lookout Point dams—run their turbines only at certain times of the day to meet peak electrical demand. These "peaking projects" produce widely varying daily flows and reservoir elevations that disrupt aquatic habitat and species and must be re-regulated by their associated downstream dams—Big Cliff, Foster, and Dexter dams—which further complicates fish passage.

16. The 2008 BiOp concluded that the WVP dams block Upper Willamette River ("UWR") Chinook salmon and steelhead from accessing and utilizing a majority of their historic habitat located upstream of these reservoirs, impairing their ability to spawn and then migrate downstream back to the ocean. NMFS determined this was a primary—though not only—cause

of the precipitous decline of UWR Chinook salmon and steelhead that has occurred since the dams were built.

17. Today, the lack of adequate fish passage—specifically, the ability to access and successfully utilize habitat upstream of WVP dams, and then emigrate downstream through these reservoirs and dams to the ocean—remains a key harm to adult UWR Chinook salmon and steelhead that is impeding the recovery of the species.

18. Some adult fish that migrate upstream are captured at the base of the dams and then trucked above Project dams to enable them to continue on to their (former) natal streams upstream of the dams and reservoirs to reproduce. Trucking is not an ideal solution because it causes additional stress and injury to adult fish, thereby additionally impairing recovery.

19. For adults that are trucked above dams and successfully spawn, the resulting juveniles have limited success migrating downstream through these reservoirs and dams, into the mainstem Willamette River, and out to the ocean. Large reservoirs can be difficult for juvenile fish to pass through and survive. Long residence times in the reservoirs can create disease problems and extend opportunities for predation. Further, the velocity of water moving within the reservoirs may be too low for fish to effectively recognize an egress route.

20. Juveniles that survive that journey downstream and reach the dam find only limited, hazardous, and difficult to locate options to pass through dams via turbines, regulating outlets, or (occasional) spill. While all three passage routes may injure or kill fish, regulating outlets and spill are often safer options than passing through turbines. If the Corps makes operational decisions to pass water (and fish) through either regulating outlets or spill, this means that the Corps has less water for their revenue-generating turbines. Further, regulating outlets are

often impossible or difficult for fish to find unless reservoirs are drawn down, and spill is only available at times during spring and summer when reservoirs are full enough to use spill gates.

21. The Corps makes operational decisions that can further compound issues that lead to low numbers of successful downstream migrations through the reservoirs and dams. When the Corps refills and keeps reservoirs higher, the potential reservoir outlets that serve as potential outmigration paths—turbines and regulating outlets—are deeper and more difficult for fish to find. For peaking projects, intermittent refill operations also provide relatively long periods of virtually no flow in reservoirs so fish cannot detect and follow the downriver flow.

Harm from Dam Passage Routes

22. Juvenile fish generally have three potential downstream migration routes to pass through WVP dams: turbines, regulating outlets, and (sometimes) spill. Because these routes were not originally intended for fish migration, they present a potential for injuries from roughness, sharp objects, turbulence, pressure changes, or other structural or operational characteristics. Under current conditions, most existing routes are either difficult to locate, particularly the regulating outlets, or present physical hazards and challenges, ultimately causing injury, mortality, or delayed migration. As the United States Geological Survey explained, "[s]tudies have shown that existing passage routes at Project dams generally have lower-than-adequate passage and survival to support sustainable natural populations upstream of dams."[1]

[1] U.S. Geological Survey, Synthesis of Downstream Fish Passage Information at Projects Owned by the U.S. Army Corps of Engineers in the Willamette River Basin, Oregon (2017), p. 84.

Turbines

23. The Willamette Dams have two principal types of turbines: Kaplan and Francis. Kaplan turbines are often used on lower head projects, such as the re-reg dams (Big Cliff, Foster, Dexter), while Francis turbines are often used for higher head dams—Detroit, Green Peter, Cougar, Hills Creek, and Lookout Point.

