Appendices

To the
Proposed ESA Recovery Plan
For Northeast Oregon Spring/Summer
Chinook Salmon
And Steelhead Populations

In the
Snake River Chinook Salmon
Evolutionarily Significant Unit

And
Snake River Steelhead
Distinct Population Segment

November 2017

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Appendix A

Results of Expert Panel Deliberations

Limiting Factors and Threats to the Recovery of Oregon Snake River Populations of Spring/Summer Chinook and Summer Steelhead

Oregon Department of Fish and Wildlife

January 26, 2007

Introduction

This document describes the results of a two-day meeting convened by the Oregon Department of Fish and Wildlife (ODFW) to assist NOAA Fisheries in developing strategic guidance on limiting factors and threats to the recovery of Oregon populations of spring Chinook (Figure 1) and summer steelhead (Figure 2) in the Snake River. This step of the process, henceforth referred to as the "Expert Panel", was based the deliberations of 14 individuals with extensive scientific, technical, and local expertise on issues confronting spring Chinook and summer steelhead populations in the Snake River. At the meeting, limiting factors and threats were identified for each population by considering impacts across the entire life cycle (gravel to gravel) rather than considering only impacts that might occur in tributaries that define the populations. This distinction is especially important because it will advise potential management actions that might be needed across the entire life cycle in order to improve viability of the populations. Threats were described in terms of the limiting factor(s) primarily affected, life stage(s) primarily affected, and specific nature of the threat. The panel also prioritized limiting factors and threats for each population to provide strategic guidance to recovery actions.

Definition of Terms and Components of Expert Panel Deliberations

Limiting Factors

Limiting factors are the physical, biological, or chemical conditions and associated ecological processes and interactions (e.g., population size, habitat connectivity, water quality, water quantity, etc.) experienced by the fish that may influence viable salmonid population (VSP) parameters (i.e. abundance, productivity, spatial structure, and diversity).

Limiting Factor Categories

In a 2005 Report to Congress on the Pacific Coastal Salmon Recovery Fund, NOAA presents draft guidelines for limiting factors and threats assessments. After considering the suggested list, Oregon has chosen categories that are similar-to but different-from the set NOAA has recommended. Oregon believes that it's list and the effort to identify limiting factors and threats at specific life stages and spatial scales will more effectively inform recovery actions that are strategic to the remediation of the causes of the limiting factors.

Figure 1. Oregon populations of spring Chinook in the Snake River.

Figure 2. Oregon populations of summer steelhead in the Snake River.

The categories of limiting factors and definitions used in Oregon's expert panel deliberation are as follows:

1. ***Water quantity/hydrograph*** – Timing and magnitude of flow conditions.
2. ***Water quality*** – Water characteristics including temperature, dissolved oxygen, suspended sediment, pH, toxics, etc.
3. ***Predation*** – Consumption of naturally produced fish by one or more species (not to include fishery mortality).
4. ***Competition*** – Adverse interaction between naturally produced fish and hatchery fish or other species, both of which need some limited environmental factor (i.e. food or space).
5. ***Nutrients*** – Impaired nutrient levels that ultimately results in reduce food productivity (an example might be lack of salmon carcasses).
6. ***Disease*** – Pathological condition in naturally produced fish resulting from infection.
7. ***Physical habitat quality/quantity*** – Quality or quantity of physical habitat. Examples include instream roughness, channel morphology, riparian conditions, fine sediment, etc.
8. ***Habitat access*** – Impaired access to spawning and/or rearing habitat. Examples include impassable culverts, delayed migration over dams, dewatered stream channels, etc. If, for example, a stream has been diked, thereby eliminating access to off-channel habitat, habitat access should be considered a problem. If off-channel habitat to which access has been eliminated is in impaired condition, it also considered an element of the physical habitat quality/quantity limiting factor.
9. ***Population traits*** – Impaired population condition(s) including: genetic, life history, morphological, productivity, fitness, behavioral characteristics, and population size. Although population traits are caused by other limiting factors, they may *also* and independently be a limiting factor.

Threats

Threats are the human actions (e.g., fishing, operation of hatcheries, operation of the hydro system, road building, riparian habitat degradation, channel straightening, etc.) or natural (e.g., flood, drought, volcano, tsunami, etc.) events that *cause or contribute-to* limiting factors. Threats may be associated with one or more specific life cycle stages and may occur in the past, present, or future.

<u>Threat Categories</u>

Five categories of threats were used to describe causes of limiting factors:

1. ***Harvest practices*** – Direct and indirect mortality associated with fisheries on naturally produced fish.
2. ***Hatchery practices*** – Negative impact of hatchery practices on naturally produced fish. Hatchery practices include: number of fish released, removal of adults for broodstock, breeding practices, rearing practices, release practices, water quality management, blockage of access to habitat, etc.
3. ***Hydropower*** – Negative impact of current hydropower-system management on naturally produced fish.
4. ***Land management practices*** – Negative impact of current land management activities on naturally produced fish. Land management practices include timber harvest, agriculture, urbanization, transportation, mining, etc. This category includes both current land management practices that are causing limiting factors and impairing fish populations as well as the legacy effect of past practices.
5. ***Introduced species*** – Negative impact of non-native plants or animals on naturally produced fish. The impact of hatchery fish is considered under the hatchery threat category.

Life Stages

Limiting factors and threats were identified for each population by considering impacts across the entire life cycle (gravel to gravel) rather than considering only impacts that might occur in tributaries that define the populations. In order to be as spatially explicit as possible given the time constraints of the process, the Expert Panel considered life stage specific limiting factors and threats for six specific geographic areas that together encompass the entire lifecycle of Oregon populations of Snake River spring Chinook and summer steelhead. These geographic areas and the specific life stages considered are:

1. ***Tributaries*** – All streams and rivers within a specific population area (Life stages: eggs, alevin, fry, summer parr, winter parr, smolts, returning adults, spawners).
2. ***Mainstem Grande Ronde River*** – below Indian Creek (Life stages: summer parr, winter parr, smolts, returning adults). NOTE: This geographic areas was only considered as a separate entity for spring Chinook populations because it is included as part of the Upper Grande Ronde River steelhead population area and thus does not need to be considered separately for steelhead.
3. ***Mainstem Columbia River*** – Bonneville Dam upstream to confluence with Snake River (Life stages: smolts and returning adults).
4. ***Mainstem Snake River*** – confluence with Columbia River upstream to confluence with Grande Ronde River (Life stages: smolts and returning adults).
5. ***Estuary*** – All tidally influenced areas of the Columbia River below Bonneville Dam, including the Columbia River Plume (Life stages: smolts, returning adults).
6. ***Ocean*** – All saltwater areas that Snake River spring Chinook and summer steelhead spend part of their life cycle in that are outside of the estuary (Life stages: sub-adults, adults).

Panel Composition

The Expert Panel was composed of 14 individuals with a broad range of science and technical experience. The names and affiliations of these panelists, along with those of the two facilitators of the process are shown in Table 1. Some panel members had expertise across all potential limiting factors and threats; some had expertise in ecology and evolutionary biology; and some members were familiar with local conditions and data specific to individual spring Chinook or summer steelhead populations in the Snake River. An effort was made to enlist panel members with diverse employment perspective (e.g., Oregon, federal, Tribal, private sector, academic). Panelists were selected by Oregon in consultation with NOAA Fisheries Service. Prospective panelists were identified entirely based on scientific and technical expertise rather than representation of employer's interests. Participation by panel members was by assignment within ODFW and was voluntary for others.

Table 1. Names and affiliations of expert panelists and facilitators.

Name	Affilliation	Name	Affilliation	Name	Affilliation
Tim Beechie	NOOA	Jesse Schwartz	CTUIR	Bruce McIntosh	ODFW (facilitator)
Phaedra Budy	USGS-BRD	Howard Shaller	USFWS	Jeff Rodgers	ODFW (facilitator)
Jay Hesse	Nez Perce	Brad Smith	ODFW		
Tim Hoffnagle	ODFW	Phil Trask	Consultant		
Marylou Keefe	Consultant	Robin Waples	NOOA		
Sharon Kiefer	IDFG	John G. Williams	NOOA		
Larry Lestelle	Consultant	Jeff Zakel	ODFW		

Panel Preparation

Each panel member was provided with a packet containing background information on assessments of population viability, limiting factor and threat analyses, and basin plans. Digital versions of the information provided in this packet may be found at:
https://nrimp.dfw.state.or.us/recplan/default.aspx?p=202&XMLname=578.xml

Overview of Panel Deliberation Process

The panel deliberation consisted of seven elements, or stages. Stages 1-4 were designed primarily to get panel members focused on considering limiting factors and threats in the context of recovery planning effort and to provide a starting point for detailed discussions and final guidance regarding life stage specific key and secondary limiting factors and threats. Stages 5-7 were designed to provide panel members with a forum to identify, discuss and reach consensus on the details of the life stage specific key and secondary limiting factors and threats they were tasked with developing. Below are more detailed descriptions of each stage.

First Stage

Panelists rank limiting factors.

Prior to the meeting, each panelist received a spreadsheet containing worksheets for each of Oregon's spring Chinook and summer steelhead population in the Snake River. An example of the essential content of each worksheet is shown in Table 2.

For each population, panelists assigned a limiting-factor-category score to each limiting factor category to indicate the relative effect they believed the limiting factor has on VSP parameters for the specific population they were scoring. Allowable limiting-factor-category scores were: 0 = no effect; 1 = minor effect; 2 = moderate effect; and 3 = major effect. Next, each panelist assigned a threat-factor-category score to each threat category and limiting factor to indicate the relative impact they believed each threat category has on the individual limiting factors. Allowable threat-factor-category scores were: 0 = no impact; 1 = minor impact; 2 = moderate impact; and 3 = major impact. An example of a completed population spreadsheet is shown in Table 3.

Table 2. Example of worksheet used by expert panelists in stage one to assign relative scores to the impact of limiting factors on population viability, and impact of potential threats on limiting factors.

	Score limiting factors in relation to effect on population viability (based on VSP parameters): 0=no effect 1=minor effect 2=moderate effect 3=major effect								
	Limiting Factors								
Threats	**Water Quantity - Hydrograph**	**Water Quality**	**Predation**	**Competition**	**Nutrients**	**Disease**	**Physical Habitat Quality/ Quantity**	**Habitat Access**	**Population Traits**
Harvest									
Hatchery									
Hydro									
Land Management									
Introduced Species									
	Score threats based on their impact on limiting factors: 0=no impact 1=minor impact 2=moderate impact 3=major impact								

Table 3. Example of completed stage one worksheet depicting an individual panelists view of the relative effect of limiting factors on VSP parameters and impact of threats on limiting factors for a hypothetical population.

	Score limiting factors in relation to effect on population viability (based on VSP parameters): 0=no effect 1=minor effect 2=moderate effect 3=major effect								
	2	2	2	1	2	1	3	2	1
	Limiting Factors								
Threats	Water Quantity - Hydrograph	Water Quality	Predation	Competition	Nutrients	Disease	Physical Habitat Quality/ Quantity	Habitat Access	Population Traits
Harvest	0	0	0	0	1	0	0	0	1
Hatchery	0	0	1	2	1	1	0	0	1
Hydro	2	2	1	0	1	0	3	3	0
Land Management	2	2	1	0	1	0	2	3	0
Introduced Species	0	0	2	0	0	0	0	0	0
	Score threats based on their impact on limiting factors: 0=no impact 1=minor impact 2=moderate impact 3=major impact								

Second Stage

Calculate composite threat/limiting factor category score for each panelist.

For each panelist, a *composite score* for the relative importance of each threat category within a limiting-factor category was calculated (the product of the limiting-factor-category raw score and the threat-category raw scores). Table 4 shows the results of this stage for the hypothetical panelist worksheet shown in Table 3.

Table 4. Example of calculation of stage two composite scores calculated from hypothetical limiting factor and threat scores presented in Table 3.

	Limiting Factors								
Threats	Water Quantity - Hydrograph	Water Quality	Predation	Competition	Nutrients	Disease	Physical Habitat Quality/ Quantity	Habitat Access	Population Traits
Harvest	0 (2x0)	0 (2x0)	0 (2x0)	0 (0x0)	2 (2x1)	0 (1x0)	0 (3x0)	0 (2x0)	1 (1x1)
Hatchery	0 (2x0)	0 (2x0)	2 (2x1)	2 (1x2)	2 (2x1)	1 (1x1)	0 (3x0)	0 (2x0)	1 (1x1)
Hydro	4 (2x2)	4 (2x2)	2 (2x1)	0 (0x0)	2 (2x1)	0 (1x0)	9 (3x3)	6 (2x3)	0 (1x0)
Land Management	4 (2x2)	4 (2x2)	2 (2x1)	0 (0x0)	2 (2x1)	0 (1x0)	6 (3x2)	6 (2x3)	0 (1x0)
Introduced Species	0 (2x0)	0 (2x0)	4 (2x2)	0 (0x0)	0 (2x0)	0 (1x0)	0 (3x0)	0 (2x0)	0 (1x0)

Third Stage

Calculate average composite threat/limiting factor category score for Expert Panel.

An average score of composite threat/limiting factor category scores for all panelists was calculated (sum of all composite threat scores divided by the number of panelists that completed scoring for the population).

Fourth Stage

Display initial prioritization of relative threat/limiting factor categories.

An initial prioritization of key and secondary threats and limiting factors was established by the panel facilitators. Break points between key, secondary, and other threats/limiting factors categories were as follows: ≥5-9 key; ≥4-5 secondary; <4 other. An example of this prioritization of the averaged threat/limiting factor category scores is shown in Table 5. It is important to realize that the outcome of this and the preceding stages were intended to serve as a focal point for panel discussions leading to the final limiting factor and threats identification and prioritization as outlined in stages 5-6. Because the information generated in stages 1-4 were designed to stimulate panel deliberations and do not represent the final consensus of the Expert Panel, the specific results generated by stages 1-4 are not included in this report.

Table 5. Example of stage four approach of applying break points to average threat/limiting factor category scores to identify key (black cells) and secondary (gray cells) concerns.

	Limiting Factors								
Threats	**Water Quantity - Hydrograph**	**Water Quality**	**Predation**	**Competition**	**Nutrients**	**Disease**	**Physical Habitat Quality/ Quantity**	**Habitat Access**	**Population Traits**
Harvest	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.5
Hatchery	0.0	0.0	0.0	0.6	0.0	0.7	0.0	0.0	1.5
Hydro	4.6	1.0	1.9	0.4	0.4	0.3	2.8	4.0	4.0
Land Management	9.0	9.0	1.2	0.4	0.7	0.5	8.5	7.7	4.0
Introduced Species	0.0	0.0	1.4	1.3	0.0	0.2	1.3	0.0	0.2

Fifth Stage

Panelists develop final threat/limiting factor categories prioritizations.

