EVALUATION OF WALLA WALLA HABITAT RESTORATION OBJECTIVES
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"Active" restoration strategies were proposed for the geographic areas (GA's) with the largest practicable restoration potential for steelhead and spring chinook, and "passive" measures were proposed for the GA's judged to have the greatest *protection* value for these species. In practice, this procedure resulted in passive measures being applied only to those top protection GA's that were not also ranked among the top restoration areas. As previously described, there were 15 GA's that were judged to be critical to restoring production for all focal species. These areas are summarized in Table 1 below. Although some of these areas were also top priorities for protection, they were targeted for the more intensive actions comprising the active restoration program on the basis of their restoration status. Nine GA's evaluated as critical to protecting current production were not also top restoration areas, and these are also summarized in Table 1.

Table 1. Geographic Areas within the Walla Walla Subbasin targeted for Active or Passive Restoration Actions.

Active Restoration Geographic Areas	Passive Restoration Geographic Areas
Walla Walla River, Mill Cr. To the East Little Walla Walla River	Couse Creek drainage
Walla Walla River, East Little Walla Walla River to Tumalum Bridge	Lower South Fork Walla Walla Tributaries (Flume Canyon, Elbow, Elbow unnamed trib)
Walla Walla River, Tumalum Bridge to Nursery Bridge	North Fork Walla Walla, Little Meadows Creek to steelhead access limit (including Big Meadows Canyon)
Walla Walla River, Nursery Bridge to Little Walla Walla River	Pattit Creek drainage
Walla Walla River, Little Walla Walla to forks	South Fork Walla Walla River, Elbow Creek to steelhead access limit
South Fork Walla Walla River, mouth to Elbow Cr.	Skiphorton and Reser Creek drainages
North Fork Walla Walla River, mouth to Little Meadows Canyon Cr, (including L. Meadows Can Cr.)	Upper South Fork Walla Walla tributaries excluding Skiphorton and Reser Creeks (Tables, Swede, Kees, Husky, Deadman Gulch, Burnt Cabin, Bear Trap, Bear)
Coppei Creek drainage	Walla Walla River, Dry Creek to Mill Creek
Touchet River, Coppei Cr. to forks	Yellowhawk Creek mainstem, mouth to source
SF Touchet mainstem	
SF Touchet River tributaries (Beaverslide, Burnt Fork, Dry Fork of SF, Green Fork, Griffin Fork, NF Griffin Fork)	
NF Touchet River mainstem	
NF Touchet River tributaries (Jim, Lewis, Rogers, Spangler, Weidman)	
Wolf Fork, mouth to Coates Cr. (including Coates and Robinson Creeks)	
Wolf Fork, Coates to steelhead access limit (including Whitney Creek)	

Active restoration actions were intended to lessen the negative impact of the following environmental attributes, all of which were previously identified (Section xx) as significant limiting factors for the top restoration areas: fine sediment, embeddedness, turbidity, woody debris, pools and pool tailouts, anthropogenic confinement, riparian function, temperature and bed scour and flow (base flow). The Walla Walla Subbasin Work Group attempted to identify the ultimate causes of these environmental problems, as well as specific restoration actions that would reduce their impact. They also estimated the maximum degree to which this group of limiting factors might be restored to normative conditions over a 15-year period given the likely measures at hand and the economic, social and ecological constraints of the Subbasin.

Table 2 summarizes their findings and lists “strategic habitat objectives” by reach and environmental attribute. It should be clearly borne in mind that objectives are expressed in terms of the *percent restoration of normative (Historical) conditions*. Thus, a restoration objective of “75% restoration” for an environmental attribute rated “0” historically and “4” under current conditions implies a post-implementation value of “1”. An important implication of using the “percent restoration of Historical conditions” metric to express habitat objectives is that two reaches can be identical in terms of % restoration yet differ considerably in terms of absolute improvement from current conditions. This happens frequently when historical values for a targeted attribute differ considerably between reaches assigned the same habitat objective in terms of percent restoration. Clearly, the absolute degree of improvement to achieve the same percent restoration of historical conditions will have to be greater for a reach that had much better conditions historically.