24. "Injuries and mortality among fish that pass through hydroelectric turbines can result from several mechanisms … including, rapid and extreme pressure changes (water pressures within the turbine may increase to several times atmospheric pressure, then drop to subatmospheric pressure, all in a matter of seconds), cavitation (extremely low water pressures cause the formation of vapor bubbles which subsequently collapse violently), shear stress (forces applied parallel to the fish's surface resulting from the incidence of two bodies of water of different velocities), turbulence (irregular motions of the water, which can cause localized injuries or, at larger scales, disorientation), strike (collision with structures including runner blades, stay vanes, wicket gates, and draft tube piers), and grinding (squeezing through narrow gaps between fixed and moving structures)."[2]

25. The severity of the harm to fish depends on the size, operation, and type of the turbine. Turbines that are smaller in diameter have smaller openings for fish to pass through, so present relatively more frequent and acute opportunities for injury than larger turbines. WVP turbines are relatively small and thus likely more harmful than dams with larger turbines like those in the Columbia River system. Smaller turbines are particularly problematic for downstream passage of adult-sized Steelhead kelts (fish that have spawned once, and are moving

[2] Câda—"The Development of Advanced Hydroelectric Turbines to Improve Fish Passage Survival", Fisheries Vol 26, No. 9.

downstream, potentially to return and spawn multiple times) such as on the South Santiam River. Most turbine studies are of juvenile-sized fish and underestimate injuries for larger fish.

26. The way the Corps chooses to operate the turbines and reservoir system further affects the severity of harm to fish. The Corps operates the WVP project dams such that widely varying reservoir elevations seasonally occur throughout the year. This greatly alters the head conditions (the depth of water above the turbines), which makes the operational efficiency of the projects less likely to be optimal. Turbines are generally optimized for operation at certain head conditions; operating outside of those optimal conditions can be more injurious to fish.[3]

27. Further, fish that pass through Francis turbines at Detroit, Green Peter, Cougar, Hills Creek, and Lookout Point are often injured at higher rates than in similarly sized Kaplan turbines. This is because Francis turbines have smaller spaces through which fish must pass, and because Francis turbines often turn faster, thereby increasing chance of blade strike.

Regulating Outlets

28. Regulating outlets are non-turbine outlets used to pass flow through dams when other flow routes such as turbine or spill are insufficient or unavailable. Among other uses, regulating outlets serve as auxiliary outlets to provide a means to drastically lower the reservoir pool for maintenance or other purposes. Regulating outlets are typically located tens or hundreds of feet below the normal surface of the reservoir, as well as below turbine penstocks, which are the inlets for turbines.

29. Downstream migrating fish can use regulating outlets if they are available (e.g., open) and the fish can sound deep enough to locate them. But in deep reservoirs, it can be difficult or impossible for fish to sound deep enough to find regulating outlets even when the

[3] Câda—"The Development of Advanced Hydroelectric Turbines to Improve Fish Passage Survival", Fisheries Vol 26, No. 9

reservoir is drawn down to winter levels. Even if fish find the outlets, outmigration routes not originally intended for fish can present hazards for injury and mortality, such as scrapes, abrasions, gas disease, and predators near the outlet exit.

30. Juvenile passage success through dams depends upon the unique structures at each dam and how they are operated. Sometimes, turbine passage is more injurious and less desirable than regulating outlet passage. However, regulating outlets at WVP dams generally have not been retrofitted to remove physical hazards from sharpness, roughness, or other injurious features. This means that regulating outlets at WVPs dams are still likely to cause injuries or mortality of fish that find them and attempt to pass through.

Spill for fish passage

31. Spill provides a third possible passage modality in some circumstances. "Spill" refers to water discharged from near the surface of a reservoir either under or over spill gates, depending on their configuration. When spill is utilized for fish passage it typically is accomplished via an existing tainter gate on top of the spillway crest (as in the image below of Foster dam spilling), or, less commonly, a special accommodation for fish at the top of a gate.

