APPENDIX 2F

RECREATION FLOW STUDY PHOTOGRAPHS

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Klamath Photo Gallery September 20, 2003

Photo 1

PacifiCorp has applied to renew a FERC license for the Upper Klamath River Hydroelectric Project in Oregon and California. The Upper Klamath includes six distinct river segments that offer a variety of recreation opportunities, including whitewater boating and fishing.

Photo 2

As part of the relicensing process, a series of studies were conducted to help understand the benefits and impacts of proposed operations on recreation. The goal was to help the utility, stakeholders, and FERC develop protection, mitigation, and enhancement actions that balance hydropower generation and other resource values.

Photo 3

Recreation researchers, stakeholders, and utility and agency staff review a map during field reconnaissance in September 2001. Flow-recreation information was collected in two phases. Phase 1 studies integrated existing information, interviews with experienced resource users, and field reconnaissance on all six reaches.

	Photo 4 Boaters prepare to put-in on the Hell's Corner reach during a controlled flow assessment in September 2002. Phase 2 studies included controlled flow assessments on the J. C. Boyle bypass and Hell's Corner segments, allowing researchers to more precisely describe and evaluate recreation opportunities at known flows.
	Photo 5 Boaters complete surveys during the Hell's Corner controlled flow study. Boaters completed forms before going on the river, after each run, and after completing all their runs.
	Photo 6 Video station on Hell's Corner at 1,030 cfs. Video and still photographs were taken at rapids or other key river features to show how flows affected them.

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	Photo 7 After each run, boaters participated in focus groups to discuss the advantages and disadvantages of the flow, and estimate how the run might change at higher or lower flows.
	Photo 8 Boyle bypass boating participants. On the Boyle bypass reach, boaters and anglers assessed four flows ranging from 690 to 1,480 cfs, plus base flows (325 cfs). On the Hell's Corner reach, boaters and anglers assessed four flows ranging from 730 to 1,750 cfs, plus base flows (350 cfs).
	Photo 9 Spin angler in Frain Ranch area of Hell's Corner reach at 350 cfs. Anglers fished different flows and then completed a survey to rate fishability. Follow-up interviews were conducted by phone.
	Photo 10 Fish in the Fall Creek hatchery. The angling component was designed to determine acceptable and optimal flow ranges for fly, spin, and bait fishing from an angler's perspective. The controlled flow study for fishability was distinct from biological studies to determine acceptable and optimal flows for aquatic habitat.

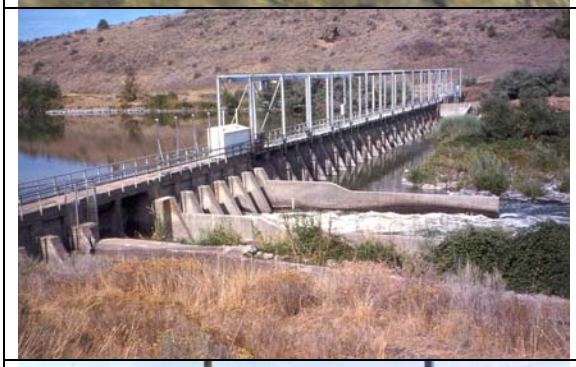
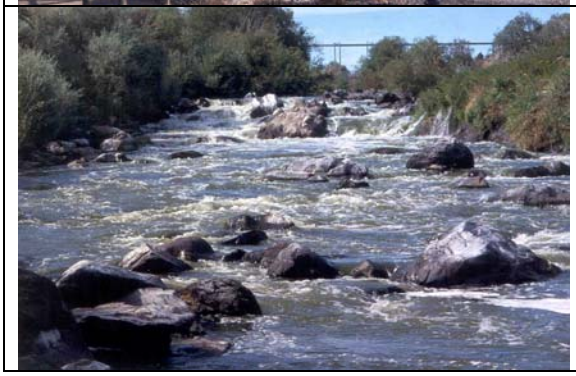
	Photo 11 Crayfish in the Hell's Corner reach at base flow (350 cfs).
	Photo 12 Link River dam. The 1.5-mile Link River bypass reach flows from Upper Klamath Lake and has two hydroelectric diversions that can remove a total of 1,450 cfs. Base flows are generally between 250 and 650 cfs, except during runoff spills in wetter years.
	Photo 13 A service road along the West Side diversion provides public access for a variety of recreation opportunities including fishing, kayaking, hiking, jogging, and berry picking.
	Photo 14 The reach has a few Class III rapids and a popular "locational playboating" wave. The river is boatable in kayaks starting at 300 cfs, but quality playboating requires flows over 1,000 cfs, which occur only during spills.