Strategic habitat objectives were evaluated for their impact on steelhead and chinook salmon production by running an EDT simulation in which Objective values were substituted for Current values. The results presented below thus estimate the benefits to Walla Walla fish populations that would be expected if all of the specific reach-by-attribute objectives summarized in Table 2 were achieved.

The “passive restoration” actions proposed for protection areas were intended permit natural regeneration of riparian corridors and upland areas, as well as protect them, and included such activities as CRP, CREP, direct seeding, riparian plantings, riparian easements, fenced exclosures and so on. The targeted environmental attributes and the assumed impact of these passive measures on them are summarized in Table 3. The EDT model was also used to estimate the benefits to Walla Walla steelhead and chinook salmon of successfully implementing the actions described in Table 3, as well as the combined impact of all active and of all passive restoration actions.

Evaluation of improved passage conditions inside the subbasin was not addressed directly. This was so primarily because of the complicated series of obstructions occurring on Mill Creek inside and near the city of Walla Walla. The Walla Walla Subbasin Work Group did not set specific objectives for specific obstructions on Mill Creek because there was insufficient time and resources to address the major engineering, economic and social/legal issues that would be entailed. Instead, they estimated the benefits that would occur if active and passive actions were implemented with no change in passage in the basin, and then to compare these figures with the benefits estimated under a “full passage scenario”: a scenario in which all impediments to passage were eliminated. It was felt that the initial step in any passage restoration program implemented inside the city of Walla Walla would be to estimate the benefits of completely eliminating the problem. Without a clear demonstration of substantial benefits to fish production under this scenario, there is little incentive to begin the costly and time-consuming engineering and economic studies entailed by a passage restoration program.

Table 2. Active habitat restoration objectives for the Walla Walla Subbasin. Cells represent percent restoration of normative (Historical) conditions for specific reach-by-attribute combinations.