Panelists reviewed and discussed the initial prioritization of key and secondary threats. This discussion allowed panelists to recall specific data or experience that may have been overlooked during initial scoring of limiting factors and threats. At this stage in the deliberation, agreement was reached regarding the *final* prioritization of key and secondary threats for each limiting factor.

Sixth Stage

Panelist identify specific life stages and geographic locations of key and secondary threat/limiting factor categories.

For each key and secondary threat/limiting factor category, the panel was asked to identify specific life stages and geographic locations where the impact needs to be addressed.

Seventh Stage

Panel facilitators compile limiting factor and threat concerns provided by the Expert Panel into life stage and geographic area specific tables for review by panelists.

Panel facilitators compiled the information generated in stages 5-6 into tables for Oregon's Snake River spring Chinook and summer steelhead populations. The tables depict the specific life stage and geographic location of each key and secondary threat/limiting factor category along with a description of the specific threat and limiting factor. The resulting tables represent the final guidance of the Expert Panel regarding key and secondary threats and limiting factors to Oregon populations of Snake River spring Chinook and summer steelhead.

Caveat: Panel's Guidance *Is-What-It-Is*

The Expert Panel conclusions are the result of a two-day meeting of a group of individuals with considerable scientific and on-the-ground knowledge of issues confronting Oregon's Snake River spring

Chinook and summer steelhead populations. Because of the complex issues, time constraints, and potential misinterpretations of the Expert Panel's conclusions by the panel facilitators, there are no doubt errors and oversights in this report. Despite these limitations, Oregon believes the work of the Expert Panel represents a valuable and timely building block for NOAA Fisheries as it develops a final list of limiting factors and threats to the recovery of spring Chinook and summer steelhead in the Snake River.

Conclusions of the Expert Panel

The following pages provide a detailed description of the key and secondary threats and limiting factors identified by the Expert Panel for each Snake River spring Chinook and summer steelhead population in Oregon. When reading the life cycle charts it may be helpful to know that the numeric codes represent the following broad categories of impacts:

1 - Direct mortality.
2 - Passage.
3 - Genetics.
4 - Competition.
5 - Cumulative impacts.
6 - Predation.
7 - Fine sediment.
8 - Physical habitat condition in the tributaries.
9 - Water quality.
10 - Water quantity/hydrograph.
11 - Disease.

Big Sheep Creek Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery	3[a]							3[a]	11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management				10[a] 9[a] 8			10[a]	8					5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

10[a] Low stream flows due to irrigation withdrawals physically reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr and returning adults**/tributaries

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

3[a] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was

concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, winter parr, and spawners**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr**/tributaries.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Catherine Creek Spring Chinook

Threat Category	Tributaries								Grande Ronde River (between Indian Creek and Wallowa River)				Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Summer Parr	Winter Parr	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest														1		1		1
Hatchery	3[a]							3[a]					11		11		4	
Hydro/Flood Control													5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management	7			10[a] 9[a] 8 2[b]			8 9[a] 10[a]	8	10[a] 9[a]	8	8	10[a] 9[a]					5[c]	
Introduced Species																		

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

2[b] Impaired access to habitat due to permanent irrigation diversion structures.
Life-stages/Location: **summer parr and returning adults**/tributaries.

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, winter parr, and spawners**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr**/tributaries; **summer parr and returning adults**/mainstem Grande Ronde River.

10[a] Low stream flows due to irrigation withdrawals physically reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr**/tributaries; **summer parr and returning adults**/mainstem Grande Ronde River between Indian Creek and Wallowa River..

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

3[a] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **returning adults**/tributaries; **winter parr and smolts**/mainstem Grande Ronde River.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: r**eturning adults**/tributaries.

10[a] Low stream flows due to irrigation withdrawals physically reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: r**eturning adults**/tributaries.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Imnaha Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery	3[c]							3[c]	11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management													5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

3[c] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices, the effect of current hatchery broodstock collection practices on the population, and the effects of current hatchery release strategies on the spawning distribution of the population.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

Code	Description
5[c]	Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat. Life-stages/Location: **smolts**/estuary.
6[a]	Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam. Life-stages/Location: **returning adults**/estuary.
11	Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern. Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Lookingglass Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery	3[b]			3[b] 10[b]	3[b]			3[b]	11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management			8										5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

3[b] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices, and the effect of current hatchery broodstock collection practices on the population.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

10[b] Low stream flows due to hatchery withdrawals reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr**/tributaries.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Minam Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery									11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management													5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Upper Grande Ronde Spring Chinook

Threat Category	Tributaries								Grande Ronde River (between Indian Creek and Wallowa River)				Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Summer Parr	Winter Parr	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest														1		1		1
Hatchery	3[b]						2[c]	3[b]					11		11		4	
Hydro/Flood Control													5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management	7		7	10[a] 9[a] 2[b] 8	7 9[b]		8 9[a] 10[a]	8	10[a] 9[a]	8	8	10[a] 9[a]					5[c]	
Introduced Species																		

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

2[c] Impaired access due to hatchery weir. Specifically the Expert Panel was concerned that the passage returning adult is delayed at hatchery weir which in some years results in stranding them in warm water.
Life-stages/Location: **returning adults**/tributaries

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, winter parr, and spawners**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr and returning adults**/tributaries and mainstem Grande Ronde River between Indian Creek and Wallowa River.

9[b] Ice flows enhanced by poor riparian conditions and altered floodplain/channel function scour the streambed and destroy stream structure.
Life-stages/Location: **winter parr**/tributaries.

10[a] Low stream flows due to irrigation withdrawals reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr**/mainstem Grande Ronde River between Indian Creek and Wallowa River.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

2[b] Impaired access to habitat due to permanent irrigation diversion structures.
Life-stages/Location: **summer parr**/tributaries.

3[b] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices, and the effect of current hatchery broodstock collection practices on the population. There was acknowledgement by the Expert Panel that this is a "Catch 22" issue. On one hand, it was acknowledged that the aggressive hatchery program is an important contributor to keeping the population from reaching extremely low levels. On the other hand, the panel expressed serious concerns about the risks of domestication due to the hatchery program.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs, alevins, fry, and winter parr**/tributaries.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **winter parr and smolts**/mainstem Grande Ronde River between Indian Creek and Wallowa River.

10[a] Low stream flows due to irrigation withdrawals reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr and returning adults**/tributaries.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Wallowa/Lostine Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery	3[a]							3[a]	11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management	7			10[a] 9[a] 8 2[b]			10[a] 2[b]	8					5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, winter parr, and spawners**/tributaries.

10[a] Low stream flows due to irrigation withdrawals physically reduce the amount of available habitat and increase stream temperatures.
Life-stages/Location: **summer parr and returning adults**/tributaries.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

2[b] Impaired access to habitat due to permanent irrigation diversion structures.
Life-stages/Location: **summer parr and returning adults**/tributaries.

3[a] Genetic effects of hatchery fish on naturally produced fish. Specifically, the Expert Panel was concerned about the domestication and changes to population structure from past hatchery practices.
Life-stages/Location: **eggs, alevins, fry, summer parr, winter parr, and spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr**/tributary.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Wenaha Spring Chinook

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		1
Hatchery									11		11		4	
Hydro/Flood Control									5[a]	2[a]	5[a]	2[a]	5[b]	6[a]
Land Management													5[c]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries.
Life-stages/Location: **returning adults**/estuary, mainstem Columbia and Snake.

2[a] Impaired condition and delayed mortality of returning adults due to conditions experienced as they migrate upstream through the Columbia and Snake hydropower system.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced spring Chinook).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment spring Chinook salmon.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[a] Predation by marine mammals exacerbated by concentrating and delaying the migration of returning adult spring Chinook at Bonneville dam.
Life-stages/Location: **returning adults**/estuary.

11 Transmission of bacterial kidney disease from hatchery chinook to naturally produced smolts during transportation (barging) downstream. There was considerable uncertainty and lack of consensus within the Expert Panel on the magnitude of this concern.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

Imnaha Summer Steelhead

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		
Hatchery								3[d]					4	
Hydro/Flood Control									5[a]	9[c]	5[a]	9[c]	5[b]	
Land Management	7			8 10[c] 10[d] 9[a]									5[c] 6[b]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

9[c] Elevated water temperatures and reduced flows due to Columbia and Snake hydropower system that result in delayed upstream migration and elevated pre-spawning mortality.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

10[c] Low stream flows due to irrigation withdrawals reduce the amount of available habitat.
Life-stages/Location: **summer parr**/tributaries.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries (assumed to be capped at 10%).
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

3[d] Genetic effect of stray spawners from Little Sheep hatchery interbreeding with spawners of natural-origin.
Life-stages/Location: **spawners**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced summer steelhead).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered

nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment summer steelhead.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[b] Predation by Caspian tern and double-crested cormorant populations in the estuary due to the deposition of dredge materials that create high-quality habitat for the birds.
Life-stages/Location: **smolts**/estuary.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr**/tributaries.

10[d] Low stream flows due to irrigation withdrawals increase stream temperatures.
Life-stages/Location: **summer parr**/tributaries.

Joseph Summer Steelhead

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		
Hatchery													4	
Hydro/Flood Control									5[a]	9[c]	5[a]	9[c]	5[b]	
Land Management	7		8	9[a]									5[c] 6[b]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

9[c] Elevated water temperatures and reduced flows due to Columbia and Snake hydropower system that result in delayed upstream migration and elevated pre-spawning mortality.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries (assumed to be capped at 10%)
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced summer steelhead).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment summer steelhead.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[b] Predation by Caspian tern and double-crested cormorant populations in the estuary due to the deposition of dredge materials that create high-quality habitat for the birds.
Life-stages/Location: **smolts**/estuary.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **summer parr**/tributaries.

Lower Grande Ronde Summer Steelhead

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		
Hatchery													4	
Hydro/Flood Control									5[a]	9[c]	5[a]	9[c]	5[b]	
Land Management	7		8										5[c]	
			10[d]										6[b]	
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

9[c] Elevated water temperatures and reduced flows due to Columbia and Snake hydropower system that result in delayed upstream migration and elevated pre-spawning mortality.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries (assumed to be capped at 10%).
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced summer steelhead).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment summer steelhead.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[b] Predation by Caspian tern and double-crested cormorant populations in the estuary due to the deposition of dredge materials that create high-quality habitat for the birds.
Life-stages/Location: **smolts**/estuary.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

10[d] Low stream flows due to irrigation withdrawals in areas upstream of population area increase stream temperatures.
Life-stages/Location: **fry and summer parr**/tributaries.

Upper Grande Ronde Summer Steelhead

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		
Hatchery													4	
Hydro/Flood Control									5[a]	9[c]	5[a]	9[c]	5[b]	
Land Management	7	7	10[c]	8	10[c]								5[c]	
				9[a]		9[b]							6[b]	
			10[d]		10[d]									
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

9[c] Elevated water temperatures and reduced flows due to Columbia and Snake hydropower system that result in delayed upstream migration and elevated pre-spawning mortality.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

10[c] Low stream flows due to irrigation withdrawals reduce the amount of available habitat.
Life-stages/Location: **summer parr**/tributaries.

10[d] Low stream flows due to irrigation withdrawals in areas upstream of population area increase stream temperatures.
Life-stages/Location: **summer parr**/tributaries.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries (assumed to be capped at 10%).
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced summer steelhead).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment summer steelhead.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[b] Predation by Caspian tern and double-crested cormorant populations in the estuary due to the deposition of dredge materials that create high-quality habitat for the birds.
Life-stages/Location: **smolts**/estuary.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

9[a] High water temperatures due to poor riparian conditions.
Life-stages/Location: **fry and summer parr**/tributaries.

9[b] Ice flows enhanced by poor riparian conditions and altered floodplain/channel function scour the streambed and destroy stream structure.
Life-stages/Location: **winter parr**/tributaries.

10[c] Low stream flows due to irrigation withdrawals reduce the amount of available habitat.
Life-stages/Location: **alevins and fry**/tributaries.

10[d] Low stream flows due to irrigation withdrawals in areas upstream of population area increase stream temperatures.
Life-stages/Location: **alevins and fry**/tributaries.

Wallowa Summer Steelhead

Threat Category	Tributaries								Mainstem Columbia (above Bonneville)		Mainstem Snake		Estuary (below Bonneville & includes plume)	
	Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Smolts	Returning Adults	Smolts	Returning Adults	Smolts	Returning Adults
Harvest										1		1		
Hatchery													4	
Hydro/Flood Control									5[a]	9[c]	5[a]	9[c]	5[b]	
Land Management	7	7	8	8	8								5[c]	
			10[c]	10[c]									6[b]	
				2[d]	2[d]									
Introduced Species														

Black cells indicate key concerns; gray cells indicate secondary concerns

***Key Concerns*:**

Code Description

5[a] Cumulative impacts of the Columbia and Snake hydropower system that results in: turbine, spill and bypass mortality at dams; altered migration timing, increased stress, and increased disease due to transportation of downstream migrants; and increased predation due to enhanced habitat for piscine predators.
Life-stages/Location: **smolts**/mainstem Columbia and Snake.

9[c] Elevated water temperatures and reduced flows due to Columbia and Snake hydropower system that result in delayed upstream migration and elevated pre-spawning mortality.
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

***Secondary Concerns*:**

Code Description

1 Direct and indirect mortality associated with fisheries (assumed to be capped at 10%).
Life-stages/Location: **returning adults**/mainstem Columbia and Snake.

2[d] Impaired access to habitat due to temporary irrigation diversion structures.
Life-stages/Location: **summer and winter parr**/tributaries.

4 Competition with hatchery fish of all species. There was a high level of uncertainty within the Expert Panel about the mechanisms and magnitude of impact. General agreement that there is correlative data but lack of information on mechanism (i.e. how hatchery fish are impacting naturally produced summer steelhead).
Life-stages/Location: **smolts**/estuary and near-shore ocean.

5[b] Impaired estuarine habitat due to the cumulative impacts of the Columbia River hydropower and Willamette River hydropower/flood control systems. Specifically, the Expert Panel was concerned that the cumulative impact of altered hydrograph, higher water temperatures, altered nutrient cycling and reduced sediment routing has lead to a reduction in both the quantity and quality of habitat, as well as a shift in food webs to the detriment summer steelhead.
Life-stages/Location: **smolts**/estuary.

5[c] Impaired estuarine habitat due to the cumulative impacts of past and current landuse. Specifically, the Expert Panel was concerned that cumulative impact of dredging, filling, diking, and channelization has significantly reduced the quality and quantity of estuarine habitat.
Life-stages/Location: **smolts**/estuary.

6[b] Predation by Caspian tern and double-crested cormorant populations in the estuary due to the deposition of dredge materials that create high-quality habitat for the birds.
Life-stages/Location: **smolts**/estuary.

7 Fine sediment in spawning gravel from past and/or present land management practices.
Life-stages/Location: **eggs and alevins**/tributaries.