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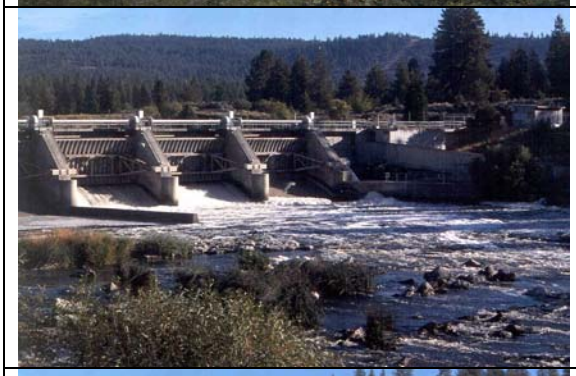
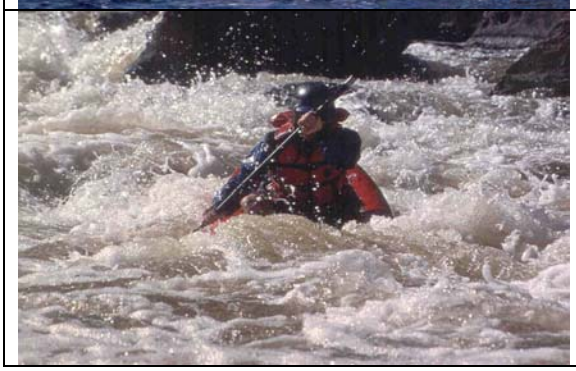
	Photo 15 Suburban homes in Klamath Falls near the downstream end of Link River. Fishing can occur along the entire reach, but many people fish from boats in this area, just upstream from the inlet to Lake Ewauna/ Keno reservoir. Flows have minor effects on this opportunity.
	Photo 16 Keno dam. The 5-mile Keno reach has no diversions, but its flows are varied to maintain a static lake level in Keno reservoir. Minimum flows in the segment are 250 cfs, but base flows are often much higher (500 to 1,000 cfs) even when Upper Klamath Lake is not spilling.
	Photo 17 The reach has limited road or trail access but offers good fishing, fine scenery, bird viewing, and several Class II and III rapids at higher flows. The largest trout on the Upper Klamath are found on this reach, but fishing is closed in summer to minimize pressure during the warmer months. Flows do not appear to have large effects on fishability, but they may limit boat-based fishing opportunities.
	Photo 18 An inflatable kayak running a Keno rapid at about 700 cfs. Boating in smaller craft is possible at these lower flows, but flows over 1,000 cfs provide stronger hydraulics and more route options. A locational playboating feature (the "Keno Wave") is best from 1,300 to 1,600 cfs.

	Photo 19 Boatability is limited by a mile-long section in the middle of the reach with shallow riffles and boulder gardens (shown here). Flows below about 1,000 cfs may ground rafts in several places, but wading-based anglers fish this section at much lower flows.
	Photo 20 J. C. Boyle dam releasing 1,480 cfs during the controlled flow study. Through most of the year, only 100 cfs is released into this 4.3-mile bypass reach, with springs adding approximately 225 cfs more (325 cfs total). Higher flows (up to 5,000 cfs) may occur for short periods in wetter years.
	Photo 21 Three photos from the Phase 1 reconnaissance on the Boyle bypass reach at base flow (325 cfs). This flow provides high-quality wading-based fly fishing opportunities, with extensive pocket water and long runs and pools. The reach is also boatable in kayaks at this flow, but with many hits and stops, as well as several "boat drags" and portages. There is little whitewater at this level, although several rapids are technically difficult.
	Photo 22 See caption for Photo 21.