GEOGRAPHIC AREA	REACH[a]	Fines	Embed	Turbidity	Pools	Pool Tailouts	Carcass Loading	Benthic Production	Backwater Pools	LWD	Riparian Function	Temp Maximum	Temp Minimum	Bed Scour	Confine Hydro
Walla Walla River (Mill Creek-E. L. WW)	MacAvoy	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Springbranch	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Walla10	100%	100%	100%	100%	100%	10%	25%	25%	50%	33%	100%	100%	17%	17%
	Walla11	100%	100%	100%	100%	100%	5%	13%	13%	25%	33%	100%	100%	11%	11%
	Walla12	100%	100%	100%	100%	100%	5%	13%	13%	25%	33%	100%	100%	17%	17%
	Walla13	100%	100%	100%	100%	100%	5%	13%	13%	25%	33%	100%	100%	---	---
	Walla8	100%	100%	100%	100%	100%	10%	25%	25%	50%	33%	100%	100%	17%	17%
	Walla9	100%	100%	100%	100%	100%	10%	25%	25%	50%	33%	100%	100%	17%	17%
Walla Walla River (E.L. WW-Tumalum Bridge)	Walla14	100%	100%	100%	100%	100%	5%	13%	13%	25%	33%	100%	100%	23%	23%
	Walla15	100%	100%	100%	100%	100%	10%	25%	25%	50%	20%	100%	100%	23%	23%
	Walla16	100%	100%	100%	0%	0%	15%	38%	38%	75%	---	---	---	---	---
Walla Walla River (Tumalum Bridge-Nursery Bridge)	Walla17	50%	50%	50%	50%	50%	8%	20%	20%	40%	18%	5%	---	25%	25%
	Walla18	50%	50%	50%	50%	50%	8%	20%	20%	40%	18%	5%	---	25%	25%
	Walla19(obstruction)	---	---		---	---	---	---	---	---	---	---	---	---	---
Walla Walla River (Nursery Br to L. WW)	Walla20	---	---	---	---	---	8%	20%	20%	40%	18%	5%	---	13%	13%
	Walla21(dam)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Walla Walla River (L. WW to Forks)	Walla22	---	---	---	---	---	5%	14%	14%	27%	17%	5%	---	25%	25%
	Walla23	---	---	---	---	---	---	---	---	---	---	5%	---	25%	25%
South Fork WW (mouth-Elbow)	WallaSF1	50%	50%	50%	---	---	5%	14%	14%	27%	42%	5%	---	25%	25%
	WallaSF2	50%	50%	50%	---	---	4%	10%	10%	20%	42%	5%	---	25%	25%
	WallaSF3	50%	50%	50%	---	---	13%	34%	34%	67%	50%	5%	---	---	---
North Fork WW (Mouth-L. Meadows Canyon Cr; plus L. Meadows)	Little Meadow Canyon	---	---	---	---	---	---	---	---	---	---	5%	---	---	---
	WallaNF1	---	---	50%	50%	50%	5%	14%	14%	27%	17%	5%	---	38%	38%
	WallaNF2	---	---	---	---	---	5%	14%	14%	27%	---	5%	---	17%	17%
Coppei Creek	Coppei	100%	100%	100%	50%	50%	10%	25%	25%	50%	50%	100%	---	33%	33%
	NF Coppei	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SF Coppei1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SF Coppei2	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Touchet River (Coppei-Forks; plus Whiskey)	Touchet10	50%	50%	50%	62%	62%	10%	25%	25%	50%	33%	62%	62%	34%	34%
	Touchet10A(obstr)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Touchet11	---	---	---	62%	62%	---	---	---	---	33%	62%	62%	31%	31%
	Touchet7	50%	50%	50%	67%	67%	9%	22%	22%	43%	33%	100%	100%	34%	34%
	Touchet8	50%	50%	50%	---	---	9%	22%	22%	43%	33%	100%	100%	17%	17%
	Touchet9	50%	50%	50%	62%	62%	10%	25%	25%	50%	33%	62%	62%	34%	34%
	Whiskey1	100%	100%	100%	---	---	15%	38%	38%	75%	33%	100%	100%	11%	11%
	Whiskey1A (culvert)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Whiskey2	100%	100%	100%	---	---	10%	25%	25%	50%	33%	100%	100%	---	---
South Fork Touchet Mainstem	SFTouchet1	50%	50%	50%	100%	100%	10%	25%	25%	50%	33%	100%	100%	17%	17%
	SFTouchet2	50%	50%	50%	100%	100%	---	---	---	---	---	---	---	---	---
	SFTouchet3	50%	50%	50%	100%	100%	---	---	---	---	---	---	---	17%	17%
South Fork Touchet Tributaries	BeaverSlide	100%	100%	100%	---	---	---	---	---	---	67%	---	---	---	---
	BurntFk	50%	50%	50%	67%	67%	10%	25%	25%	50%	50%	---	---	17%	17%
	Dry Fork of SFTouchet	50%	50%	50%	---	---	---	---	---	---	50%	---	---	---	---
	GreenFk	50%	50%	50%	80%	80%	9%	22%	22%	43%	50%	---	---	33%	33%
	GriffinFk1	50%	50%	50%	93%	93%	5%	13%	13%	25%	---	---	---	---	---
	GriffinFk2	50%	50%	50%	93%	93%	5%	13%	13%	25%	---	---	---	---	---
	GriffinFk3	50%	50%	50%	93%	93%	---	---	---	---	---	---	---	---	---
	NFGriffinFk	100%	100%	100%	---	---	---	---	---	---	50%	---	---	17%	17%
North Fork Touchet Mainstem	NFTouchet1	50%	50%	50%	33%	33%	9%	22%	22%	43%	33%	55%	55%	22%	22%
	NFTouchet2	50%	50%	50%	33%	33%	9%	22%	22%	43%	33%	55%	55%	22%	22%
	NFTouchet3	50%	50%	50%	25%	25%	9%	22%	22%	43%	---	29%	29%	---	---
	NFTouchet4	50%	50%	50%	25%	25%	9%	22%	22%	43%	---	29%	29%	---	---
	NFTouchet5	50%	50%	50%	25%	25%	10%	25%	25%	50%	---	29%	29%	---	---
	NFTouchet6	50%	50%	50%	25%	25%	10%	25%	25%	50%	---	---	---	---	---
	NFTouchet7	50%	50%	50%	---	---	---	---	---	---	---	---	---	---	---
North Fork Touchet Tributaries (excluding Wolf)	Jim	---	---	---	72%	72%	5%	13%	13%	25%	---	---	---	---	---
	Lewis	---	---	---	71%	71%	---	---	---	---	---	---	---	---	---
	Rodgers	---	---	---	72%	72%	10%	25%	25%	50%	---	---	---	---	---
	Spangler	---	---	---	46%	46%	5%	13%	13%	25%	---	---	---	---	---
	Weidman	---	---	---	72%	72%	---	---	---	---	---	---	---	---	---
Wolf Fork (Mouth-Coates; plus Robinson & Coates)	Coates	50%	50%	50%	29%	29%	10%	25%	25%	50%	50%	---	---	14%	14%
	Robinson	50%	50%	50%	69%	69%	10%	25%	25%	50%	40%	100%	100%	40%	40%
	Wolf1	50%	50%	50%	58%	58%	9%	22%	22%	43%	40%	100%	100%	33%	33%
	Wolf2	50%	50%	50%	25%	25%	10%	25%	25%	50%	25%	100%	100%	25%	25%
Wolf Fork (Coates to access limit; plus Whitney)	Whitney	---	---	---	57%	57%	---	---	---	---	50%	---	---	5%	5%
	Wolf3	---	---	---	75%	75%	10%	25%	25%	50%	25%	---	---	17%	17%
	Wolf4	---	---	---	67%	67%	---	---	---	---	---	---	---	---	---