8 Impaired physical habitat from past and/or present landuse practices. Specific concerns include: removal of large wood from stream channels; inadequate large wood recruitment due to impaired riparian conditions; stream straightening and channelization; revetments; loss of access to off-channel habitat; and floodplain connectivity to stream channels.
Life-stages/Location: **fry, summer parr, and winter parr**/tributaries.

10[c] Low stream flows due to irrigation withdrawals reduce the amount of available habitat.
Life-stages/Location: **fry and summer parr**/tributaries.

Appendix B

Tributary Habitat Recovery Actions for Northeast Oregon Snake River Chinook and Steelhead

General Tributary Habitat Recovery Actions Across MPGs

Throughout the Oregon portion of the Snake River Basin, land use practices, both past and current, have contributed significantly to factors limiting steelhead and spring/summer Chinook production. These causal agents, or threats, and their associated limiting factors are discussed for each Snake River population in Chapter 6.

Below, recovery actions are suggested to address threats to the populations and their related limiting factors. These actions were identified using existing documents (subbasin plans, water quality management plans, and the Mid-Columbia steelhead recovery plan). The actions were further refined through a series of meetings and discussions with landowners, local biologists and natural resource specialists from BLM, CTUIR, GRMW, Nez Perce Tribe, NMFS, NRCS, ODF, ODFW, OWRD, SWCD, USFS, and OWRD who are most familiar with the population areas. During the meetings, the participants estimated the amount of effort and general locations for the different actions. The recovery actions described below are intended to increase productivity, abundance, and spatial structure (distribution) by reducing or removing the existing threats causing the limiting factors. In doing so, these actions will promote recovery of the Oregon Snake River spring/summer Chinook salmon and steelhead populations.

In northeast Oregon, five interrelated limiting factors were identified in all spring/summer Chinook and steelhead populations. These factors are excess fine sediment, water quality (primarily temperature), water quantity (primarily low summer flows), habitat quantity/diversity (primarily lack of pools and large wood), and degraded riparian condition. Sediment levels are elevated above historic conditions throughout the area, except in wilderness area watersheds. Excess sediment reduces habitat quality and quantity by filling interstitial spaces in spawning gravel and reducing pool depths. Temperature levels are generally elevated in streams across the Grande Ronde Basin. Low summer flows, often limited naturally, are exacerbated through land and water management practices. Most water withdrawals for agricultural use occur during the irrigation season, generally between May and September, and coincide with natural low flow periods in Northeast Oregon. Water is also removed from the streams for municipal purposes. Past and present land management practices have also altered natural flow regimes by reducing wet meadow and floodplain habitats, and otherwise disrupting interactions between aquatic/riparian zones and the uplands. The resulting reduction in available habitat due to less and warmer water is limiting for all life stages of salmonids. There has been a reduction in large wood and pool habitat across the basin, relative to historic levels. Many reaches suffer from degraded riparian habitat conditions and a loss of floodplain connectivity.

Actions taken to address the threats, and therefore the limiting factors, will be very similar across the Oregon Snake River spring/summer Chinook and steelhead populations because of the similarity in historic land management practices. Sediment producing roads, water diversions, agricultural

development, residential development, and both current and legacy livestock grazing and timber harvest activities figure prominently in the existence of the most common limiting factors.

The following discussion identifies common approaches that can be used to alleviate or minimize the primary limiting factors and associated threats found throughout the Oregon Snake River spring/summer Chinook salmon and steelhead populations. Much of the discussion is adapted from existing subbasin plans, watershed restoration plans, and local management plans (NPCC 2004a; NPCC 2004b; GRMW 1995; WC-NPT 1999). This list of proposed recovery actions is followed by a discussion on each of the Oregon Snake River salmon and steelhead populations in detail. The common approaches listed below will be recommended where appropriate. In each population reach discussion, recommended site-specific actions are listed where they are known. These actions are those identified in current planning and assessment documents, as well as local resource professionals and land managers.

Excess Fine Sediment

Excess fine sediment is a common theme across the streams of the Oregon Snake River drainages. The most common threats resulting in excess sediment include: road construction, management and location; livestock grazing and feeding operations; timber management operations; and agricultural practices. Restoration actions listed below are commonly used to respond to those threats associated with sediment loading of streams.

- Decommission, obliterate or relocate sediment producing roads not needed for the transportation system.
- Improve drainage, install culverts, adjust maintenance activities, or resurface sediment producing roads that cannot be decommissioned, obliterated, or relocated
- Manage livestock grazing to avoid adverse impacts to riparian areas and ensure that grazing plans are designed to improve riparian condition. This could include exclusion, partial season use, development of off-site water, herding, etc.
- Reestablish riparian vegetation by planting and protecting trees, shrubs, and sedges (native species preferred).
- Stabilize active erosion sites, where appropriate, through integrated use of wood structures (limit use of rock) and vegetation reestablishment.
- Where appropriate and feasible, relocate channelized stream reaches to restore natural functions.
- Promote interaction of stream channels and floodplains by removing, where feasible and appropriate, channel confinement structures (roads, dikes, tailings, berms, etc.).
- Work with landowners to protect riparian corridors through incentive programs (e.g. CREP, WRP, EQIP).
- Promote/implement development of grazing plans to improve upland native vegetative condition.
- Implement an integrated noxious weed management program including survey, prevention practices, education, treatment and revegetation in a manner to establish and maintain native vegetation and avoid chemical runoff into streams.
- Relocate animal feedlots from any active floodplain.
- Create/construct wetlands and filter strips for livestock feedlots and irrigation return flows.

Reduced Water Quality, High Summer Water Temperature

High summer stream temperatures are found in nearly all low and mid elevation (<1,500 meters) streams across the Oregon Snake River Basin. High temperatures can be a naturally occurring phenomena, but human activities have had, and continue to have, a major influence on them. Water withdrawals throughout the Oregon portion of the Snake River Basin reduce the amount of summer flows, contributing to higher summer stream temperatures. In addition to withdrawals, activities that have reduced riparian vegetation, drained wet meadows, physically altered streams, and disconnected them from their floodplain are major contributors to high summer stream temperatures. Restoring natural stream temperature regimes throughout the Snake River anadromous populations will be a long-term proposition, requiring a holistic approach that involves restoration actions which deal directly with these threats. The following restoration actions are recommended:

- Improve the density, condition, species, and age composition of riparian vegetation through planting, seeding, improved grazing and forest management practices.
- Re-establish historic wet meadow complexes where feasible.
- Reduce irrigation withdrawals through an integrated program of irrigation efficiency improvements, diversion point consolidations, water right leasing, water right purchase, and other actions, where applicable with willing landowners.
- Decommission, obliterate or relocate all riparian area roads not needed for the transportation system and revegetate with appropriate vegetation to promote stream shade.
- Improve drainage, install culverts, adjust maintenance activities, or resurface riparian roads that cannot be decommissioned, obliterated, or relocated.
- Manage livestock grazing to avoid adverse impacts to riparian areas and ensure that grazing plans are designed to improve riparian condition. This could include exclusion, partial season use, development of off-site water, herding, etc.
- Work with landowners to protect riparian corridors through incentive programs (e.g. CREP, WRP, EQIP).
- Stabilize active erosion sites, where appropriate, through integrated use of wood structures (limit use of rock) and vegetation reestablishment.
- Promote interaction of stream channels and floodplains by removing, where feasible and appropriate, channel confinement structures (roads, dikes, tailings, berms, etc.).
- Apply active channel restoration to reconnect channels with floodplains or historic channels where appropriate and feasible.

Low Flow Conditions

Restoration actions that address low-flow related impacts are a challenge. Human use of water in the arid west comes at a direct cost to aquatic species, and the protection of instream flow often competes with use of existing legally appropriated water rights and long-standing, water-dependent practices (i.e., irrigated agriculture). There are activities, however, that can improve instream flows while minimizing conflict, such as efficiency measures and voluntary or compensated transfer of water rights to instream uses. The following actions are recommended to increase flows in streams where low summer flows are primary limiting factor for anadromous fish:

- Identify flow deficient stream reaches caused by irrigation withdrawals;

- Improve riparian function and water storage by reconnecting floodplains through removal of confinement structures (roads, dikes), enhancing riparian vegetation, reestablishing beaver populations where ecologically appropriate, and managed grazing in riparian areas;
- Re-establish historic wet meadow complexes;
- Improve hydrologic function of forested watersheds through manipulation of tree species and density toward historic conditions;
- Reduce irrigation withdrawals through an integrated program of irrigation efficiency improvements, diversion point consolidations, water right leasing and water right purchase, and measurement to valid water rights quantities where applicable;
- Promote education and technical training in the efficient use of irrigation water;
- Reduce water withdrawals during non-irrigation season by improving stock watering facilities and delivery systems.

Loss of Habitat Quantity/Diversity and Degraded Riparian Conditions

There has been a loss of pool habitat and instream large wood, resulting in less available migration holding or rearing habitat and less overall habitat complexity in streams throughout northeast Oregon. Habitat quantity/diversity is closely associated with the limiting factor of riparian conditions and past channel alterations. As such, they are addressed in this section collectively. Actions recommended to improve riparian conditions and habitat quantity/diversity include:

- Improve the density, condition, species, and age composition of riparian vegetation through planting, seeding, grazing management and improved forest management practices.
- Reconstruct channelized stream reaches to historic or near-historic form and location where appropriate and feasible.
- Remove or relocate channel confinement structures such as draw-bottom roads and dikes where appropriate and feasible.
- Maintain existing LWD by promoting forestry practices that maintain existing instream and riparian area large wood, and promote adequate future large wood recruitment.
- Add in-channel structure (LWD, boulders) as appropriate to improve habitat complexity in the short term.
- Work with landowners to protect riparian corridors through incentive programs (e.g. CREP, WRP, EQIP).
- Relocate developed recreational facilities, where appropriate, from riparian areas to upland sites.
- Decommission, obliterate or relocate sediment producing roads not needed for the transportation system and replant with appropriate species for future large wood.
- Improve drainage, install culverts, adjust maintenance activities, or resurface sediment producing roads that cannot be decommissioned, obliterated, or relocated.
- Manage livestock grazing and feeding operations in riparian areas to improve riparian vegetation for future large woody debris and instream habitat complexity.

Tributary Habitat Recovery Actions for the Grande Ronde/Imnaha Chinook MPG

Grande Ronde River Migration Corridor

This 102-mile reach of the Grande Ronde River mainstem, from the mouth to Indian Creek, is not included in any population; however, it is used by all populations within the Grande Ronde River portion of the Grande Ronde/Imnaha Rivers MPG as a migration and rearing corridor. The reach includes the lowermost reaches of seven larger tributary streams (Courtney, Mud, Wildcat, Grossman, Elbow, Sheep, and Phillips creeks) which are not located in any population but are used by spring/summer Chinook for migration and rearing.

> **Primary Limiting Factors**: Habitat Quantity/Diversity (lack of pools, glides, and spawning gravel); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Water Quantity (low flows); Water Quality (high temperatures, nutrient levels)
>
> **Threats**: A*g*riculture; Livestock Grazing; Roads; Timber Harvest; Upstream Impacts (water diversions, agriculture, channelization, roads, livestock grazing, etc.); recreation

Restoration actions in this reach have low to moderate potential for increasing spring Chinook abundance (NPCC 2004). This reach is rated low priority for treatment under DEQ's WQMP (WQMP); water quality improvements are dependent on upstream improvements (ODEQ 2000). Restoration actions upstream of this reach (e.g., in reach UGC1) that reduce water withdrawal amounts, and reduce upstream water quality impacts (i.e., roads, agriculture, livestock, and logging operations) would be of most benefit to the reach.

The riparian area along the north river bank is subject to high levels of anthropogenic disturbance and should be a priority restoration effort in this reach. Railroad tracks are located along this riparian area, requiring the railroad to periodically clear the right-of-way of vegetation. Spring steelhead fishing is one of the most common uses of this reach; fishermen use ATVs to access this area of the river through a limited number of authorized ATV trails. Some unauthorized use does occur. ATV use of the railroad ROW is not authorized on BLM land. Palmer Junction is a very popular launch site in the spring for jet boats, which is an authorized use of this portion of the river.

ODEQ (2000) suggests the following restoration actions to reduce stream temperatures within this reach: increase shade cover, reduce bankfull channel widths to a maximum of 131 feet, maintain or increase instream flows during critical periods (July through September), and increase sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less.

Other recommended actions to address the threats in this reach would enhance habitat diversity and reduce environmental impacts of grazing and timber harvest operations (GRMW 1995; NPCC 2004); work with landowners to help maintain riparian vegetation, limit ATV use in the area, and help prevent resource damage; and place public information material at Palmer Junction and Mud Creek boat ramps to inform anglers of salmon-friendly boating and angling practices.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately 19 miles of road.
- Protect and enhance riparian area through the following potential restoration actions:
    1. Improve grazing practices on approximately 1400 acres of private land; This can include development and implementation of approximately 36 grazing management plans;
    2. Construct protection fence on approximately 12 miles of stream to protect riparian areas from degradation by livestock;
    3. Relocate approximately five feedlots or protect streams with adequate buffer;
    4. Develop approximately 60 off-channel livestock watering sites;
    5. Reduce and minimize streambank erosion on approximately two mile of the river;
    6. Plant riparian vegetation in approximately 60 acres of riparian zone;
    7. Enroll approximately nine miles of river into CREP or a similar program;
    8. Move or eliminate three recreation sites located in the riparian area/floodplain.

- Enhance instream habitat by:
    1. Adding structure (primarily large wood) in approximately 2.5 miles of stream;
    2. Relocate and/or reconnect approximately one mile of stream to the floodplain.

Wenaha River Chinook Population

Nearly all Wenaha River Chinook salmon habitat is located in the Wenaha-Tucannon Wilderness. Habitat conditions in the Wenaha Subbasin have had few impacts from human activities, and there are no ongoing land use activities other than dispersed recreation.

The limiting factors within this population can be primarily attributed to naturally occurring conditions. Much of the habitat deficiency found in the Wenaha River system is due to the river's large size and natural riffle-dominated character (Huntington 1994). Through the EDT process, the area containing this population was rated high for protection. Restoration actions in the Lower Grande Ronde River geographic area would have the greatest potential to increase abundance and productivity in the Wenaha River spring/summer Chinook population (NPCC 2004a). Restoration actions for the Lower Grande Ronde River would produce greater than a 30 percent increase in abundance for this population compared to less than 5 percent for any of the Wenaha River reaches listed below, according EDT estimates.

Aside from treatment of noxious weeds, no restoration actions are recommended for the Wenaha River reaches. The EDT analysis indicates that restoration actions would result in less than a 5 percent change in abundance and productivity of spring/summer Chinook. The Wenaha River and its reaches are considered a high priority for protection.