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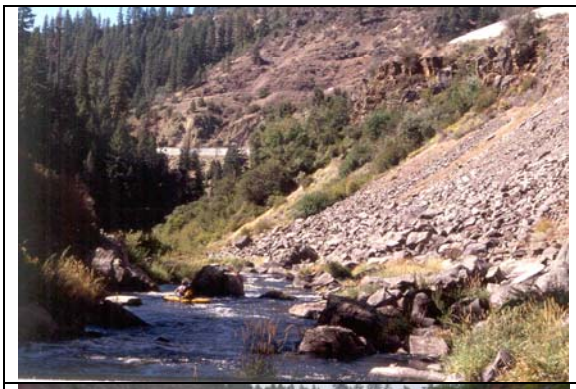	Photo 23 See caption for Photo 21.
	Photo 24 Three photos from Boyle bypass at 690 cfs. Fishability at this (and higher) flows was unacceptable because of fast currents, minimal wadeable area, and increased turbidity. Boating quality was also marginal at this level. Kayaks and small catarafts were able to negotiate the reach, but nearly all boaters had to portage one rapid (Sidecast Slide). The catarafts also became stopped several times, and sometimes required "boat-drags" to continue. Most rapids involved numerous hits, and route options were limited.
	Photo 25 See caption for Photo 24.
	Photo 26 See caption for Photo 24.

	Photo 27 Four photos from Boyle bypass at 960 cfs. This flow produced good technical opportunities for kayaks, acceptable technical opportunities for small rafts, but unacceptable standard trips for all craft. The entire reach was boatable, although most rafts portaged Sidecast Slide. Rapids had more power and route options than 690 cfs, but the channel was still rocky, with limited oar-space for rowing rigs. Rafts had numerous hits and stops, and a few became stuck or had people fall out. Despite these minor problems, the river was not too "pushy," allowing boaters to scout rapids on a reach they had not run before.
	Photo 28 See caption for Photo 27.
	Photo 29 See caption for Photo 27.

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	Photo 30 See caption for Photo 27.
	Photo 31 Two photos from Boyle bypass at 1,230 cfs. This flow improved boatability and power in the river compared with 960 cfs. Rapids were less rocky, route options improved, and the size of waves and holes also increased without becoming too "pushy." While some rapids remained "technical," this flow defined the start of "standard" whitewater trips, particularly for kayaks. It was acceptable but not optimal for rafting, and could provide acceptable commercial rafting (assuming 5 to 6 passengers plus a guide).
	Photo 32 See caption for Photo 31.

	Photo 33 Three photos from Boyle bypass at 1,480 cfs. This was the highest flow in the study, and it provided near-optimal "standard" boating for both kayaks and rafts. There were no substantial boatability problems and considerable power in hydraulics, as well as more route options in rapids. Definition remained in most rapids, although a few became noticeably "pushier" or had shorter recovery areas. Commercial rafting would be viable at this flow, particularly after lines through the more difficult rapids become known. While some rapids had powerful hydraulics, the river was less powerful than a two-turbine, "big water" run on Hell's Corner.
	Photo 34 See caption for Photo 33.
	Photo 35 See caption for Photo 33.

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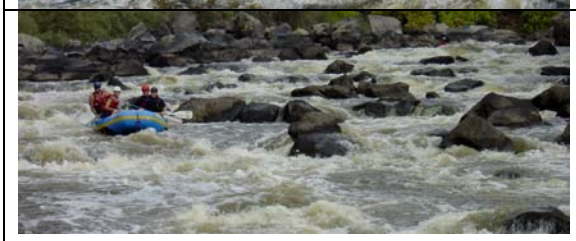
	Photo 36 Caldera rapid at 730 cfs (top) and 1,750 cfs (bottom). The 16-mile Hell's Corner reach includes a 5-mile section with over 20 Class III and IV rapids. Flows fluctuate from daily peaking hydroelectric generation, usually ranging from 350 cfs at base levels in morning to 1,600 cfs (one turbine) or 2,800 cfs (two turbines) in the middle of the day. This flow regime has substantial effects on whitewater and fishing opportunities in the segment.
	Photo 37 See caption for Photo 36.
	Photo 38 Hell's Corner rapid at 730 cfs (top) and 1,750 cfs (bottom). Higher flows (particularly those above about 1,500 cfs or one turbine) provide near-optimal "standard" boating for kayaks and rafts. There are no substantial boatability problems and considerable power in hydraulics, as well as more route options in rapids. Commercial rafting with larger rafts and full passenger loads (usually 5 to 6) is viable at this flow, offering an exciting trip. In contrast, flows below 1,000 cfs have substantial boatability issues, as well as less power in rapids and diminished aesthetics.
	Photo 39 See caption for Photo 38.