32. Spill can be advantageous relative to other egress routes because it withdraws water from near the surface, where fish are more likely to be, and where fish can sense and move toward the flow. Thus, spill can be a more effective and less injurious egress route than regulating outlets or turbines that often require fish to sound (descend) to great depths and then locate obscure egress routes, which generally cause relatively higher injuries. However, many problems with mortality and injury have been discovered at WVP spillways, which prevents spill from being categorized as the best fish migration route for any particular dam.

Figure 1 Foster dam spilling under tainter gates

33. Spill is only possible when reservoir elevations are high enough for water to pass through the spill gates. Because spill gates are usually located in the top 20-50 feet of the dam face, this generally requires reservoirs to be nearly full. Thus, when WVP reservoirs are drawn down and operated for flood control during fall and winter, reservoir elevations are maintained well below the spillway crest to make room for potentially flooding flows from high precipitation events. This means spill is generally only available, if at all, as a passage modality during the late spring and early summer conservation season when flows are high and reservoirs are nearly full. This is also a time when juveniles historically out-migrated, however, so this could be a useful time to employ spill. When spill is not generally an available fish passage method—during late summer, fall, and winter—juveniles would be forced to find other egress routes—turbines, regulating outlets, or other minor outlets.

34. Further, spill as a modality for passing fish is not readily feasible at some dams, such as Cougar, photo below, where the spillway is currently just a rocky chute, intended solely for emergency events, or Fall Creek, where spill would disrupt valuable downstream habitat.

Figure 2 Rocky spillway at Cougar (unsuitable for fish in current configuration)

35. Even when spill is available, though, the Corps is often reluctant to do so because it requires re-routing water that may otherwise be used to generate hydropower—and therefore causes lost revenue for the Bonneville Power Administration.

36. Despite the benefits of spill, spill can have drawbacks. Spill can entrain gasses, which raises total dissolved gas to levels that can injure fish. Measures can be taken to minimize this, such as redirecting the spill jet so that it does not plunge deeply into the tailrace (the pool immediately below a dam). Spill also requires reservoir elevations to be high, which presents other problems for fish related to predators, disease, travel time, and temperature as described below.

<u>Harm from Reservoirs</u>

37. Reservoirs create unnatural and potentially unfavorable conditions that harm fish in several ways. Reservoirs have greater surface area and deeper pools than rivers. Water velocity through the deep, still reservoirs is virtually non-existent, which reduces migration cues that enable juvenile fish to migrate downstream through reservoirs and dams out to the ocean. This creates a still, artificial habitat that may support resident fish that otherwise would not be widely present to predate on juvenile salmon and steelhead. These conditions can also lead to

higher water temperatures near the surface, algae blooms, and higher levels of diseases or parasites.

38. Deep reservoirs with deep regulating outlets and turbines make outmigration routes difficult for the fish to find, or access, encouraging unnaturally long residence time in the reservoirs—often months long. Long residence times in the reservoirs pose risks and hazards to juvenile salmon through increased exposure to poor water conditions, parasites, and predators. Reservoirs at the Lookout Point, Green Peter, Foster, and Detroit dams are particularly problematic because they are quite large.

39. Refilling and high reservoir levels in the spring—when fish naturally would prefer to migrate—through early fall forces juveniles to descend to great depths to try to discover obscure outmigration routes through either turbines or regulating outlets. Juvenile salmonids acclimate to depth by ingesting air into their swim bladder to achieve neutral buoyancy, but there is a limit to the effectiveness of this. Fish can swim deeper, but below about 22 feet they are negatively buoyant and tend to sink, which requires more effort to maintain their position and can make them more vulnerable to injury or death. In my professional opinion, I anticipate that few juvenile fish will readily find and use outlets deeper than 65 feet. This makes juvenile passage at dams impossible or quite difficult when reservoir levels are high and turbines and/or regulating outlets are deeper than 65 feet.