a. See Table X for detailed reach description.

b. LWD addition assumed to increase carcass retention, benthic production and area of backwater pools.

Table 3. Passive habitat restoration objectives for the Walla Walla Subbasin. Cells represent percent restoration of normative (Historical) conditions for specific reach-by-attribute combinations.

GEOGRAPHIC AREA	REACH[a]	Fines	Embed	Turbidity	Riparian Function	Temp Maximum	Pools	Pool Tailouts	Backwater Pools	Benthic Production	Predation Risk	Carcasses	LWD	High Flow	Low Flow	Flashy Flow
Couse Creek Drainage	Couse1	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Couse2	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Couse3	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Couse4	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Couse5	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Couse6	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Lower SF Walla Walla Tribs (Flume Canyon, Elbow)	Flume Canyon	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Elbow Cr3	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Elbow Cr2	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Elbow Cr1	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Elbow Cr Trib	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
NF Walla Walla, L. Meadows to access limit (plus Big Meadows)	Big Meadow Canyon	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaNF3	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaNF4	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaNF5	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Pattit Drainage	Cougar	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Patit	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WPatit1	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WPatit2	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
SF Walla Walla, Elbow to access limit	WallaSF4	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF5	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF6	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF7	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF8	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF9	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	WallaSF10	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Skiphorton & Reser Creek Drainages	Reser Cr [Walla SF]	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Skiphorton Cr1	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Upper SF Walla Walla tribs (excluding Skiphorton & Reser)	WallaSF Trib	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Table Cr	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Swede Canyon	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Kees Canyon	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Husky Sp Cr	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Deadman Gulch	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Burnt Cabin Gulch	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Bear Trap Sp	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Bear Cr	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Walla Walla, Dry to Mill	Walla6	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Walla7	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Yellowhawk mainstem (mouth to source)	Yellowhawk1	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk2	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk3	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk4	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk5	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk6	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk7	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Yellowhawk8	15%	15%	15%	15%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

a. See Table X for detailed reach description.

b. LWD addition assumed to increase carcass retention, benthic production and area of backwater pools.

Tables 4 –7 summarize the results of EDT simulations for spring chinook and summer steelhead assuming achievement of the strategic habitat objectives summarized in Tables 2 and 3. The Tables are organized by population and passage scenario. Specifically, Tables 4 and 5 address spring chinook simulated with current obstructions and in the absence of all obstructions, respectively. Similarly, Tables 6 and 7 address steelhead with current obstruction and in the absence of all obstructions. The tables are further broken down into populations: Mill Creek, SF Walla Walla, Mainstem/NF Walla Walla and Touchet for spring chinook; and Mainstem vs. Tributary for steelhead.