Minam River Spring Chinook Population

The Minam River spring Chinook population is not considered viable and is at high risk of extinction within the next 100 years according to the TRT viability assessment (ICTRT 2007). The high risk rating is given based on current abundance and productivity. However, the high risk is not due to poor tributary habitat. There do not appear to be any within-basin habitat changes that would impose any

significant selective mortality on adult or juvenile life stages (ICTRT 2007). Current spawning distribution is believed to be identical to historic, with spawning primarily occurring in the mainstem above the Little Minam River. Recent surveys have indicated some spawning in the lower Minam River, which is identified by the ICTRT (2007) as having a high intrinsic spawning potential.

Approximately 90 percent (136,822 acres) of the land in this watershed is within the Eagle Cap Wilderness and is largely undisturbed (NPCC 2004a, ODFW 2006). Except for the lingering effects of historic splash dam logging, the habitat in the Minam River and its tributaries is mostly undisturbed. The lower 30 miles of the Minam River still show the effects of splash dam log transport that occurred over 80 years ago. A splash dam was constructed at "Big Burn" (RM 30) in 1918 and was used until 1924. Below this site, the river continues to have a high width-to-depth ratio and lacks habitat complexity. The lowest 10 miles (approximately 15,795 acres) are in private ownership, where the river has been affected by roads and livestock grazing (Wallowa County-Nez Perce Tribe 1999). The primary limiting factor for the Minam River Chinook salmon population is limited habitat quantity and diversity resulting from a lack of pools and large wood. Excess fine sediment and high summer stream temperatures are also limiting factors. The primary threats in lower 10 miles (private lands) of this population are road construction and location, timber harvest (both historic and current), and livestock grazing. Above the Wilderness boundary the only threat (except for historic splash damming below RM 30) is the use of the river corridor for recreation.

The Snake River Oregon recovery planning team recommends that restoration actions in the Minam River Watershed focus on the lower reach, below RM 9. Restoration actions should include those that increase the quantity and quality of rearing habitat. These actions should also result in an increase of spawning gravels, as more pools and sections of slower water provided by improved habitat complexity allow deposition of smaller substrate. We also recommend that the Minam River spring Chinook habitat continue to be protected.

In the following reach discussions we recommend restoration actions for the Minam River spring Chinook population by reach that would address the primary limiting factors and threats. These are actions that have been recommended to address known limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Minam River—Mouth to Cougar Creek (MRC1)

Primary Limiting Factors: Habitat Quantity/Diversity (low abundance of pools and woody debris); Excess Fine Sediment; Water Quality (high summer temperatures)

Threats: Roads; Timber harvest and Historic Splash Damming; Livestock Grazing

The lower Minam River, where current land uses have a greater effect on Chinook salmon habitat, would be the highest priority for restoration actions in this population. EDT analysis indicates that a change in abundance of approximately 30 percent could be achieved with restoration in the lower Minam reach (NPCC 2004a).

The highest priority for restoration actions in this reach are those that increase habitat quantity and diversity by increasing the amount of pool habitat and reduce the effects of livestock grazing, roads, and

timber harvest that are currently a source of instream fine sediment and riparian area degradation. These actions would increase the health and survival of rearing Chinook, and allow greater spawning success within this reach.

- Improve instream habitat quantity and diversity through the following actions:
  1. Add structure to approximately two miles of stream;
  2. Promote and maintain future large wood recruitment through riparian area forest management.
- Reduce the effects of roads on Chinook salmon habitat through the following actions:
  1. Decommission or relocate approximately five miles of road;
  2. Improve maintenance on approximately eight miles of road;
  3. Replacement of a culvert;
  4. Better manage ATV use in riparian areas along approximately two miles of stream.
- Reduce the effects of livestock grazing by the following actions:
  1. Improve grazing practices on approximately 75 acres of private land;
  2. Establishment of a grazing plan for the private land in this reach;
  3. Develop approximately five off-channel livestock watering sites.

Benefits of these actions would be realized at the implementation site as well as downstream (as fine sediment input is reduced and summer stream temperatures improve). Implementation time for these actions could be between 5 and 10 years, with benefits of increased habitat diversity and reduced sediment realized within 5 to 10 years. Decreasing stream temperatures will take much longer.

Middle Minam River—Cougar Creek to Little Minam River (MRC2)

Primary Limiting Factors: Habitat Quantity/Diversity (low abundance of pools and woody debris)

Threats: Recreation; Historic Splash Damming

This reach of the Minam River is not a high priority for restoration actions. Little change in abundance for the Minam River Chinook salmon population could be realized with restoration within this reach (NPCC 2004a). Restoration actions recommended for this reach would be those that increase habitat quantity and diversity, and reduce the impacts of recreation on Chinook salmon habitat. Recommended actions include developing interpretive signs at Moss Springs and Rock Springs trailheads to educate visitors about low-impact camping and recreation use. Riparian vegetation restoration projects are also recommended if recreation use impacts fish habitat or the riparian area (WWNF 2002). Recreational use of roads, campgrounds, and trails should be managed to avoid sediment input to waterways (Wallowa County-Nez Perce Tribe 1999). Use of natural fire, in accordance with USFS wilderness plans, could be applied within wilderness boundaries. These actions would assist in reducing the probability of a large catastrophic fire in the upper reaches of the watershed where spawning, incubation, and early rearing occur. Benefits of the above actions would be realized at the implementation site as well as downstream. Implementation time for these actions could be up to five years, with benefits realized within 5 to 10 years.

Upper Minam River, Little Minam River to headwaters (MRC3)

Primary Limiting Factors: Habitat Quantity/Diversity (lack of large wood and pools)

Threats: Recreation

This reach is located within the Eagle Cap Wilderness and habitat conditions are close to historic. It is subject to relatively low human impact, and due to its protected status this reach is low restoration priority. Infrequent pools and low to moderate amounts of woody material occur naturally in this system. Although restoration actions are not a high priority for this reach, potential restoration actions include restoring riparian vegetation from recreation impacts; relocating dispersed camp sites from riparian areas, managing recreational use of trails to avoid erosion and sediment input to waterways (e.g., at campsites); and use of natural fire within wilderness boundaries to assist in reducing the probability of a large catastrophic wildfire which may impact spawning and rearing habitat.

Little Minam River—Mouth to Headwaters (MRC4)

Primary Limiting Factors: None Known

Threats: Recreation

This reach is located within the Eagle Cap Wilderness and habitat conditions are close to historic. It is subject to relatively low human impact and due to its Wilderness location, and is therefore a low restoration priority. Potential restoration actions include managing recreational trails to avoid erosion and sediment input to waterways (e.g., at campsites); and use of natural fire applied within wilderness boundaries to assist in reducing the probability of a large catastrophic wildfire which may impact spawning and rearing habitat.

Lostine/Wallowa Spring Chinook Population

The ICTRT has concluded that the Lostine/Wallowa spring Chinook population is not viable and is at high risk of extinction within the next 100 years. Current spawning distribution may be reduced from historic levels in the mainstem Wallowa River below the confluence with the Lostine River, in the Middle Wallowa River MaSA (ICTRT 2007). The Middle Wallowa River MaSA contains areas with high intrinsic spawning potential, including the mainstem Wallowa River between Dry Creek and the Lostine River, Bear Creek below current spawning distribution, and the lower several miles of Dry and Whiskey creeks (ICTRT 2007).

Stream habitats occupied by Lostine/Wallowa spring Chinook have undergone significant modification to accommodate urban and suburban residential development, ranching, transportation (roads and railroads) and irrigated agriculture. There has been extensive channelization, modification of riparian vegetation, draining of wetlands, and construction of water diversions in valley stream reaches. Roads, timber harvest, grazing of sheep and cattle, dry land agriculture, and recreation activities in mid-elevation areas have also contributed to reduced water quality (mainly sediment and temperature) in stream reaches used by Lostine/Wallowa spring Chinook.

Abundance, productivity, and spatial distribution of the Lostine/Wallowa Rivers spring Chinook are being limited by poor water quality (high summer water temperature and low dissolved oxygen levels), habitat quantity and diversity (lack of habitat complexity, and a lack of pools and large woody

debris), water quantity (low and high flows caused by altered hydrologic function), excess fine sediment, predation, and limited fish passage (Huntington 1994; Wallowa County–Nez Perce Tribe 1999; NPCC 2004a, Christian 2007). The primary causes for these limiting factors are: irrigation water withdrawals for livestock and agriculture, stream channel modifications, draining of wetlands, and riparian zone degradation (Huntington 1994; WallowaCunty – Nez Perce Tribe 1999; NPCC 2004a).

The Snake River Oregon recovery planning team recommends that restoration actions most needed in this population are those that: increase summer flows, especially in the lower reaches of the Lostine River, Bear Creek, Hurricane Creek, and upper reach of the Wallowa River; increase habitat complexity; reconnect floodplains; and improve riparian conditions. The highest priority reaches for restoration actions that would increase abundance and productivity in this population are the Upper Wallowa River, Lower Lostine River, Middle Wallowa River, Hurricane Creek, and Prairie Creek (NPCC 2004a).

In the following reach discussions we recommend restoration actions for the Lostine/Wallowa Rivers spring Chinook population by reach that would address the primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Wallowa River—Mouth to Minam River (WLC1)

Primary Limiting Factors: Water Quality (high summer water temperatures); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and wood); Water Quantity

Threats: Livestock Grazing; Timber Harvest; Roads/Railroad

This reach ranks in the top five priority reaches for restoration within this population (NPCC 2004a). However, few restoration actions have been identified. Priority actions for this reach should be to protect existing riparian vegetation and function, and controlling sediment inputs, mostly road-related, from tributaries (particularly Howard Creek) (NPCC 2004a; Wallowa County–Nez Perce Tribe 1999). Potential restoration actions within this portion of the river are limited and water quality improvements likely will depend on improving conditions higher in the watershed and within the reach's tributaries, e.g. Howard Creek.

Middle Wallowa River—Minam River to Rock Creek (WLC2)

Primary Limiting Factors: Water Quality (high summer water temperatures, contaminants, e. coli, coliform); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and wood); Degraded Riparian Condition; Loss of Floodplain Connectivity

Threats: Livestock Grazing; Timber Harvest; Roads/Railroad

The primary threats within this reach are State Highway 82 and the railroad, which are located on opposite sides of the river and significantly confine the channel. Neither of these transportation ways is likely to be moved from their present location.

Priority actions for this reach should be to protect existing riparian vegetation and function, minimize sediment input from State Highway 82 and the railroad, increase the quantity and quality of pool habitat and large wood structure, and reduce the effects of roads and livestock grazing within the reach.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the effects of roads on this reach through the following actions:
    1. Decommission or relocate approximately eight miles of road;
    2. Improve maintenance on approximately 15 miles of road;
    3. Replace three culverts.
- Reduce the effects of livestock grazing in this reach through the following actions:
    1. Improve grazing management on approximately 200 acres of private land;
    2. Develop grazing management plans for two private land grazing operations;
    3. Move one livestock feeding operation out of the riparian area;
    4. Fence approximately one mile of stream from livestock grazing;
    5. Develop approximately two off-channel livestock watering facilities.
- Modify the diversion at the Deer Creek steelhead hatchery facility to improve Chinook juvenile access to rearing areas in Deer Creek.

Water quality and sediment-related limiting factors in this reach are a largely a result of upstream influences. Actions upstream in the Wallowa River mainstem and tributaries that minimize and control irrigation withdrawals and returns, control sediment inputs, and improve environmental management practices within timber and agricultural operations (particularly animal feeding operations) would also benefit the water quality within this reach.

Upper Wallowa River – Rock Creek to Wallowa Lake (WLC3)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high summer water temperatures, nutrients, contaminants); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and large wood); Degraded Riparian Condition; Floodplain Connectivity; Fish Passage

Threats: Livestock Grazing; Livestock Feeding Operations; Residential Development; Water Diversions; Stream Channelization; Roads/Railroad; Agricultural Development; Barriers

The EDT analysis in the Grande Ronde Subbasin Plan (NPCC 2004a) identifies this reach as having high potential for increases in abundance and productivity relative to other reaches within the Wallowa-Lostine spring Chinook population. Consequently, it should be strongly considered for restoration.

Priority actions for this reach should be to protect and restore riparian vegetation and function, establish minimum instream flows adequate to protect Chinook spawning and rearing, minimize and control irrigation withdrawals and returns, eliminate sources of fine sediment input, improve management of grazing operations (particularly animal feeding operations), promote habitat-friendly residential development, reconnect channels and floodplains, restore natural channels (where feasible), and increase

the quantity and quality of pool habitat and large wood structure (NPCC 2004a). Some specific recommendations follow.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Enhance and protect riparian areas through the following actions:
    1. Improve livestock grazing management on approximately 500 acres of private land. This can include developing and implementing up to 30 grazing plans;
    2. Protect up to 16 miles of stream from direct livestock effects through fencing of riparian areas and development of up to 45 off-channel livestock watering sites;
    3. Plant riparian vegetation in up to 150 acres of riparian area;
    4. Reduce and minimize erosion on up to 1.25 miles streambank;
    5. Enroll up to 15 miles of stream into CREP or similar program.
- Improve instream habitat by implementing the following actions:
    1. Increase and improve habitat in up to 10 miles of channelized stream by relocating channelized reaches, adding structure, removing confinement structures, and reconnecting floodplains;
    2. Restore up to 70 cfs of flow to the Wallowa River by improving irrigation efficiency and purchasing water currently used for irrigation.
- Modify five diversion structures to improve passage of juvenile and adult Chinook salmon.

Hurricane Creek (WLC4)

Primary Limiting Factors: Water Quantity (low summer flows); Water Quality (contaminants); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and wood); Floodplain Connectivity; Passage (dewatered stream reaches)

Threats: Livestock Grazing; Water Diversions; Residential Development; Agriculture; Roads; Stream Channelization; Barriers (physical structures and dewatered reaches)

EDT analysis predicted approximately 50 percent and 30 percent increase in spring Chinook abundance and productivity, respectively, following restoration actions in Hurricane Creek (NPCC 2004a). Restoration actions in Hurricane Creek should focus on the lower portion of the drainage. Actions to reduce irrigation withdrawals in the drainage and to restore and protect riparian areas and their function would likely result in increased abundance and productivity of spring Chinook (NPCC 2004a). Priority restoration actions in this reach are to protect and enhance riparian vegetation (fencing and/or planting); reestablish natural stream channels and floodplain connectivity; and address water use and low flows through conservation, improved efficiency, purchase/lease of water rights, and enforcement, and modification of an irrigation diversion structure. These priority actions, especially restoration of riparian areas and reduced water use/improved stream flow, should also help reduce sediment effects on aquatic resources in Hurricane Creek. Additional actions that may need to be considered for sediment reduction include road surface and drainage improvements and construction of filter strips, settling

basins, or off-channel wetlands to reduce sediment delivery from roads, feedlots, pastures, and fields (Wallowa County–Nez Perce Tribe 1999). Some specific actions follow.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Enhance and protect riparian areas by the following actions:
  1. Improve livestock grazing management on approximately 50 acres of private land. This can include developing and implementing up to 10 grazing plans;
  2. Protect up to two miles of stream from direct livestock effects through fencing of riparian areas and developing up to 20 off-channel livestock watering sites;
  3. Plant riparian vegetation in up to 10 acres of riparian area;
  4. Reduce and minimize erosion on up to 0.5 miles streambank;
  5. Enroll up to four miles of stream into CREP or similar program.
- Improve instream habitat by implementing the following actions:
  1. Increase and improve habitat by adding structure in up to 0.5 miles of stream;
  2. Restore up to 15 cfs of flow to Hurricane Creek by improving irrigation efficiency, purchasing water currently used for irrigation, and monitoring/enforcing withdrawal amounts.
- Increase available habitat for spring Chinook in Hurricane Creek by pursuing opportunities to restore flow to the section between the Upper Alder Slope Ditch diversion at RM 7.6 and the Lower Alder Slope diversion at RM 3.5. This reach is dewatered by irrigation withdrawals in late summer and early fall.
- Improve fish passage in this reach by modifying the diversion structure at the Upper Alder Slope Ditch diversion. An additional 0.5 miles of Chinook salmon spawning and rearing habitat could be available.