40. At Detroit Dam, the regulating outlets are located at 1,265 feet and 1,340 feet and the reservoir's full pool level is approximately 1569 feet, which requires fish to descend 229 or 304 feet to access the regulating outlets. The minimum conservation pool—the lowest level to which the Corps generally lowers a reservoir in fall and winter—is approximately 1450 feet, which requires fish to descend 110 or 185 feet to access a regulating outlet. In my professional

opinion, at these reservoir elevations, it seems unlikely that fish would readily or safely be able to find and pass through the regulating outlets. Furthermore, even the injurious turbines are located at 1,403 feet, which would make them inaccessible at full pool by requiring fish to descend 166 feet to access them. At minimum conservation pool (1450’) the turbines are somewhat more accessible but fish would still need to descend 47 feet.

41. At Cougar dam, the regulating outlets are located at approximately 1488 feet, and the full pool is 1699 feet, which requires fish to descend 211 feet. The minimum conservation pool is 1,532 feet, which requires fish to descend 44 feet. While fish are unlikely to successfully pass through the regulating outlet at full pool, they may be more likely to pass as the reservoir elevation approaches the minimum conservation pool.

42. At Lookout Point dam, the regulating outlet is located at 734 feet, and the full pool of the reservoir is 925 feet, requiring fish to descend 194 feet to find that outlet, which makes it unlikely fish would readily or safely be able to pass through it. When the reservoir is lowered in the fall and winter to the minimum conservation pool of approximately 825 feet, fish would still need to descend 91 feet to the regulating outlet, which is still very deep and likely makes the regulating outlet difficult or harmful for fish to access. The turbine inlets are located at between 768 and 790 feet, which requires fish to descend between 157 and 135 feet at full pool, or between 57 and 35 feet at minimum conservation pool. This means turbines are largely inaccessible at full pool, but potentially available at minimum conservation pool.

Harm from Ongoing Operations and Maintenance

43. Not all fish problems are attributable to structural issues associated with the existence of the dams. The Corps’ operation and maintenance of the Willamette Project harms fish. In a typical year, the Corps generally fills these reservoirs in late spring and strives to keep

them full throughout the summer, as far as feasible, which largely benefits recreation and other purposes. This often results in many deep reservoirs during the late spring and summer periods. Deep reservoirs impair and delay juvenile downstream passage during the spring and summer—when the fish desire to emigrate—as explained above. Natural migration timing is frustrated and out of sync by refilling and keeping full reservoirs that reduce velocities for migration cues and makes passage routes more difficult to access. At all WVP dams, the timing of the drawdown in fall is largely based on flood control activities of the Corps that evacuate reservoirs to make room for flood storage and not for benefits to the fish.

44. The Corps' operation of Detroit Dam and its reservoir illustrates these issues. The Corps normally maintains the Detroit reservoir pool high in the summer, presumably, among other things, to support recreation. However, ecologically it might be advantageous to facilitate fish passage during spring or summer months by lowering reservoir elevations and making the reservoir's lower outlets more accessible to fish.

45. The Corps' operation of Detroit, Green Peter, and Lookout Point for peaking power generation harms fish. The Corps operates turbines at these dams intermittently to generate power during periods of highest electricity demand, which are typically afternoons and evenings. These turbines are mostly "off" at other times, which results in long periods of near zero velocity water within these reservoirs in order to store water in the reservoirs for later power generation episodes. This causes low flows and velocity within the reservoir, which impairs the abilities of fish to sense viable ways out of the reservoir.

46. Power-peaking also causes abrupt changes in water flows and velocities downstream, which requires the Corps to operate re-regulation dams—Foster on the South Santiam, Dexter on the Middle Fork Willamette, and Big Cliff on the North Santiam—to smooth

the peaks and valleys of flow discharges from the peaking operations. However, large reservoir elevation and flow variations can occur in reaches between the peaking dams and their regulation dams, which impairs the potential value of those intervening reaches as habitat. Peaking also causes most juvenile passage to be through the turbines; this occurs because the Corps often prefers not to operate the regulating outlets and spillways unless necessary and instead prioritizes use of the revenue-producing turbines for power production.

47. Operational necessities such as outages and repairs may also cause the Corps to utilize comparatively less desirable (for fish) water sources (e.g., turbines v. regulating outlets v. spill). This can harm fish if they are forced to use an outmigration route that is less suitable or more injurious.