Three additional points should be considered before the interpreting model output. First, steelhead were divided into "Tributary" and "Mainstem" populations because life history patterns differ for juvenile steelhead as a function of stream size[1], and because limiting factors usually differ greatly between creeks and larger river segments. Second, out-of-Subbasin harvest rates of 0 and 7% are assumed for steelhead and spring chinook, respectively. Finally, a genetic fitness rate (relative to a hypothetical endemic stock) of 90%was assumed for steelhead and spring chinook under Current conditions.

Spring chinook benefits with current obstructions in place. It is difficult to speak of the impact of habitat changes on an extirpated stock like Walla Walla spring chinook. In order to avoid awkward circumlocutions, we speak in this and subsequent sections of "the Touchet River spring chinook population", or the "Mill Creek spring chinook population". The reader should understand such phrases as referring to the potential of Touchet River or Mill Creek habitat to support a (currently non-existent) spring chinook population. One additional editorial liberty in the service of readability is he substitution of the term "diversity index" for the more cumbersome "life history diversity index".

Because most it is essentially inaccessible to spring chinook, none of the habitat objectives restore production in Mill Creek. The Passive Restoration alternative also fails to improve spring chinook performance in any of the populations, with or without passage restoration – as expected for an action with the main intent of simply preserving existing habitat quality in key production areas. The Active alternative, on the other hand, results in some fairly impressive benefits, as does the combined Active/Passive alternative. [Note: there is so little difference between the Active and combined Active/Passive alternatives that both will henceforth be referred to simply as the "Active alternative".]

While the abundance of the South Fork Walla Walla population increases by only 53% (from 184 to 283) under the Active alternative, mean abundance for the Touchet and Mainstem/North Fork populations increases by 660 and 440%, respectively (from 31 to 204 and from 48 to 211). Equally significant is the 93 and 13% increase in productivity for the Mainstem /North Fork and Touchet populations – especially in light of the fact the productivity of the former population increases nearly to 3.0, a value frequently associated with "healthy", self-sustaining populations, while the productivity of the latter population increases to 1.95, a value which could be considered marginally self-sustaining. Also impressive are the seventeen-fold and eight-fold increases in diversity indices for the Mainstem/North Fork and Touchet populations. The impacts on the productivity and diversity index of the South Fork population – 6 and 50% increases, respectively – are less spectacular, but do serve to bolster the capacity of the South Fork to support a fairly robust and productive natural population.

Integrated over all four spring chinook production areas, the successful implementation of the Active habitat restoration strategy is estimated to result in a biological system that could support a spring chinook population with a mean abundance of 698 adults, a productivity of 4.95 returns/spawner and a diversity index of 25%. The productivity figure alone might be justification for a reintroduction program, as many other healthy populations have productivity values in this range. The low diversity index is, however, somewhat cautionary, as it implies a risky overdependence on a relatively small portion of the watershed.

Spring chinook benefits with full passage. It is appropriate to discuss the restoration of full passage itself, apart from other habitat work, as the first of our series of restoration actions. As might be expected given

[1] Juvenile steelhead are much more likely to emigrate from smaller streams before smolting than larger streams. Accordingly, 90% of the juveniles spawned in tributaries were assumed to display a "transient" life history pattern, whereas only 50% of fish spawned in mainstem reaches were assumed to be transients.

the concentration of obstructions in lower Mill Creek, full passage restoration does restore some spring chinook production potential to Mill Creek. Unfortunately, it does not restore much. Mean abundance for a spring chinook population without passage increases from 0 to just 24 adults with full passage. Such a population would, however, have a fairly high productivity (3.5 returns/spawner) although it would be highly dependent upon a relatively small portion of the Mill Creek drainage (diversity index = 11%). Similar modest benefits could be expected for the Mainstem/North Fork, Touchet and South Fork populations, in which mean abundance would increase from 16-35%, and productivity would increase from less than 1% to 11%. As upper Mill Creek is the major beneficiary of a passage restoration program, these figures imply that upper Mill Creek in its current condition is not especially productive habitat for spring chinook. They also imply that the obstructions in the upper mainstem, that currently reduce the accessibility of the North and especially the South Fork, are not major limiting factors by themselves.