Prairie Creek (WLC5)

Primary Limiting Factors: Water Quantity (high flows); Water Quality (contaminants); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and wood); Floodplain Connectivity; Fish Passage

Threats: Livestock Grazing; Water Diversions and Irrigation Water Management; Residential Development; Agriculture; Roads; Barriers

The EDT analysis suggests that an increase in population abundance of approximately 30 percent could be realized with restoration in this reach. Restoration actions in Prairie Creek should focus on private lands in the valley portions of the drainage. Actions to reduce irrigation effects to the system, restore and protect riparian areas and their function, control runoff from agriculture and grazing operations (particularly animal feeding operations), stabilize eroding stream banks, eliminate passage barriers, and increase instream woody debris would likely result in increased abundance and productivity of spring Chinook (NPCC 2004a; Christian 2007).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Enhance and protect riparian areas by the following actions:
  1. Improve livestock grazing management on approximately 200 acres of private land. This can include developing and implementing up to 20 grazing plans;
  2. Protect riparian areas by moving or fencing (with adequate buffer) up to three feedlots;
  3. Protect up to seven miles of stream from direct livestock effects through fencing of riparian areas and developing up to 20 off-channel livestock watering sites;
  4. Plant riparian vegetation in up to 50 acres of riparian area;
  5. Reduce and minimize erosion on up to 10 miles streambank;
  6. Enroll up to 10 miles of stream into CREP or similar program.

- Improve instream habitat by adding structure in up to three miles of Prairie Creek, and reconnecting up to one mile of floodplain.

- Improve passage for juvenile Chinook salmon by replacing the following culverts and other barriers:
  1. 1 bridge with cement apron (2nd St. in Enterprise);
  2. 13 culverts (most crossings, all county and private roads);
  3. Prairie Creek tributaries – 2 culverts (private roads).

- Screen irrigation diversions in upper Prairie Creek once connectivity has been reestablished.

The feasibility of improving irrigation water delivery and application methods should be investigated to reduce demand for Wallowa River and Imnaha basin water in Prairie Creek. This would also substantially decrease sediment production in the Prairie Creek system. Identification and establishment of minimum instream flows is recommended to protect Chinook spawning and rearing. Additional actions may need to be considered to improve water quality including road surface and drainage improvements and construction of filter strips, settling basins, or off-channel wetlands to reduce sediment and nutrient delivery from roads, pastures, and fields (Wallowa County–Nez Perce Tribe 1999).

Bear Creek (WLC6)

Primary Limiting Factors: Water Quantity (low flows); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and wood); Fish Passage (barriers and dewatered reaches in summer); Riparian Condition; Floodplain Connectivity

Threats: Water Diversions; Livestock Grazing; Timber Harvest; Residential Development; Agriculture; Roads; Barriers (barriers and dewatered reaches); Recreation; Stream Channelization

Because the upper portion of the watershed is on National Forest and is part of the Eagle Cap Wilderness, it is offered a higher level of protection and is in better overall condition than private

property in the watershed's lower reaches. Consequently, restoration actions should focus on the lower privately owned portions of this reach. The *Oregon Plan for Salmon and Watersheds, Summer Streamflow Restoration Priorities* lists lower Bear Creek as a "highest priority" for flow restoration needs (OWRD 2001).

Priority restoration actions for the privately owned portions of Bear Creek and Little Bear Creek include reducing irrigation withdrawals, reducing input of fine sediment, reestablishing and protecting healthy riparian areas, reestablishing functioning channel courses with connected floodplains, eliminating passage barriers, and reducing the influence of roads and Boundary Campground on sediment and channel conditions. Specific restoration actions that could address these concerns follow.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the effects of livestock grazing operations by moving one feedlot or fencing (with adequate buffer), and by developing an off-channel water source.
- Protect riparian areas by eliminating up to four recreation sites located in riparian areas.
- Improve instream habitat by:
    1. Adding structure in up to three miles of Bear Creek;
    2. Reconnecting up to two miles of channelized stream to its floodplain;
    3. Noncommercially thinning approximately 30 acres of riparian forest along approximately one mile of stream to facilitate large wood recruitment;
    4. Return approximately eight cfs of flow to Bear Creek through improving irrigation efficiency and/or buying water from irrigators.
- Improve passage for juvenile Chinook salmon by modifying two diversion structures that currently limit fish passage.

Lower Lostine River – Mouth to Silver Creek (WLC7)

Primary Limiting Factors: Water Quantity (low flows); Excess Fine Sediment; Water Quality (temperature, nutrients, contaminants); Habitat Quantity/Diversity (lack of pools and wood); Fish Passage; Floodplain Connectivity

Threats: Water Diversions; Livestock Grazing; Stream Channelization; Residential Development; Agriculture; Roads; Barriers (irrigation diversions and dewatered reaches)

The Grande Ronde subbasin plan identifies this reach as being the top restoration priority for the Lostine/Wallowa Rivers population; the plan's EDT analysis concluded that restoration in this reach had the highest potential for increasing the abundance and productivity of the Lostine/Wallowa River spring Chinook population. The Oregon Plan for Salmon and Watersheds, Summer Streamflow Restoration Priorities lists the lower Lostine River as a "high priority" for flow restoration needs (OWRD 2001). Consequently, this reach should be a top restoration priority.

The highest priority restoration action is to continue addressing water use and low flows in the lower Lostine River through conservation, improved efficiency, purchase/lease of water rights (such as the Oregon Water Trust water lease program), and enforcement. Long term incentive programs need to be

developed and implemented with the cooperation of local irrigators, with an emphasis on improving the efficiency of irrigation methods (J. Harbeck, Nez Perce Tribe, personal communication). Examples include ditch consolidation (e.g. there are 14 ditches on the Lostine), and water exchange programs (e.g., leaving water in the Lostine in exchange for pumping a limited volume of water from the Wallowa River). Although flow and passage projects have improved habitat and passage conditions in the lower Lostine, an instream flow study conducted in 1995 and 1996 recommended that minimum flows of 40 cfs should be maintained for passage of adult salmon (R2 Resource Consultants 1998). Approximately 25 cfs of additional flow could be returned to the Lostine River through additional efficiencies, conservation, and water purchase (T. Smith personal communication).

Other restoration actions that would contribute to increasing abundance and productivity of Chinook in this reach include restoring channelized stream segments, identifying and controlling sediment sources, eliminating passage barriers, protecting and enhancing riparian vegetation, and increasing instream pools and woody debris.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Improve riparian areas by:
    1. Planting riparian vegetation along approximately one mile of stream;
    2. Reducing and minimizing erosion along approximately 0.25 miles of stream;
    3. Enrolling approximately five miles of stream in CREP or a similar program;
    4. Improving grazing practices on approximately 10 acres of private land;
    5. Developing two grazing plans on private land;
    6. Fencing approximately 0.5 miles of stream to protect riparian areas from grazing;
    7. Developing two off-channel water sources for livestock;
- Enhance instream habitat by:
    1. Restoring natural stream channels and floodplain connectivity by reconnecting approximately two miles of channelized stream and removing confinement structures (levees, dikes) on approximately three miles of stream;
    2. Add structure to approximately four miles of stream;
    3. Modify approximately three diversion structures to improve fish passage. Two of them, existing fish ladders at the City of Lostine Dam and Sheep Ridge Dam, should be rebuilt or replaced in the near future to assure that fish passage is maintained (Christian 2007, WWNF 2001).

Upper Lostine River – Silver Creek to Headwaters (WLC8)

Primary Limiting Factors: Excess Fine Sediment

Threats: Recreational activity (harassment and riparian impacts); Roads

Within the upper part of the watershed riparian areas are in good condition, except in isolated areas in the immediate vicinity of campgrounds, and water quality is suitable for salmonids (no sections are

303(d)-listed). Limiting factors in the upper Lostine River system likely have a minimal effect on abundance and productivity of spring Chinook (NPCC 2004a). The Grande Ronde subbasin plan's EDT analysis concluded restoration in this reach has low potential for increasing abundance and productivity of spring Chinook; consequently, other than protection, this reach should not be a top restoration priority. Additional protection for spring/summer Chinook can be accomplished through improved maintenance of the Lostine River road, improved education of recreationists on the importance of avoiding harassment of spawning fish. Relocating sediment-producing campsites out of riparian areas could also be considered.

Lookingglass Creek Chinook Population

Historically, spring Chinook spawned and reared in Lookingglass Creek, Little Lookingglass Creek, and Mottet Creek. Naturally spawning spring Chinook salmon were extirpated when the Lookingglass Hatchery was built in 1982 (WWNF 2004; NPCC 2004a). Currently, most returning adult Chinook salmon are not permitted to pass upstream of the Lookingglass Hatchery.

Restoration in this population is not currently a high priority because limited increases in abundance and productivity would be realized as long as a very limited number of returning spawners are allowed to pass the hatchery facility. If restoration were planned for this population, restoration of the Lower Grande Ronde River between the Wenaha River and the Wallowa River would have the greatest potential for increasing abundance and productivity for this population (NPCC 2004a). The highest priority restoration actions within the Lookingglass Creek drainage would focus on improving habitat quantity and diversity by increasing the amount of large wood and number of pools, and improving riparian function.

In the following reach discussion we recommend restoration actions for the Lookingglass Creek spring Chinook population by reach that would address the primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lookingglass Creek—Mouth to Headwaters (LGC1)

Primary Limiting Factors: Fish Passage; Habitat Quantity/Diversity (lack of pools and large wood, decreased riparian function); Excess Fine Sediment

Threats: Hatchery Operations; Roads; Livestock Grazing; Logging

Lookingglass Creek is one of the most undisturbed non-Wilderness watersheds in the Grande Ronde River Basin. In order for an endemic population of spring Chinook to once again exist in this watershed, the Lookingglass Hatchery would need to allow spawning adults to pass upstream. This would be the highest priority restoration action for this population.

According to the Grande Ronde River Subbasin Plan, restoration actions implemented in the lower Grande Ronde River to increase rearing habitat would have more of a beneficial effect on this population than would restoration actions within the Lookingglass Creek drainage. This is due to the undisturbed nature of the Lookingglass Creek Watershed.

In addition to allowing passage beyond the hatchery, restoration actions within the Lookingglass Creek drainage should be focused on restoring and protecting riparian areas; reducing sediment input from roads, and timber harvest and grazing operations; installing large wood in strategic locations; eliminating other fish passage barriers (e.g., culverts); and reconnecting channelized segments of stream to their floodplains. Some specific restoration actions could include the below list.

- Reduce the effects of roads within the Lookingglass drainage through actions to:
    1. Decommission or relocate approximately five miles of road within riparian areas.
    2. Improve road maintenance on 10 miles of riparian roads.
    3. Replace approximately four culverts.

- Enhance and protect riparian areas through the following actions:
    1. Improve grazing practices on approximately 1,000 acres of private land.
    2. Develop and implement approximately 10 grazing plans on private land.
    3. Relocate or fence (providing adequate buffers) two feedlots.
    4. Manage forested riparian areas to promote future large wood recruitment on approximately 300 acres.
    5. Plant riparian vegetation in approximately 200 acres of riparian area.
    6. Enroll approximately four miles of private land streams in CREP or a similar program.
    7. Relocate or close approximately 15 recreation sites located in riparian areas.
    8. Better manage riparian ATV use along approximately two miles of stream.

- Improve instream function and habitat by:
    1. Reconnecting approximately three miles of channelized stream to its floodplain.
    2. Adding structure (large wood, etc) to approximately four miles of stream.

Catherine Creek Spring Chinook Population

The Catherine Creek spring Chinook population is not considered viable and is at high risk of extinction within the next 100 years according to the TRT viability assessment (Carmichael et al. 2006). Abundance, productivity, and spatial distribution of Catherine Creek spring Chinook are being limited by poor water quality (high summer water temperature), water quantity (low summer flows), limited habitat quantity and diversity (lack of pools and large wood), excess fine sediment, and poor riparian conditions. The primary causes for these limiting factors are: water withdrawals; road location and use; agricultural practices that continue to limit riparian vegetation and contribute sediment and pollution to streams; livestock grazing; lingering effects of past timber harvest; and current forest practices that continue to limit riparian vegetation and contribute sediment to stream channels.

Spawning no longer occurs in the Lower Catherine Creek MaSA, where low flows and high summer stream temperatures are having the largest impact. The middle portion of Catherine Creek, primarily between Ladd Creek and the town of Union, has a very high potential for increases in population

abundance through restoration actions (NPCC 2004a). This section of Catherine Creek also has a high intrinsic spawning potential (Carmichael et al. 2006).

Based on current available data the limiting factors of water quality and water quantity have the largest impact on this population, affecting primarily rearing juvenile and spawning adult Chinook. Improving habitat conditions in the middle reach of Catherine Creek through restoration activities that help increase flows, moderate summer water temperatures, reconnect floodplains and wet meadows, improve riparian habitat and instream complexity would be a high priority for the Catherine Creek spring Chinook population.

In the following reach discussions, we recommend restoration actions for the Catherine Creek spring Chinook population by reach that would address the primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Indian Creek (CCC1)

Primary Limiting Factors (in order of effect to the reach): Habitat Quantity/Diversity (low pool frequency, lack of diversity, substandard streambank conditions); Water Quantity (low summer flows); Water Quality (high summer temperatures, low dissolved oxygen levels); Excess Fine Sediment; Riparian Condition

Threats (in order of effect to the reach): Water Withdrawals, Agriculture, Livestock Grazing; Timber Harvest; Roads

The EDT analysis lists this reach as a second priority for restoration in the Catherine Creek Chinook population, after Middle Catherine Creek (CCC3). It has a high potential for increases in Chinook salmon abundance through restoration (NPCC 2004a).