Plaintiffs' Proposed Interim Measures

48. I have reviewed the Plaintiffs' requests and various proposals for the Corps to conduct reservoir drawdowns and other fish passage measures at Detroit, Cougar, Green Peter, Fall Creek, and Lookout Point dams.[4] As explained below in more detail, in my professional opinion, implementation of the proposed drawdowns and passage operations would provide some immediate benefit to fish by making outmigration routes easier for fish to locate, and would not be technically challenging, dangerous, or impair flood control. I understand these may be the most feasible options for now. But they are just a first step—meaningful success restoring juvenile salmon passage will require more drastic measures in the future.

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[4] These include the following: Draft Environmental Assessment Downstream Fish Enhancement for Juvenile Salmonids at Hills Creek, Fall Creek, and Cougar Dams 2013-2020, dated November 2013, and Final Environmental Assessment Downstream Fish Enhancement for Juvenile Salmonids at Fall Creek Dam, Lane County, Oregon, dated November 2014; Draft Environmental Assessment Downstream Fish Passage Enhancement for Juvenile Salmonids at Lookout Point Dam, Lane County, Oregon, dated June 2017

General Effects of Reservoir Drawdowns

49. I am familiar with the effects of evacuating—also known as drawing down—reservoirs. Reservoir drawdowns have several benefits for juvenile salmon and steelhead. Drawing down a reservoir reduces its volume, which decreases residence time for both water and fish. Drawdowns help concentrate and can move fish toward egress routes and past the dam. Most importantly, drawdowns can make the relatively lower regulating outlets, which are often a safer passage route than the relatively more conveniently higher turbine inlets, more accessible to juveniles. They can also increase migration cues with higher average water velocity to available egress routes.

50. Drawdowns can have benefits for stream health downstream, as well, if stored gravels are released to replenish depleted downstream reaches. If drawn down very low, as is being done at Fall Creek, accumulated sediment can be passed downstream, replenishing sediment-starved downstream reaches and partially restoring normal stream processes. This is a potential benefit because since initial dam construction, the dams have retained most silt and gravel that was formerly passed through. Below the dams, stream sections now have become rockier, with less gravel, sand, and sediment than before the dams were constructed. This is a problem for ecological health and fish because rocky stream reaches are not as suitable for spawning fish.

51. Between 2001 and 2003, I spent a significant amount of time with NMFS monitoring the construction of the temperature control tower for Cougar Dam and Reservoir, which required a very deep atypical drawdown of the reservoir during 2002 to enable construction of the temperature tower. I inspected the river from the ground and the air and observed the extent of sediment impacts upstream and downstream. While the deep drawdown

discharged a considerable amount of accumulated sediment, in the end it proved manageable. Based on this and other experiences, I believe that downstream sediment impacts associated with the far lesser drawdowns proposed by the Plaintiffs will be short-term and manageable. That drawdown was much deeper than the ones that Plaintiffs have proposed

Detroit Drawdown

52. I have considered the Plaintiffs' proposal to draw down Detroit Reservoir to 1,370 feet by November 15 and to hold until December 15. I have reviewed the Corps' Operational Measures Evaluation Report ("OMET") that analyzed the impacts of a similar proposal (DET_04).

53. This proposal prioritizes regulating outlet passage over turbine passage because the turbines would not be used at this reservoir elevation and survival through the regulating outlet is generally better than through the turbines.[5] In my professional opinion, this proposal will therefore benefit fish passage.

54. The OMET report did not find unacceptable impacts to flood control from a similar drawdown operation and I therefore believe Plaintiffs' proposal is technically feasible to complete without impacting flood control operations. While the OMET report found the reservoir would only refill during about 50% of water years, Plaintiffs' proposal should allow for refill more often because the drawdown would only be for one month, six weeks shorter than the OMET proposal, which should reduce impacts to other project needs.

Cougar Drawdown and Delayed Refill

55. I have considered the Plaintiffs' proposal to draw down Cougar Reservoir to 1,505 feet elevation between November 15 and December 15. I reviewed the November 2013

[5] USGS reported regulating outlet survival ranged from 72% to 94% (USGS Table 9) as compared to turbine survival of 54% (USGS page 24).