The benefits of Active Restoration under a full passage scenario are comparable to benefits without passage. In descending order, the most improved populations would be the Mainstem/North Fork, Touchet, South Fork and Mill Creek populations. Successful implementation of Active the habitat restoration program would increase mean abundance by a factor of 5.5 in the Mainstem/North Fork, by a factor of 4.5 in the Touchet and by 56% and 32% in the South Fork and Mill Creek, respectively. Productivity would increase by 81% in the Mainstem/North Fork, 16% in the Touchet and by just 3 and 4% in the South Fork and Mill Creek. The diversity index increases dramatically under the Active restoration scenario: 10-fold in the Mainstem/North Fork, by a factor of 8.7 in the Touchet, and by 50% and 9% in the South Fork and Mill Creek.

When assessed simply in terms of the absolute impact on production potential, it would appear likely that full passage plus Active restoration might create habitat in three of the four drainages capable of sustaining a naturally-spawning spring chinook population. Certainly this would seem true of the South Fork, with an estimated mean abundance of 334, a productivity of 6.92 and a diversity index of 90%. The Mainstem/North Fork area, with a mean abundance of 231, a productivity of 3.1 and a diversity index of 20% is also a good bet, although the low diversity index is somewhat troubling. The Touchet drainage, with a productivity of just 2.02, would not by itself be a promising reintroduction candidate, although it could prove useful as a satellite population to a core South Fork/North Fork/Mainstem population.

Prospects for reintroducing a naturalized spring chinook population to the Walla Walla under a full passage/Active restoration scenario also look promising when the habitat evaluated over all four areas simultaneously. An integrated, Subbasin-wide analysis suggests habitat with the capacity to support a population with a mean abundance of 1,021, a productivity of 5.36 and a diversity index of 30%. [Note: EDT procedures for integrating multiple populations entail calculating weighted means across populations. The result is that the sum of abundances for component sub-populations frequently differs somewhat from the abundance estimate for the composite population.] The productivity and diversity index figures especially suggest an opportunity to reestablish a naturalized spring chinook population.

<u>Steelhead benefits with current obstructions in place.</u> Although the Passive restoration scenario did not improve steelhead performance in either the Tributary or Mainstem population[2], combined Active/Passive restoration (hereafter simply “Active” restoration), produced substantial benefits. These benefits were not, however, so great as the benefits to spring chinook, primarily because the footprint of the actions more closely matched spring chinook spawning and rearing areas than steelhead spawning and rearing areas. Moreover, steelhead use and in many ways prefer smaller streams as habitat than spring chinook, and many of the targeted restoration reaches that are used by steelhead are in larger, mainstem areas, which are less valuable to steelhead. Nevertheless, under the Active restoration scenario, steelhead mean abundance increased 53% (from 1,036 to 1,587) for the Tributary population, and 467% (from 41 to 191) for the Mainstem population. Productivity under the Active scenario remained virtually unchanged for Tributary fish (from 3.32 to 3.35), but increased by 62% (from 1.3 to 2.11) for Mainstem fish. The relative

[2] The Mainstem and Tributary steelhead populations were defined on the basis of mean channel width. The Mainstem population consists of a number of reaches in the Walla Walla River (from the Touchet confluence to the Little Walla Walla), in the Touchet River (mouth to Acclimation Pond outlet) and in Mill Creek (mouth to Paradise Creek). All other reaches were considered small enough to support a “tributary-spawning population”.

improvements in diversity index for Tributary and Mainstem steelhead were substantial, increasing by multiples of 2.7 and 6, respectively, but the absolute values attained were still seriously low (19 and 6%, respectively). These results suggest that steelhead abundance would increase noticeably under Active restoration, especially in mainstem areas, that resilience would increase marginally, but that the great bulk of production would continue to occur in a few high quality tributaries and would therefore be vulnerable to localized events.