	Photo 40 Kayaker surfing the first wave at Caldera at 1,750 cfs. Playboating opportunities improved at several locations at higher flows, but they are best at flows above 1,500 cfs.
	Photo 41 Two photos of Hell's Corner rapids at 730 cfs. This was the lowest flow during the controlled flow study; it produced unacceptable technical boating. Kayaks, small catarafts, and lightly loaded rafts were able to negotiate the reach, but none reported quality whitewater conditions. All craft had numerous hits, and the rafts and catarafts were dragged off rocks several times. Route options were limited and there were few playboating features. This flow defines the low end of the boatable range, but few thought it would attract much use, and it probably does not provide commercial rafting opportunities (even for lightly loaded rafts with skilled passengers).
	Photo 42 See caption for Photo 41.

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	Photo 43 Three photos of Hell's Corner at 1,065 cfs. This flow produced acceptable technical boating, but it lacked the power and "splashiness" of higher flows. All craft were able to run the reach without "boat-drags," but some rafts became stopped in a few shallow riffles, and hits were common. Rapids had more power and greater margin for error than 730 cfs, but the channel was rocky and had limited oar-space for rowing rigs. Because the water was not "pushy," boaters generally had adequate time to pick their way through the boulder gardens. This flow might be commercially viable as a "low flow" or technical opportunity, but boats would probably have to be small (12 to 13 feet) and carry fewer people (3 to 4 passengers plus a guide). Passengers might also have to be more skilled or physically fit to offset increased safety hazards associated with more frequent hits and inadvertent swims.
	Photo 44 See caption for Photo 43.
	Photo 45 See caption for Photo 43.

	Photo 46 Two photos of Hell's Corner segment at 1,365 cfs. This flow provided improved boatability and power in the river compared with 1,065 cfs. Rapids were less rocky and there were many more route options; while many boats still hit rocks, there were few stops and no boat drags. The size of waves and holes increased, improving whitewater challenge. While some rapids remained "technical," this flow defined the start of "standard" whitewater trips, particularly for kayaks and small rafts. It was acceptable but not optimal for rafting, and was near the low end of the acceptable range for commercial rafting (assuming 5 to 6 passengers plus a guide). As a technical, "low flow" commercial rafting opportunity (using smaller rafts and fewer people), this flow was within the optimal range.
	Photo 47 See caption for Photo 46.
	Photo 48 Two photos of Hell's Corner at 2,800 cfs. Although not specifically evaluated during the controlled flow study, these flows provide even more exciting whitewater, with considerable power in the rapids and no boatability problems. These higher flows may also be safer for inadvertent swimmers, although recovery areas between rapids are smaller and the river is "pushier."

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	Photo 49 See caption for Photo 48.
	Photo 50 Fishing in the Frain Ranch area at base flows. Current trout anglers clearly prefer to fish lower flows, with optimal levels from base flows to about 500 cfs. This provides good quality wading-based fishing, and allows anglers to cross the river to reach otherwise inaccessible water. Anglers may be able to adjust techniques to fish higher flows or different species, but quality decreases or the type of fishing opportunity changes.
	Photo 51 See caption for Photo 50.
	Photo 52 See caption for Photo 50.

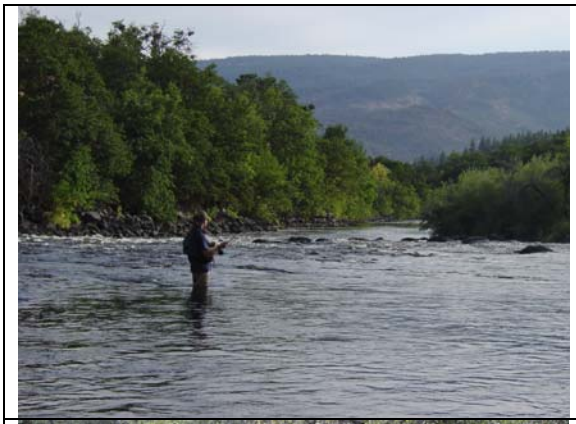	Photo 53 Fishing on the California reach of Hell's Corner at 730 cfs. Compared with Frain Ranch, anglers can fish slightly higher flows on this section because few cross the runs and pools that are more common. Fishability evaluations require distinguishing between flows for fishing ("angler habitat") and flows for the fishery ("fish habitat").
	Photo 54 Copco No. 2 bypass reach at 10 cfs. Base flows are provided through most of the year in this 1.3-mile segment, although spills up to 5,000 cfs may occur when inflows to Copco reservoir exceed the 3,200 cfs capacity of the powerhouse. Base flows allow hiking in and along the channel, but do not provide fishing or boating.
	Photo 55 See caption for Photo 54.
	Photo 56 Five photos from the Copco No. 2 bypass reach at 150 cfs. "Demonstration flows" of 150 cfs, 580 cfs, and 1,200 cfs were released in September 2003 to assess fisheries and recreation. This flow provided marginal technical kayaking, with interesting bedrock rapids but few route options and numerous hits in boulder garden rapids. It was unacceptable for a small cataraft (which repeatedly became grounded). If a fishery existed, this flow is likely to offer good fishing conditions, with pools, runs, and extensive pocket water.