Draft Environmental Assessment for Downstream Fish Enhancement for Juvenile Salmonids for Hills Creek, Fall Creek, and Cougar Dams. The preferred alternative for Cougar Reservoir was very similar to Plaintiffs' proposal—drawing down and holding the reservoir at an elevation of 1505 feet above sea level for approximately one month in December.[6] The Corps opined this would not change project outflows but rather would just prioritize fish passage through the regulating outlets rather than the turbines.[7] Plaintiffs' proposal is also similar to a drawdown analyzed in the Corps' OMET report (CGR_03) that analyzed drawing down Cougar reservoir to 1,516 feet between November 15 and January 31. The Corps found that measure would actually increase flood control capacity.

56. In my professional opinion, Plaintiffs' proposed drawdown would be beneficial to juvenile salmonids in the immediate future because they would be closer to, and more likely to find, the regulating outlet to pass through the dam, and less reservoir volume would result in a greater average water velocity for fish to sense the downstream direction. This proposed drawdown is much less severe than the 2002 drawdown, which lowered the reservoir elevation much further.

57. I have also considered the Plaintiffs' proposal to conduct delayed refill at Cougar in the spring. This is the same as a measure analyzed in the OMET Report (CGR_05). In my professional opinion, this measure would benefit fish passage by making the regulating outlets more accessible during the spring when fish naturally prefer to migrate. In the OMET report, the Corps found that this would also increase flood control storage capacity, indicating this is technically feasible from a flood control perspective.

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[6] EA at 10.
[7] EA at 11.

Fall Creek Spring Drawdown

58. The Corps conducts deep drawdowns at Fall Creek dam during December. This completely drains Fall Creek reservoir and flushes most fish, including salmonids as well as most potential predators, downstream, along with much sediment. When the reservoir is refilled, there is less predation while the predator population is temporarily suppressed. In this manner the annual Fall Creek drawdown has facilitated and improved downstream juvenile passage in the fall.

59. I have considered Plaintiffs' proposal to add a second drawdown of Fall Creek reservoir in the spring. This is similar to a proposal by ODFW that I have reviewed. The study proposal notes that the deep drawdown during the fall has been effective at passing fish. It also explains that another study revealed wild juvenile Chinook salmon attempted to pass the dam during May and June, when there is no viable outlet for fish passage because the reservoir level is far above the regulating outlets. This ODFW-proposed spring drawdown would study if allowing juvenile spring migrants to pass the dam at their natural migration time would reduce reservoir predation and potential copepod impacts, and mimic a more natural life history pattern. Because juvenile fish prefer to out-migrate in the spring, such a study is important to verify these hypotheses. If results show the hypothesis valid, then the reservoir should be operated in this manner unless more effective permanent fish passage measures are developed and implemented.

60. In my professional judgment, a drawdown in the spring, as proposed by the ODFW study, would likely be particularly useful to these Fall Creek fish, and would not present any unusual technical or operational challenges.

Lookout Point Drawdown and Passage Study

61. I have considered Plaintiffs' proposal to draw down Lookout Point reservoir to an elevation of 750 feet between November 15 and December 15. I have reviewed a draft Environmental Assessment by the Corps that assessed the impacts of a similar drawdown, and a study proposal from 2017 that described these operations.[8] This drawdown would only require juvenile fish to sound approximately 16 feet to the regulating outlet, which provides for a manageable outmigration depth for passage of downstream migrating juveniles. This is a significant improvement from the typical height of the reservoir at that time of the year—approximately 825 feet at the minimum flood control pool—which requires fish to sound to a depth of 91 feet to access the regulating outlet. Sounding 91 feet is a far more difficult passage option for juveniles than the 16 feet proposed in the deep drawdown.

62. I have also considered Plaintiffs' proposal for ungated spill in the spring for 2-4 weeks. I have reviewed a draft Environmental Assessment by the Corps that assessed the impacts of a similar operation. In my professional opinion, this measure would increase the likelihood of successful downstream fish passage.