Steelhead benefits with full passage. With full restoration of passage, the benefits of Active restoration are comparable across steelhead populations. Abundance increases 52% (from 1,083 to 1,655) for the Tributary population, and 44% (from 201 to 290) for the Mainstem population. Productivity increases very slightly for Tributary fish (from 3.25 to 3.32) but decreases 19% for Mainstem fish (from 2.94 to 2.41). The diversity index shows the most improvement under Active restoration, more than doubling for both populations (from 9 to 21% for Tributary steelhead and from 4 to 9% for Mainstem steelhead).

The differences between steelhead performance under Active restoration with and without full passage are more quantitative than qualitative. Abundance would be somewhat greater, as would mainstem productivity. Life history diversity, however, would continue to be seriously depressed, and Walla Walla steelhead as a whole would continue to be vulnerable to chance localized disasters.

Too much weight should not be given to the preceding caveat on steelhead benefits. The substantial increases in abundance should buffer the impacts of low life history diversity to some degree, as will the increase in mainstem population productivity. Moreover, the initial estimates of life history diversity for either population are so very low that any measure of improvement is critical.

Table 4 Performance of Walla Walla River spring chinook by population <u>assuming current obstructions to passage</u>. Performance is estimated under current, historical, PFC, passive restoration, active restoration, and combined passive/active restoration scenarios. EDT simulation assuming 90% fitness and 7% mainstem harvest, March, 2004.

Mill Creek Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	0	0.00	0	0%	0	0	0
Historical	2,667	14.80	2,860	100%	67,588	252	75,153
PFC	1,070	6.15	1,278	100%	46,983	227	58,227
Passive Restoration	0	0.00	0	0%	0	0	0
Active Restoration	0	0.00	0	0%	0	0	0
Passive + Active Restoration	0	0.00	0	0%	0	0	0
South Fork Walla Walla Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	184	6.28	218	56%	9,040	225	11,568
Historical	1,895	24.55	1,975	100%	35,442	361	37,378
PFC	877	8.16	1,000	94%	27,593	247	31,619
Passive Restoration	184	6.28	218	56%	9,040	225	11,568
Active Restoration	280	6.29	333	83%	12,365	231	15,286
Passive + Active Restoration	283	6.32	336	84%	12,447	232	15,368
Walla Walla mainstem and North Fork Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	31	1.53	88	1%	2,638	98	22,763
Historical	4,920	13.37	5,318	100%	202,029	269	238,482
PFC	2,207	5.70	2,676	89%	124,094	236	162,999
Passive Restoration	31	1.53	88	1%	2,638	98	22,763
Active Restoration	199	2.95	302	16%	17,204	17,204	41,166
Passive + Active Restoration	204	2.95	308	17%	12,447	148	41,514
Touchet Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	48	1.73	115	3%	2,565	66	12,704
Historical	8,447	14.01	9,096	100%	259,357	236	298,209
PFC	3,900	6.19	4,651	97%	176,248	208	176,248
Passive Restoration	48	1.73	115	3%	2,565	66	12,704
Active Restoration	211	1.95	434	22%	13,389	84	54,108
Passive + Active Restoration	211	1.95	434	22%	13,389	84	54,108

Table 5 Performance of Walla Walla River spring chinook by population assuming no obstructions to passage anywhere in the subbasin. Performance is estimated under current, historical, PFC, passive restoration, active restoration, and combined passive/active restoration scenarios. EDT simulation assuming 90% fitness and 7% mainstem harvest, March, 2004.