The highest priority for restoration actions in this reach are those that: increase habitat quantity and diversity by increasing the amount of pool habitat and adding large wood in Indian Creek and its tributaries; increase low summer flows and decrease high summer stream temperatures through establishment of instream flows adequate to protect Chinook spawning and rearing habitat, improvements in irrigation efficiency, purchase of water, restoring wetlands, reconnecting floodplains, restoring stream shading riparian vegetation, and protecting riparian areas from the effects of agriculture and livestock grazing; reduce the amount of instream fine sediment from agricultural and livestock grazing practices, and roads through stream/riparian area protection. These actions would increase the health and survival of rearing Chinook, and increase spawning success within this reach.

Grande Ronde River and Lower Catherine Creek – Indian Creek on the Grande Ronde River to Pyles Creek on Catherine Creek (CCC2)

Primary Limiting Factors (in order of effect to the reach): Water Quantity (low summer flows); Water Quality (high summer temperatures, low dissolved oxygen levels); Habitat Quantity/Diversity (low pool frequency, lack of diversity, substandard streambank conditions); Fish Passage; Excess Fine Sediment; Riparian Condition

Threats (in order of effect to the reach): Agriculture; Water Diversions; Livestock Grazing; Roads; Stream Channelization

This reach contains a portion of the Grande Ronde River, from Indian Creek to the State Ditch, that is considered in the TRT Viability Assessment (ICTRT 2007) to be in the Catherine Creek spring Chinook population. As such we are including it in the Catherine Creek population. However, the Grande Ronde River Subbasin Plan (NPCC 2004a) includes it as part of the Grande Ronde River spring Chinook population, in the Middle Grande Ronde River 4 geographic area. In the Subbasin Plan, this geographic area ranks as high (2nd for the Upper Grande Ronde River population) potential for increasing abundance of spring Chinook with over 95 percent potential increase in abundance. The Lower Catherine Creek portion of this reach also shows a very high potential for increasing spring Chinook abundance; the Grande Ronde Subbasin Plan classifies this area as a high restoration priority (4th for this population) for Chinook salmon within the Grande Ronde River Subbasin (NPCC 2004a).

The highest priorities restoration actions in this reach will:

- increase low summer flows by establishing instream flows adequate to protect Chinook spawning and rearing habitat, improving irrigation delivery efficiency, buying water, reconnecting floodplains, and restoring wet meadows;
- lower summer stream temperatures in this reach and upstream reaches by increasing shading riparian vegetation, reconnecting floodplains, and restoring wetlands;
- increase the amount of habitat quantity and diversity by increasing pool habitat and adding large wood;
- improve fish passage at diversion structures; and
- protect riparian areas from the effects of livestock grazing.

The following is a list of restoration actions that have been recommended for this reach in available literature (e.g., Grande Ronde River Subbasin Plan) and by local natural resource professionals.

- Reduce the effects of agricultural practices, water withdrawals and livestock grazing on tributary habitat by pursuing the following actions:
    1. Development of approximately 18 grazing plans for private grazing operations;
    2. Moving approximately 10 feeding operations away from stream channels, or fencing the riparian areas adjacent to them to provide filter strips;
    3. Construction of approximately 20 miles of riparian stream fencing;
    4. Development of up to 100 off-site watering sources to provide livestock water away from stream channels;
    5. Enrolling up to 48 miles of fish-bearing streams into CREP or other stream protection program;
    6. Identify and establish minimum instream flows for successful Chinook spawning and rearing. Actions can include water leases and purchases, increased irrigation efficiency, and wetland restoration.
- Improve juvenile and adult fish passage by modifying four irrigation diversion structures.

- Improve instream and riparian habitat conditions in this reach through the following actions:
    1. Plant up to 300 acres of riparian area to reestablish riparian vegetation in impacted areas;
    2. Stabilize erosion along up to three miles of Catherine Creek;
    3. Relocate the stream channel to its historical location on up to six miles of channelized reach;
    4. Remove confinement structures and reconnect the Catherine Creek floodplain on up to 25 miles of stream;
    5. Add structure (large wood) to up to five miles of Catherine Creek.

The above listed projects would increase the survival and distribution of rearing juveniles and improve spawning success by increasing the amount of available quality habitat for both rearing and spawning Chinook salmon.

Middle Catherine Creek – Pyles Creek to North and South Forks (CCC3)

Primary Limiting Factors (in order of effect to the reach): Water Quantity (low summer flows); Excess Fine Sediment; Water Quality (high summer temperatures, low dissolved oxygen levels); Habitat Quantity/Diversity (low pool frequency, lack of diversity, substandard streambank conditions); Riparian Condition and Fish Passage.

Threats (in order of effect to the reach): Agriculture; Livestock Grazing; Water Diversions; Roads

The Middle Catherine Creek reach is the highest priority for restoration actions in the Catherine Creek spring Chinook population. This reach has the highest potential for an increase in population abundance through restoration actions (NPCC 2004a).

Priority actions for this reach should focus on increasing base summer flows by improving irrigation efficiency and/or buying water; reducing sediment input to Catherine Creek from agriculture, livestock grazing, and roads; increasing habitat diversity and quantity by increasing the amount of pool habitat and adding large wood; improving existing riparian conditions through protection from agriculture and livestock grazing impacts, and planting riparian vegetation; and eliminating fish passage barriers.

A list of restoration actions identified in available literature (e.g., Grande Ronde River Subbasin Plan) and by local natural resource professionals follows.

- An estimated 10 cfs could be kept in Catherine Creek with improvements in irrigation water delivery systems and/or purchase of instream water rights. Pursuit of this restoration action would be a top priority in this reach.

- Reduce the effects of agricultural practices and livestock grazing on private land by pursuing the following actions:
    1. Development of approximately 18 grazing plans for private grazing operations;
    2. Moving approximately 10 feeding operations away from stream channels, or fencing the riparian areas adjacent to them to provide filter strips;
    3. Construction of approximately 10 miles of riparian stream fencing;

4. Development of up to 50 off-site watering sources to provide livestock water away from stream channels;
5. Enrolling up to 15 miles of fish-bearing streams into CREP or other stream protection program.

- Improve instream and riparian habitat conditions in this reach through the following actions:
  1. Riparian planting of up to 36 acres to reestablish riparian vegetation in impacted areas;
  2. Stabilize erosion along up to one mile of Catherine Creek;
  3. Relocate stream channel on up to two miles of channelized reach;
  4. Reconnect the Catherine Creek floodplain on approximately three miles of stream;
  5. Add structure (large wood) to up to four miles of Catherine Creek;
  6. Decommission, obliterate, or move two miles of road, and improve maintenance on four miles of road;
  7. Move one dispersed recreation site from riparian areas;
  8. Manage approximately 2 miles of timbered riparian area to maintain existing and future instream large wood sources.

- Improve fish passage for juveniles and returning adults by removing one fish passage barrier and modifying five diversion structures in this reach.

The projects listed above would increase the survival and distribution of rearing juveniles and improve spawning success by increasing the amount of available quality habitat for both rearing and spawning Chinook salmon.

Lower and Middle Catherine Creek Tributaries (CCC4)

Primary Limiting Factors (in order of effect to the reach): Excess Fine Sediment; Habitat Quantity/Diversity (low pool frequency, lack of diversity, substandard streambank conditions); Water Quantity (low summer flows); Water Quality (high summer temperatures); Riparian Condition

Threats (in order of effect to the reach): Agriculture; Water Diversions; Livestock Grazing; Roads; Timber Harvest

The Grande Ronde Subbasin Plan reports restoration within this area would have little potential for increasing the abundance and productivity of spring Chinook within the basin (NPCC 2004a). However, a portion of this reach has relatively good spawning numbers, and therefore offers good protection and restoration opportunities.

Restoration actions in this reach should focus on:

- eliminating sediment sources from agriculture, livestock grazing, and roads;
- increasing habitat quantity and diversity by increasing the amount of pool habitat and adding large wood;

- increasing instream flows by identifying and establishing minimum instream flows for Chinook spawning and rearing, improving irrigation system efficiency and/or purchase of water; and

improving stream temperatures by reconnecting floodplains, restoring wetlands, and increasing shading vegetation in riparian areas.

The following actions have been recommended in available literature (e.g., the Grande Ronde River Subbasin Plan) and by local natural resource professionals.

- Improve livestock grazing on private land by pursuing the following actions:
  1. Development of approximately three grazing plans for private grazing operations;
  2. Moving approximately one feeding operations away from stream channels, or fencing the riparian areas adjacent to them to provide filter strips;
  3. Construction of approximately three miles of riparian stream fencing;
  4. Development of up to 15 off-site watering sources to provide livestock water away from stream channels;
  5. Enrolling up to one mile of fish-bearing stream into CREP or other stream protection program.

- Improve instream and riparian habitat conditions in this reach by:
  1. Riparian planting of up to 12 acres to reestablish riparian vegetation in impacted areas;
  2. Stabilize erosion along up to 0.25 miles of stream;
  3. Relocate stream channel on up to one mile of channelized reach;
  4. Reconnect the floodplain on approximately one mile of stream;
  5. Add structure (large wood) in up to one mile of stream;
  6. Improve maintenance on four miles of road;
  7. Replace one culvert that is either a passage or sediment concern; and
  8. Move one dispersed recreation site from riparian areas.

The projects listed above would increase the survival of rearing juveniles and improve spawning success by increasing the amount of available quality habitat for both rearing and spawning Chinook salmon.

Catherine Creek - North and South Forks (CCC5)

Primary Limiting Factors (in order of effect to the reach): Excess Fine Sediment; Habitat Quantity/Diversity (low pool frequency, lack of diversity, substandard streambank conditions); Water Quantity (low summer flows); Water Quality (high summer temperatures); Riparian Condition

Threats (in order of effect to the reach): Livestock Grazing; Timber Harvest

The Grande Ronde Subbasin Plan identifies restoration within NF Catherine Creek as having moderate potential for increasing spring Chinook abundance (NPCC 2004a). SF Catherine Creek exhibits less

potential for increasing spring Chinook abundance (NPCC 2004a). Priority actions for this portion of the watershed should:

- reduce sediment input to streams from livestock grazing and roads;
- increase habitat quantity and diversity by increasing pool habitat and adding large wood;
- reduce summer stream temperatures by improving stream shading riparian vegetation, reconnecting floodplains, and restoring wet meadows; and
- restore degraded riparian conditions and protect them from livestock grazing impacts.

The following actions have been recommended in available literature (e.g., the Grande Ronde River Subbasin Plan) and by local natural resource professionals.

- Reduce or eliminate the effects of agricultural practices and livestock grazing on riparian functions, sediment delivery and water quality by pursuing the following actions:
    1. Construction of approximately 16 miles of riparian stream fencing;
    2. Development of up to 80 off-site watering sources to provide livestock water away from stream channels.

- Improve instream and riparian habitat conditions through the following actions:
    1. Add structure (large wood) to one mile of stream;
    2. Decommission, obliterate, or move 15 miles of road, and improve maintenance on 20 miles of road;
    3. Replace four culverts that pose either fish passage or sediment concerns;
    4. Move five dispersed recreation sites from riparian areas;
    5. Non-commercially thin overstocked riparian timber stands to promote future large wood recruitment (up to 2,000 acres).

The projects listed above would increase the survival of rearing juveniles and improve spawning success by increasing the amount of available quality habitat for both rearing and spawning Chinook salmon.

Upper Grande Ronde River Spring Chinook Population

The TRT determined that the Upper Grande Ronde spring Chinook population does not meet viability criteria and is considered at the highest risk possible (high risk for both abundance/productivity and spatial structure/diversity) (ICTRT 2007). Currently spawner distribution is much reduced from historic conditions, with less than half of the historical MaSAs occupied.

Based primarily on the EDT analysis, in-basin factors limiting spring Chinook populations in the Upper Grande Ronde River system (listed in descending order of importance) are excess fine sediment, habitat quantity and diversity (lack of pools, large wood, and reduced wetted widths), high summer water temperature, low summer flow, and riparian degradation (loss of riparian vegetation) (GRMW 1995; Huntington 1994; NPCC 2004a). Primary threats associated with these limiting factors are water withdrawals, roads, agriculture, livestock grazing, and timber harvest.

The Upper Grande Ronde watershed is rated high priority for treatment under DEQ's WQMP (ODEQ 2006) for temperature, sediment, and flow. The plan outlines management measures for permitted direct discharges (e.g., wastewater treatment plants and industrial facilities) and BMP's for non-point source (e.g., roads, forestry operations, agriculture, and municipal sources). Water quality issues addressed in the plan include pH, dissolved oxygen, nutrients, industrial effluent, temperature, and sediment (ODEQ 2000).

The Snake River Oregon recovery planning team has concluded that improving habitat conditions in the upper Grande Ronde River above the City of La Grande would be a high priority for the Upper Grande Ronde River spring Chinook population. This should be done through restoration activities that help increase summer low flows, moderate summer temperatures, reconnect floodplains and wet meadows, and improve riparian habitat and instream complexity.

In the following reach discussions we recommend restoration actions for the Upper Grande Ronde River spring Chinook population by reach that would address known primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Middle Grande Ronde River Mainstem—Mouth of State Ditch to Five Points Creek (UGC1)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high temperatures); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Habitat Quantity/Diversity (low pools, lack of diversity)

Threats: Water Diversions; Stream Channelization; Livestock Grazing; Agriculture; Railroad and Highway Proximity; Urban Development

This reach of the Grande Ronde River has a moderate to high potential for increases in population abundance through restoration actions (NPCC 2004a). Therefore, this reach is a high priority for restoration within the Upper Grande Ronde River spring Chinook population (NPCC 2004a). This reach is also rated high priority for treatment under DEQ's WQMP (ODEQ 2000). Increasing summer low flows and increasing the frequency of large pools (which would address lack of winter rearing and holding habitat) should be the priority restoration actions for this reach. Restoration of wet meadows and reconnection of floodplains are two actions that can increase summer low flows. In addition, the two irrigation withdrawals could be ameliorated by identifying "rate and duty" requirements to alleviate the overuse of water at specific diversions, thereby returning some flow by diverting only the lawfully appropriated right. These actions would also benefit all Grande Ronde River reaches downstream.

Other restoration actions can include protecting and restoring riparian vegetation and function. The area between La Grande and Five Points Creek needs structure to provide pools for over-wintering juveniles, and to improve pool habitat for Chinook migration upstream.
Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately one mile of road.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 1300 acres of private land. This can include development and implementation of approximately five grazing management plans;
  2. Relocate or protect from streams (with adequate buffer) approximately three feedlots;
  3. Construct protection fence on approximately 10 miles of stream to protect riparian areas;
  4. Develop approximately 50 off-channel livestock watering sites;
  5. Plant riparian vegetation in approximately 215 acres of riparian zone;
  6. Reduce and minimize erosion on approximately 20 miles of the river;
  7. Enroll approximately 15 miles of river front into CREP or a similar program;
  8. Move or eliminate one riparian recreation site;
  9. Control ATV use along approximately two miles of river;
  10. Protect returning adults and rearing juveniles from harassment along approximately two miles of river.