63. In addition to better facilitating juvenile fish passage, this study is important for evaluating long-term fish passage options in the basin. USGS (p. 83) notes that ". . . less is known about route-specific passage and survival [on the Middle Fork] than in other basins." This means that this study proposal would facilitate a better understanding of juvenile passage injuries and mortality incurred through the different passage routes at Lookout Point dam.

64. In my professional judgment, the deep drawdown study proposed for Lookout Point is feasible, will be a benefit for juvenile Chinook downstream passage for the immediate

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[8] Draft Environmental Assessment Downstream Fish Passage Enhancement for Juvenile Salmonids at Lookout Point Dam, Lane County, Oregon, June 2017; JPL – 15-04-LOP

future, and does not present risks other than, principally, lost hydropower revenue. The deep drawdown should not interfere with flood control operations because the low reservoir elevations will leave ample room for the Corps to conduct flood control operations and capture high precipitation events during the flood control season (November to February).

Green Peter Outplanting

65. The RPA required the Corps to outplant salmon above Green Peter dam if NMFS determined it was necessary to evaluate future fish passage options. NMFS determined it was necessary, and ODFW and the Grand Ronde Tribe support this requirement[9] to re-evaluate reintroduction and productivity of historic UWR spawning habitat in the upper reaches of the South Santiam River.

66. Past fish passage efforts and studies have not adequately studied viable passage options for downstream juvenile passage or evaluated upstream habitat productivity, as this study proposes to do.[10] Abandoning the productivity of the habitat upstream of Green Peter reservoir—through failing to even investigate it—is premature. Though past efforts to pass fish through this reservoir have been dismal, there may be options available in the future which might yet make this habitat accessible and useful. As with Lookout Point, the outplanting study is an important first step for reconnecting South Santiam populations of Chinook salmon and steelhead with historic habitat above the dams. In my professional opinion, the Corps should implement the outplanting above Green Peter dam that is required by the RPA to research upstream habitat productivity and passage potential.

Conclusions

[9] Issue Elevation form, Sept 29, 2017.
[10] USGS p. 4; USGS p. 29.

67. The Corps' operation and maintenance of the dams harm UWR Chinook salmon and steelhead through several mechanisms. By maintaining unnatural reservoirs upstream of the dams, the Corps facilitates unnatural habitat and unnatural temperature regimes, which can disrupt natural migration patterns and timing. The Corps' operation and maintenance of dams disrupts sediment transport that benefits downstream spawning locations, prevents adults from migrating upstream to their desired spawning habitat, and degrades stream form and off-channel habitat for juvenile rearing. Upstream passage via trucking, though no other feasible options are currently available, remains problematic because it causes additional handling injury and stress of adults. Downstream juvenile passage through dams is perilous because outmigration routes are inconveniently located and hazardous, and spill may only be possible as a migration route for a small portion of the year. For these reasons, the Corps' operation and maintenance of the Willamette Dams harms UWR Chinook salmon and steelhead, and remedial measures are needed immediately to improve habitat and passage conditions for these species.

68. I have been involved with many projects that posed and caused real hazards to people downstream, so am particularly thoughtful of the hazards that dams and their operations can pose. Thus, I would not support the proposed interim measures—namely deeper drawdowns— if I thought they posed unacceptable risks to human health and safety. Based on my review of the agency's documents, my knowledge of the Corps' operations, and the Plaintiffs' allowance for the Corps to address flood control and human health and safety needs, I do not have such concerns about the proposed interim measures and believe the Corps has the technical competence to implement them. I view the principal adverse effects of deeper drawdowns as being loss of hydropower revenue, possible incomplete refilling of reservoirs in the spring, and some (tolerable) increase in fine sediment discharge. Based on my professional

experience evaluating fish passage operations, I believe Plaintiffs' proposed interim measures will provide immediate benefits for UWR Chinook salmon and steelhead.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Signed this 29th day of November, 2018, in Portland, Oregon.

s/ John K. Johnson

John K. Johnson