Mill Creek Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	25	3.50	35	11%	1,824	145	3,704
Historical	2,667	14.80	2,860	100%	67,588	252	75,153
PFC	1,070	6.15	1,278	100%	46,983	227	58,227
Passive Restoration	25	3.50	35	11%	1,824	145	3,704
Active Restoration	33	3.64	45	12%	3,146	147	9,100
Passive + Active Restoration	33	3.64	46	12%	3,175	146	9,238
South Fork Walla Walla Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	214	6.73	252	56%	9,274	219	11,563
Historical	1,895	24.55	1,975	100%	35,442	361	37,378
PFC	877	8.16	1,000	94%	27,593	247	31,619
Passive Restoration	214	6.73	252	56%	9,274	219	11,563
Active Restoration	331	6.89	388	90%	12,679	225	15,278
Passive + Active Restoration	334	6.92	390	90%	12,763	226	15,361
Walla Walla mainstem and North Fork Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	42	1.70	101	2%	3,383	96	22,804
Historical	4,920	13.37	5,318	100%	202,029	269	238,482
PFC	2,207	5.70	2,676	89%	124,094	236	162,999
Passive Restoration	42	1.70	101	2%	3,383	96	22,804
Active Restoration	226	3.09	335	18%	18,334	146	41,141
Passive + Active Restoration	231	3.09	342	20%	18,590	146	41,491
Touchet Population							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	54	1.74	127	3%	2,828	68	12,706
Historical	8,447	14.01	9,096	100%	259,357	236	298,209
PFC	3,900	6.19	4,651	97%	176,248	208	176,248
Passive Restoration	54	1.74	127	3%	2,828	68	12,706
Active Restoration	242	2.02	478	26%	14,568	82	54,707
Passive + Active Restoration	242	2.02	478	26%	14,568	82	54,707

Table 6. Performance of Walla Walla River summer steelhead: Current, Historical, PFC, Passive Restoration, Active Restoration, and Passive + Active Restoration. EDT simulation of tributary- and mainstem-spawning populations, assuming current obstructions, 90% fitness, no harvest, March 2004.

Tributary-spawning Steelhead							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	1,036	3.32	1,482	7%	63,721	177	97,673
Historical	12,417	19.10	13,101	83%	186,891	226	200,228
PFC	3,183	4.60	4,063	64%	159,223	190	216,203
Passive Restoration	1,036	3.32	1,482	7%	63,721	177	97,673
Active Restoration	1,572	3.34	2,244	19%	87,799	162	134,008
Passive + Active Restoration	1,587	3.35	2,262	19%	88,550	162	134,994
Mainstem-Spawning Steelhead							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	41	1.30	199	1%	2,580	77	21,046
Historical	4,034	14.00	4,345	83%	68,437	171	75,981
PFC	976	3.80	1,325	70%	53,655	164	80,764
Passive Restoration	41	1.30	199	1%	2,580	77	21,046
Active Restoration	190	2.11	361	6%	12,940	117	31,086
Passive + Active Restoration	191	2.11	364	6%	13,048	117	31,249

Table 7. Performance of Walla Walla River summer steelhead: Current, Historical, PFC, Passive Restoration, Active Restoration, and Passive + Active Restoration. EDT simulation of tributary- and mainstem-spawning populations, assuming no obstructions anywhere in the Subbasin, 90% fitness, no harvest, March, 2004.

Tributary-spawning Steelhead							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	1,083	3.25	1,564	9%	64,414	174	97,969
Historical	12,417	19.10	13,101	83%	186,891	226	200,228
PFC	3,183	4.60	4,063	64%	159,223	190	216,203
Passive Restoration	1,083	3.25	1,564	9%	64,414	174	97,969
Active Restoration	1,641	3.32	2,349	20%	89,075	161	134,329
Passive + Active Restoration	1,655	3.32	2,368	21%	89,793	161	135,314
Mainstem-Spawning Steelhead							
Scenario	Mean Adult Abundance	Adult Productivity	Adult Carrying Capacity	Life History Diversity	Mean Smolt Production	Smolt Productivity (smolts/spawner)	Smolt Carrying Capacity
Current	201	2.94	305	4%	11,901	135	21,151
Historical	4,034	14.00	4,345	83%	68,437	171	75,981
PFC	976	3.80	1,325	70%	53,655	164	80,764
Passive Restoration	201	2.94	305	4%	11,901	135	21,151
Active Restoration	288	2.41	493	9%	16,529	122	31,227
Passive + Active Restoration	290	2.41	495	9%	16,645	122	31,392