- Enhance instream habitat by:
  1. Adding structure (primarily large wood) in approximately 10 miles of stream;
  2. Relocate approximately three miles of channelized river;
  3. Remove confinement structures (dikes, levees) along approximately 10 miles of river;
  4. Reconnect approximately five miles of river to its floodplain;
  5. Add structure to approximately 10 miles of river;
  6. Restore approximately five cfs of flow to the river through irrigation efficiencies and/or water purchase;
  7. Noncommercially thin approximately two river miles of forested riparian area to promote future large wood recruitment.
- Improve fish passage by removing one barrier and modifying three irrigation diversions.

Middle Grande Ronde River Mainstem—Five Points Creek to Meadow Creek (UGC2)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high water temperatures); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Habitat Quantity/Diversity (lack of pools, lack of diversity)

Threats: Livestock Grazing; Timber Harvest; Roads (highways 82 and 244)

This reach exhibits moderate to high potential for increasing the abundance of spring Chinook within the Upper Grande Ronde population; however, restoration opportunities are limited (NPCC 2004a). This reach is rated high priority for treatment under DEQ's WQMP. Suggested treatments to reduce stream temperatures include increasing shade cover, maintaining/increasing instream flows during critical periods (July through September), reducing bankfull channel widths to a maximum of 98 feet, and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration activities within the reach should focus on increasing deep pool habitat, implementing appropriate standards/guidelines and BMPs within timber harvest and grazing operations, and protecting and restoring riparian vegetation (GRMW 1995; NPCC 2004a). Restoration actions that focus on reducing impacts higher in the watershed and tributaries, e.g., identifying and eliminating sources of sediment and thermal pollution would also benefit this reach.

Restoration efforts should involve management of the highway adjacent to the river and adding structural habitat components to the river (e.g., large woody debris and large boulders). Maintenance activities should limit or curtail inputs of road debris and gravel to the river (sidecasting). Restoration actions could include planting trees and restoring other riparian vegetation where shade has been removed. All riparian protection mechanisms should be pursued.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately one mile of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 1100 acres of private land. This can include development and implementation of approximately 10 grazing management plans;
    2. Relocate or protect streams (with adequate buffer) from one feedlot;
    3. Construct protection fence on approximately eight miles of stream to protect riparian areas;
    4. Develop approximately 40 off-channel livestock watering sites;
    5. Plant riparian vegetation in approximately 91 acres of riparian zone;
    6. Reduce and minimize erosion on approximately one mile of the river;
    7. Enroll approximately two miles of river into CREP or a similar program;
    8. Move or eliminate approximately six riparian recreation sites.
- Enhance instream habitat by:
    1. Adding structure (primarily large wood) in approximately 15 miles of stream;
    2. Relocate approximately two miles of channelized river;
    9. Removing confinement structures (old railroad grades, dikes, and levees) and reconnecting the floodplain along approximately 10 miles of river.

Fly and Beaver Creeks (UGC3)

Primary Limiting Factors: Water Quality (high temperatures); Riparian Condition (vegetation, streambanks); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools)

Threats: Livestock Grazing; Timber Harvest; Roads

Lower Fly and Little Fly creeks are rated high priority for treatment under DEQ's WQMP (ODEQ 2000); Upper Fly Creek is rated low priority. Beaver Creek is rated medium priority (ODEQ 2000). The WQMP recommends that restoration efforts focus on protecting high quality water and habitat.

In this reach restoration activities should focus on reducing the effects of livestock grazing, timber harvest, and roads by reducing sediment input, improving riparian conditions (vegetation and streambanks), and increasing habitat complexity. Improved riparian conditions and habitat quantity/diversity, particularly in Fly Meadows, will lead to an improvement in summer water temperature. Examples of potential restoration activities include improving, closing, and/or relocating roads (to address sediment inputs), replanting riparian areas (to address elevated temperatures), and implementing appropriate standards/guidelines and BMPs within timber harvest and grazing operations.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook habitat through the following actions:
    1. Improve maintenance on approximately 0.25 miles of road;
    2. Decommission or relocate approximately 3.25 miles of roads located in riparian areas.
- Protect and enhance riparian areas through the following actions:
    - Improve grazing practices on approximately 37 acres of private land. This can include development and implementation of one grazing management plan;
    - Reduce and minimize erosion on approximately 0.25 miles of the stream;
    - Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately 50 acres
- Instream habitat could be enhanced by:
    1. Adding structure (primarily large wood) in approximately 4.5 miles of stream.
    2. Relocating approximately two miles of channelized river and reconnecting it to the floodplain;
    3. Stabilizing and rehabilitating a headcut in Little Fly Creek.
- Improve fish passage in the Fly Creek drainage by replacing the following culverts:
    1. Fly Creek – 2 culverts;
    2. Little Fly Creek – 1 culvert;
    3. East Fork Little Fly Creek – 1 culvert;
    4. Lookout Creek – 1 culvert;
    5. Umapine Creek – 1 culvert;
    6. Unnamed Tributary – 1 culvert;
    7. Squaw Creek – 1 culvert

Meadow Creek and Tributaries (McCoy and Dark Canyon Creeks) (UGC4)

Primary Limiting Factors: Excess Fine Sediment; Water Quality (high temperatures, D.O., alkalinity, ammonia, chloride, pH); Habitat Quantity/Diversity (lack of pools); Water Quantity (low summer flows)

Threats: Timber Harvest (historic splash damming); Roads

Lower Meadow Creek is ranked fourth in priority for restoration in the Upper Grande Ronde spring Chinook population (NPCC 2004a). Future actions within the Meadow Creek drainage should protect and restore existing riparian vegetation and function (to address elevated temperatures), implement appropriate standards/guidelines and BMPs within areas used for grazing and timber harvest (to address sedimentation and temperature), improve, Decommission, and/or relocate roads (to address sedimentation), and increase pool habitat through large wood placement (GRMWP 1994GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook habitat through actions to:
    1. Improve maintenance on approximately three miles of road;
    2. Decommission or relocate approximately one mile of riparian road (Upper McCoy, Dark Canyon, and Meadow creeks).

- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 620 acres of private land. This can include development and implementation of eight grazing management plans.
    2. Construct protection fencing along approximately two miles of stream to protect riparian areas;
    3. Develop up to 10 off-channel livestock water developments;
    4. Plant riparian vegetation in approximately 50 acres of riparian area;
    5. Enroll approximately five miles of stream in CREP or a similar program;
    6. Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately six miles of stream;
    7. Relocate or remove one recreation site within a riparian area.

- Enhance instream habitat by:
    1. Adding structure (primarily large wood) in approximately eight miles of stream (particularly Meadow Creek);
    2. Relocating approximately 3.5 miles of channelized stream, and reconnecting it to the floodplain;
    3. Removing channel confining structures (levees, dikes) along approximately four miles of stream (railroad grade along Bear Creek);
    4. Adding structure to approximately eight miles of stream.

- Improve fish passage by removing one barrier.

Upper Grande Ronde River Mainstem, Meadow Creek to Sheep Creek (UGC5)

Primary Limiting Factors: Sediment; Water Quantity (low summer flows); Water Quality (high temperatures, pH); Habitat Quantity/Diversity (lack of pools and large woody debris); Degraded Riparian Condition

Threats: Livestock Grazing; Timber Harvest; Roads

Based on EDT results in the Grande Ronde Subbasin Plan (NPCC 2004a), restoration within this portion of the Grande Ronde River would have the highest benefit of all reaches within the Upper Grande Ronde population. Protection benefit also ranked very high (2nd of 17 reaches), and therefore also is likely to be of great benefit to the population (NPCC 2004a). This reach is also rated high priority for treatment under the WQMP (ODEQ 2000). Restoration and protection activities should be a very high priority for this reach and should be given equal focus.

The WQMP suggested that treatments to reduce stream temperatures include increasing shade cover, maintaining/increasing instream flows during critical periods (July through September), reducing bankfull channel widths to a maximum of 82 to 98 feet, and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat through actions to:
    1. Improve maintenance on approximately one mile of road;
    2. Road obliteration of two miles of draw-bottom road on Warm Springs Creek, and relocation to alternate site.

- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 510 acres of private land. This can include development and implementation of five grazing management plans;
    2. Move or fence (with adequate buffer) two feedlots;
    3. Construct protection fencing along approximately 12 miles of stream to protect riparian areas;
    4. Develop up to 60 off-channel livestock water developments;
    5. Plant riparian vegetation in approximately 43 acres of riparian area (particularly along the Grande Ronde River mainstem);
    6. Enroll approximately seven miles of stream in CREP or a similar program;
    7. Reduce and minimize erosion along approximately one mile of stream;
    8. Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately one mile of stream;

9. Relocate or remove five recreation sites within a riparian area.

- Enhance instream habitat by:
  1. Adding structure (primarily large wood) in approximately eight miles of stream (between Starkey and Vey Meadows);
  2. Relocating approximately 3.5 miles of channelized stream, and reconnecting it to the floodplain;
  3. Removing channel confining structures (levees, dikes) along approximately four miles of stream (railroad grade along Bear Creek).

- Improve fish passage by removing the following barriers:
  1. Replace two culverts in Winter Canyon.

Upper Grande Ronde River Mainstem, Sheep Creek to Meadowbrook Creek (UGC6)

Primary Limiting Factors: Sediment; Water Quantity (low summer flows); Water Quality (high temperatures); Habitat Quantity/Diversity (lack of pools and large woody debris); Degraded Riparian Condition

Threats: Livestock Grazing; Timber Harvest; Roads

Based on EDT results in the Grande Ronde Subbasin Plan (NPCC 2004a), restoration within this portion of the Grande Ronde River would be of very high benefit to the Upper Grande Ronde spring Chinook population (the reach ranked 4th of 17 reaches). This reach may even have the highest restoration benefit for the Upper Grande Ronde Chinook population (P. Boehne personal communication). Protection benefit also ranked very high (5th of 17 reaches), and therefore also is likely to be of great benefit to the population (NPCC 2004a). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000). Within the reach, protection and restoration activities should be given equal priority.

This reach also benefits from restoration projects implemented in the reaches above Meadowbrook Creek (WWNF 2004). Future restoration activities should continue to focus on reducing sediment load, improving water quality (particularly temperature), and increasing pools and large wood structure.

Suggested treatments to reduce stream temperatures in the WQMP include increasing shade cover, maintaining/increasing instream flows during critical periods (July through September), reducing bankfull channel widths to a maximum of 65 feet, and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately three miles of road.

- Protect and enhance riparian areas through the following actions:

  - Improve grazing practices on approximately 220 acres of private land. This can include development and implementation of one grazing management plan;
  - Construct protection fencing along approximately three miles of stream to protect riparian areas;
  - Develop up to 15 off-channel livestock water developments;
  - Plant riparian vegetation in approximately 18 acres of riparian area (particularly along the Grande Ronde River mainstem);
  - Enroll approximately three miles of stream in CREP or a similar program;
  - Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately 1.5 miles of stream.

- Improve fish passage by replacing one culvert.

Upper Grande Ronde River Mainstem, Meadowbrook Creek to East Fork, and Clear Creek Tributary (UGC7)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (lack of pools and large woody debris); Degraded Riparian Condition

Threats: Timber Harvest; Historic Dredge Mining; Livestock Grazing

Based on EDT results in the Grande Ronde Subbasin Plan (NPCC 2004a), restoration within this portion of the Grande Ronde River would be of moderate benefit to the Upper Grande Ronde spring Chinook population (the reach ranked 11th of 17 reaches). Protection benefit also ranked in the moderate range (12th of 17 reaches) (NPCC 2004a). Clear Creek is rated low priority for treatment under DEQ's WQMP; efforts should focus on protecting high quality water and habitat. The East Fork of the Grande Ronde River is rated low priority in the headwaters, but high priority in the mine tailing area (ODEQ 2000). Overall within the reach, protection and restoration activities should be given equal priority.

Restoration projects within the Clear Creek drainage and reaches above the mouth of East Fork Grande Ronde River have been implemented to improve conditions and likely will provide some benefit within this reach (WWNF 2004). Future restoration activities should continue to focus on reducing sediment load, increasing pools and large wood, and addressing impacts from historic mining and the associated tailings (e.g., restoring floodplain connectivity, increasing pool habitat, and adding large woody debris). Examples of potential restoration activities include improving, closing, and/or relocating roads, planting riparian areas, and continuing to implement appropriate standards/guidelines and BMPs within timber harvest operations.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat through the following action:
  1. Improve maintenance on approximately six miles of road;
  2. Road obliteration of two miles of draw-bottom road.

- Protect and enhance riparian areas through the following action:
  1. Improve grazing practices on approximately 37 acres of private land. This can include development and implementation of one grazing management plan;
  2. Construct protection fencing along approximately 0.5 miles of stream to protect riparian areas from livestock impacts;
  3. Develop two off-channel livestock water developments;
  4. Plant riparian vegetation in approximately 37 acres of riparian area (particularly along the Grande Ronde River mainstem);
  5. Enroll approximately 0.5 miles of stream in CREP or a similar program;
  6. Reduce and minimize erosion along approximately one mile of stream;
  7. Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately 63 riparian acres;
  8. Relocate or remove 10 recreation sites within riparian areas.

- Enhance instream habitat by:
  1. Adding structure (primarily large wood) in approximately two miles of stream (particularly mainstem Grande Ronde River between Muir Creek and East Fork Grande Ronde River);
  2. Relocate approximately two miles of channelized stream, removing confinement structures and reconnecting it to the floodplain;
  3. Headcut stabilization and meadow rehabilitation in the Upper Grande Ronde tributaries between Tanner Gulch and East Fork Grande Ronde River.

- Improve fish passage by removing the following barriers:
  1. Replace one culvert in Muir Creek;
  2. Replace one culvert in East Fork Clear Creek;
  3. Replace one culvert in East Fork Grande Ronde River.

Sheep Creek and Chicken Creek (UGC8)

Primary Limiting Factors: Sediment; Water Quality (high temperatures); Habitat Quantity/Diversity (lack of pools)

Threats: Roads; Livestock Grazing; Timber Harvest

Based on EDT results in the Grande Ronde Subbasin Plan (NPCC 2004a), restoration within this reach would be of relatively high benefit to the Upper Grande Ronde spring Chinook population (ranked 4th). Sheep Creek's protection benefit ranked highest of all 17 reaches (NPCC 2004a). Lower Sheep Creek is rated high priority for treatment under DEQ's WQMP; Upper Sheep Creek is rated low priority. Chicken Creek is rated low to medium priority (ODEQ 2000). Restoration and protection activities within the Sheep Creek drainage should be a very high priority for the Upper Grande Ronde spring Chinook population.