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	Photo 57 See caption for Photo 56.
	Photo 58 See caption for Photo 56.
	Photo 59 See caption for Photo 56.
	Photo 60 See caption for Photo 56.

	Photo 61 Columnar basalt canyon walls dominate the downstream end of the reach, offering fine scenery to recreation users.
	Photo 62 Three photos of Copco No. 2 bypass reach at 580 cfs. Compared with 150 cfs, this flow offered improved boatability for kayaks and small rafts, although a boulder-choked rapid at the end of the run stopped rafts. Bedrock rapids in the first half of the run had considerable power and offered "standard" boating opportunities. Wading and fishing would be more difficult at this flow, which probably identifies the high end of the fishing range (if a fishery existed).
	Photo 63 See caption for Photo 62.
	Photo 64 See caption for Photo 62.

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	Photo 65 Copco No. 2 bypass at 1,200 cfs. This flow provided strong hydraulics and challenging rapids in the first half of the run, bordering on a "big water" boating opportunity. It also inundated large trees on the banks. In the second half of the run, where the channel is wider and more boulder-choked, rapids were reminiscent of the Hell's Corner reach at 1,500 cfs.
	Photo 66 Iron Gate is a re-regulating dam, stabilizing flows in the 122-mile "Middle Klamath" segment. Flows follow from Upper Klamath Lake releases, which are dictated by the U.S. Bureau of Reclamation's upper basin irrigation project. Minimum flows in late summer and early fall are generally 800 to 1,100 cfs, with lower flows in dry years. Spill flows during wet periods can exceed 5,000 cfs, with higher flows downstream below major tributaries.
	Photo 67 Children swimming near Iron Gate dam (R Ranch) at 665 cfs. General recreation and swimming occur at a wide range of flows on the lower gradient, pool/drop Middle Klamath.
	Photo 68 The Tree of Heaven segment of the Middle Klamath at 665 cfs. This popular boating reach has Class II/III rapids good for kayak and canoe skill development. The segment provides technical boating opportunities for rafts and kayaks starting at 600 cfs, although flows over 800 cfs provide better boatability (fewer hits and stops). Standard boating opportunities with more powerful rapids are optimal from 1,500 to 2,000 cfs.

	Photo 69 See caption for Photo 68.
	Photo 70 See caption for Photo 68.
	Photo 71 Water quality and temperature issues occur at low flows in some areas on the river, where algae blooms may limit swimming or diminish fishing. It is difficult to specify flows needed to minimize these impacts (although water quality studies may address the issue).
	Photo 72 Three photos from the Happy Camp reach of the Middle Klamath at 665 cfs (at Iron Gate). A popular whitewater segment with considerable commercial use, it offers technical trips below 800 cfs. Flows above 1,500 cfs provide higher quality standard trips, with fewer boatability problems, more route options, and better whitewater.

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	Photo 73 See caption for Photo 72.
	Photo 74 See caption for Photo 72.
	Photo 75 Three photos of Dragon's Tooth rapid below Happy Camp at 665 cfs (at Iron Gate). This is the most difficult Middle Klamath rapid at lower flows, with limited route options and strong hydraulics. In the first two photos, a group of guided Girl Scouts successfully run the top of the rapid before hitting a downstream rock and flipping. In the third photo, a raft spins off a rock into the "Tooth," running the rest of the rapid successfully.
	Photo 76 See caption for Photo 75.

	Photo 77 See caption for Photo 75.
	Photo 78 Boaters explore Ukonom Creek and Falls on the Middle Klamath. This reach offers outstanding camping, hiking, swimming, and fishing opportunities.
	Photo 79 See caption for Photo 78.

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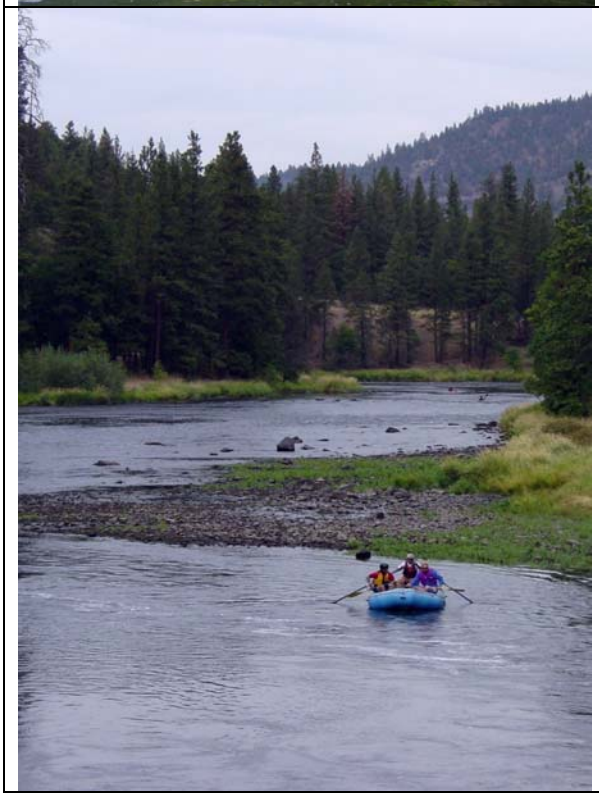
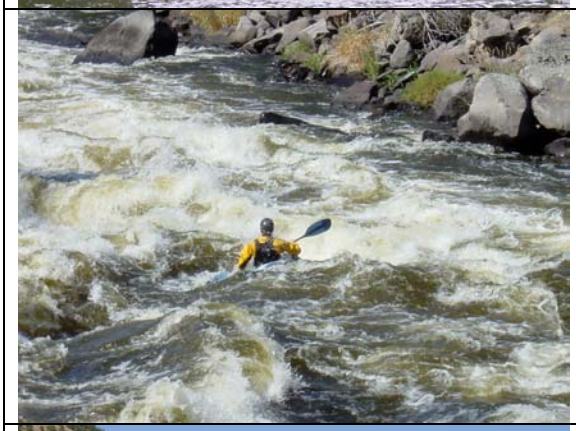
	Photo 80 Fishing for trout, steelhead, and salmon is popular on many sections of the Middle Klamath. Anglers fish from boats, the bank, or while wading. Each has slightly different flow needs, although boat-based fishing is the most flow-dependent. About 800 cfs is needed for driftboats, but 1,000 cfs provides more optimal conditions. Photo by Jack Trout.
	Photo 81 Many large beaches on the Middle Klamath provide high-quality camping or picnicking. These beaches are created and maintained by high-flow events.
	Photo 82 The Upper Klamath offers fishing and whitewater opportunities in distinct flow ranges. These opportunities occupy “niches” in the hydrograph, and not all opportunities can be provided at the same times and places. This report summarizes opportunities by segment and defines flow requirements for each.

	Photo 83 In general, low flows are best for fishing, with lower current velocities, better wading, decreased turbidity, and higher concentrations of fish. While anglers could probably adjust tackle and techniques to fish higher flows, quality would decrease or the type of fishing would change.
	Photo 84 The best boating flows are higher, offering fewer boatability problems, more route options, and bigger waves and holes. While boaters can run lower flows in some craft, higher flows provide better whitewater for private boaters and a substantial commercial rafting industry.
	Photo 85 Balancing boating and fishing opportunities on the Upper Klamath is likely to be challenging because flows for one may cause the loss of days or quality for the other. Ecological resources and hydropower generation may also be affected by changes in the flow regime. The purpose of this report is to provide information to help agencies, stakeholders, FERC, and the license applicant consider these trade-offs.

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