Restoration activities should address improving rearing habitat in this reach, which would increase the abundance and productivity of spring Chinook. Restoration should continue to focus on reducing sediment load, improving water quality (particularly temperature), and increasing pools.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat through the following action:
    1. Improve maintenance on approximately five miles of road;
    2. Road obliteration on approximately 1.5 miles of road and relocate to ridgetop location.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 366 acres of private land. This can include development and implementation of one grazing management plan;
    2. Construct protection fencing along approximately two miles of stream to protect riparian areas;
    3. Develop up to 10 off-channel livestock water developments;
    4. Plant riparian vegetation in approximately 58 acres of riparian area;
    5. Enroll approximately five miles of stream in CREP or a similar program;
    6. Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately two miles of stream;
    7. Relocate or remove two recreation sites within riparian areas.
- Enhance instream habitat by:
    1. Adding structure (primarily large wood) in approximately two miles of stream (particularly mainstem Grande Ronde River between Muir Creek and East Fork Grande Ronde River);
    2. Relocating approximately two miles of channelized stream, removing confinement structures and reconnecting it to the floodplain;
    3. Implementing headcut stabilization and meadow rehabilitation in the Upper Grande Ronde tributaries between Tanner Gulch and East Fork Grande Ronde River.
- Improve fish passage by removing the following barriers:
    1. Replace two culverts in Sheep Creek;
    2. Replace one culvert in Chicken Creek;
    3. Replace one culvert in East Sheep Creek.

Limber Jim Creek and Tributaries (UGC9)

Primary Limiting Factors: Sediment; Water Quality (high temperatures); Habitat Quantity/Diversity (lack of pools)

Threats: Timber Harvest; Roads; Dispersed Recreation

Based on EDT results in the Grande Ronde Subbasin Plan (NPCC 2004a), restoration within this portion of the Grande Ronde River system would be of moderate benefit to the Upper Grande Ronde spring Chinook population (the reach ranked 8th of 17 reaches). Limber Jim Creek's protection benefit ranked lower (13th of 17 reaches) (NPCC 2004a). This reach is rated low priority for treatment under DEQ's WQMP; efforts should focus on protecting high quality water and habitat (ODEQ 2000).

Restoration projects within Limber Jim drainage have been implemented in an effort to improve conditions; these projects will provide some benefit to this reach (WWNF 2004). Additional restoration actions should focus on improving spawning and rearing habitat by continuing to focus on reducing sediment load, improving water quality (particularly temperature), and increasing pools.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately 2.8 miles of road.

- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 18 acres of private land. This can include development and implementation of one grazing management plan.
    2. Construct protection fencing along approximately 0.25 miles of stream to protect riparian areas;
    3. Plant riparian vegetation in approximately 1.5 acres of riparian area;
    4. Enroll approximately 0.25 miles of stream in CREP or a similar program;
    5. Noncommercially thin forested riparian areas to promote future large wood recruitment on approximately 0.25 miles of stream;
    6. Relocate or remove five recreation sites within riparian areas.

- Enhance instream habitat by adding structure (primarily large wood) in approximately 0.5 miles of stream.

Imnaha River Spring Chinook Population

Primary habitat factors limiting spring/summer Chinook in the Imnaha River include high stream temperatures and excessive fine sediment (Huntington 1994; GRMW 1995; Wallowa County–Nez Perce Tribe 1999; WWNF 2003; NPCC 2004B; ODEQ 2006). The following reaches are on the Oregon Department of Environmental Quality 303(d) list for temperature: Freezeout Creek, Grouse Creek, Lightning Creek, and the Imnaha River (RM 0-42.7). Cow Creek is listed as potential concern for temperature. There are no stream reaches on the list for sedimentation, DO, or nutrient loading.

Other factors limiting spring/summer Chinook production in the Imnaha River population are poor riparian condition, low flows, and fish passage (Huntington 1994; GRMW 1995; Wallowa County–Nez Perce Tribe 1999; WWNF 2003; NPCC 2004).

All the above limiting factors can be primarily attributed to the degradation of stream channels and riparian areas resulting from livestock grazing practices, forest management practices (timber harvest), road construction, and water withdrawals.

The Snake River Oregon recovery team has concluded that a high priority for the Imnaha River spring Chinook population would be to improve habitat conditions in the lower and middle reaches the Imnaha River through restoration activities that help moderate summer temperatures. Fish passage at the irrigation diversions on lower Grouse and Summit creeks should be provided. Also, actions that improve stream temperatures and increase the amount of spawning gravel would be very beneficial in areas that currently have limited spawning occurring (e.g., the mainstem Imnaha River below Freezeout Creek).

The Imnaha River spring Chinook population has been divided into four reaches based on similar habitat conditions and current land use, as well as similar use by spring/summer Chinook.

In the following reach discussions we recommend restoration actions for the Imnaha River spring Chinook populations by reach that would address the primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Imnaha River Mainstem (IRC1)

Limiting Factors: Water Quality (high temperatures); Excess Fine Sediment; Water Quantity (low summer flows)

Threats: Roads; Channelization; Agriculture; Livestock Grazing/Feeding Operations; Upstream Impacts (water diversions)

This portion of the Imnaha River has been ranked as a moderate priority for restoration actions (NPCC 2004b). Due to the size and location of the river, treatment of problems such as high temperatures, low flows, and sediment will be most effective if they were to occur in upstream areas (NPCC 2004b), such as Big and Little Sheep creeks. The Imnaha Subbasin Plan (NPCC 2004b) recommends starting in the upper watersheds of the subbasin and working downstream with recovery actions.

Potential restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately 15 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately one mile of stream to protect riparian areas from degradation by livestock.
    2. Develop approximately 15 off-channel livestock watering sites.
    3. Plant riparian vegetation in approximately 100 acres of riparian zone.
    4. Enroll approximately three miles of river front into CREP or a similar program.

Cow, Lightning, and Horse Creeks (IRC2)

Primary Limiting Factors: Water Quality (high temperatures); Channel Stability

Threats: Livestock Grazing; Roads; Timber Harvest

The Imnaha River Subbbasin Plan ranks Cow, Lightning, and Horse creeks as 8th, 13th and 17th respectively (out of 28 reaches) for restoration actions.

Channel instability in these streams is primarily a function of naturally occurring high flow events. Addressing the threats causing high temperatures here will also promote healthy riparian areas and more stable streambanks.

- The only restoration action identified by local natural resource professionals that best address the current limiting factors and threats in this reach is to improve maintenance on approximately 13 miles of road that parallels these streams.

Upper Imnaha River Mainstem (IRC3)

Primary Limiting Factors: Water Quality (high temperatures); Excess Fine Sediment; Habitat Quantity/Diversity

Threats: Livestock Grazing; Timber Harvest; Roads; Agriculture

The Imnaha River Subbasin Plan rates this portion of the mainstem a high priority for restoration actions (NPCC 2004b). The mainstem Imnaha River from the town of Imnaha to Freezeout Creek is ranked second, while the section from Imnaha down to Fence Creek is ranked seventh. This reach contains the primary spring/summer Chinook spawning area for this population, which is located between Crazyman Creek (RM 50.6) and Blue Hole (RM 71).

Potential restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately 35 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately eight miles of stream to protect riparian areas.
    2. Develop approximately eight off-channel livestock watering sites.
    3. Enroll approximately three miles of river front into CREP or a similar program.
    4. Remove or relocate approximately 10 recreational sites located in riparian areas.
- Improve adult and juvenile fish passage in this reach by modifying the fish ladder at the Gumboot Acclimation facility to better facilitate fish passage.

Upper Imnaha River Tributaries (IRC4)

Primary Limiting Factors: Water Quantity (high and low flows); Water Quality (high temperatures); Channel Stability; Riparian Condition; Fish Passage

Threats: Roads; Timber Harvest; Livestock Grazing; Water Withdrawals; Barriers

The Imnaha River Subbasin Plan ranks these streams as low to moderate priority for restoration actions (NPCC 2004b). Restoration actions are unlikely to result in large increases in production in the tributaries, since they contain relatively low numbers of rearing juvenile Chinook salmon and are not used by other life stages. However, restoration actions in upper Imnaha tributaries that improve riparian conditions and channel stability in these tributaries will benefit water quality and instream conditions in downstream reaches in the mainstem Imnaha. Restoration actions would affect juvenile rearing and migration in the tributaries and potentially rearing and spawning in downstream reaches.

Irrigation diversion structures present passage barriers to juvenile movement in the lower reach of both Grouse Creek and Summit Creek. Both of these structures, especially the Summit Creek diversion, are high priorities for restoration actions and need to be examined to determine a solution. The Summit Creek ditch supplies water to a single landowner. This ditch could be converted to a pipe which would conserve water and eliminate the current diversion of nearly all of the Summit Creek flow. Reconstruction of the diversion structure would also eliminate the current inadequate return system for trapped juvenile steelhead. Modification of the Grouse Creek diversion could allow upstream passage for juvenile fish (downstream passage is currently possible).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook habitat through the following actions:
    1. Improve maintenance on approximately 10 miles of road;
    2. Decommission or relocate one mile of road.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately 2.5 miles of stream to protect riparian areas;
    2. Develop approximately five off-channel livestock watering sites;
    3. Enroll approximately three miles of river front into CREP or a similar program.
- Enhance instream habitat by saving approximately three cfs through improving irrigation efficiency.

Big Sheep Creek Spring Chinook Population

The Big Sheep Creek spring Chinook population has been divided into three reaches based on similar habitat conditions and current land use, as well as similar use by spring/summer Chinook. Primary factors limiting spring Chinook in the Big Sheep Creek include low flows, excessive fine sediment, high stream temperatures, poor riparian condition, (Huntington 1994; GRMW 1995; Wallowa County–Nez Perce Tribe 1999; WWNF 2003; NPCC 2004; ODEQ 2006). The following reaches are on the Oregon Department of Environmental Quality 303(d) list for temperature: Big Sheep Creek (RM 0-10) and

Little Sheep Creek (RM 0-26). There are no stream reaches on the list for sedimentation, DO, or nutrient loading.

Other factors limiting spring Chinook production in the Big Sheep Creek Watershed involve the lack of habitat quantity and diversity (lack of large wood and low pool frequency and quality), and passage barriers (Huntington 1994; GRMW 1995; Wallowa County–Nez Perce Tribe 1999; WWNF 2003; NPCC. 2004; Christian 2007).

All the above limiting factors can be primarily attributed to the degradation of stream channels and riparian areas resulting from road construction, agriculture, livestock grazing practices, water withdrawals, and forest management practices (timber harvest).

The Snake River Oregon recovery team has concluded that a high priority for the Imnaha River and Big Sheep Creek spring Chinook populations would be to improve habitat conditions in the lower and middle reaches of Big Sheep Creek, Little Sheep Creek through restoration activities that help moderate summer temperatures. There is also substantial opportunity to improve habitat conditions in the lower portion of the upper reach of Big Sheep Creek, between Owl and Coyote creeks (Brad Smith, Personal communication). This could be done by reconnecting floodplains and wet meadows, improving riparian habitat and instream complexity, and increasing flows in Big and Little Sheep creeks. Also, actions that improve stream temperatures and increase the amount of spawning gravel would be very beneficial in areas that currently have limited spawning occurring (e.g., Big Sheep Creek below Lick Creek).

In the following reach discussions we recommend restoration actions for the Big Sheep Creek spring Chinook population by reach that would address the primary limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Big Sheep and Little Sheep Creek Mainstem (BSC1)

Primary Limiting Factors: Water Quantity (low summer flows); Water Quality (high temperatures); Excess Fine Sediment; Riparian Condition; Habitat Quality/Diversity (Lack of pools and large wood); Fish Passage

Threats: Livestock Grazing; Roads; Agriculture; Water Withdrawal; Timber Harvest

Big Sheep Creek, above the mouth of Little Sheep Creek, is ranked as the top priority in this population for restoration actions. Little Sheep Creek is ranked seventh. Restoration actions addressing threats and limiting factors in this reach would affect spawning, rearing, and migration in Big Sheep Creek; and rearing and migration in Little Sheep Creek.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook salmon habitat by improving maintenance on approximately 25 miles of road.
- Protect and enhance riparian areas by pursuing the following actions:

1. Improve grazing practices on approximately 400 acres of private land. This can include development and implementation of approximately five grazing management plans.
2. Move or fence (with adequate buffer) five feedlots to protect riparian habitat.
3. Construct protection fence on approximately eight miles of stream to protect riparian areas.
4. Develop approximately 10 off-channel livestock watering sites.
5. Enroll approximately eight miles of river front into CREP or a similar program.

- Improve instream habitat for Chinook salmon and reconnect approximately one mile of channelized stream to the floodplain by removing confinement structures (levees, dikes, etc).
- Improve instream habitat by saving approximately 10 cfs for instream flows through increased efficiency and control of flow diversion upstream at the Wallowa Valley Improvement Canal (WVIC) diversion structure.
- Enhance juvenile Chinook salmon migration by modifying two passage impediment structures on Little Sheep Creek, both diversions at the steelhead acclimation facility at RM 4.6.

Upper Big Sheep Creek Mainstem (BSC2)

Primary Limiting Factors: Water Quantity (high and low flows); Water Quality (high temperatures); Excess Fine Sediment

Threats: Timber Harvest; Roads; Water Withdrawal; Livestock Grazing

The Imnaha River Subbasin Plan ranks the upper mainstem of Big Sheep Creek, below Lick Creek, as high for restoration actions. This reach contains nearly all spawning habitat for Big Sheep Creek spring Chinook. Migration, spawning, incubation, and juvenile rearing would be affected by restoration actions in this reach.

The WVIC diversion at the South Fork Big Sheep confluence, and the dry channel directly below it (during the irrigation season) present a passage barrier to juvenile Chinook salmon, though habitat above the diversion is marginal rearing habitat due to its high gradient. Salmon are not known to spawn this high in the Big Sheep Creek system.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook habitat through the following actions:
  1. Improve maintenance on approximately six miles of road;
  2. Replacement of two culverts would lessen sediment input and improve juvenile upstream migration at low flows.
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately five acres of private land;

2. Construct protection fence on approximately six miles of stream to protect riparian areas from degradation by livestock and allow riparian regeneration.

- Improve instream habitat by saving approximately 10 cfs for instream flows through increased efficiency.

Big Sheep Creek Tributaries (BSC3)

Primary Limiting Factors: Excess Fine Sediment; Water Quantity (high flows)

Threats: Roads; Livestock Grazing; Recreation

The Imnaha River Subbasin Plan ranks Camp Creek as low, and Lick Creek as moderate for restoration actions. No rankings are given the other tributaries. Potential actions that reduce or eliminate the effects of the above threats and associated limiting factors would improve rearing and migrating for juveniles Chinook salmon.

High flows in these streams are a function of the flashy nature of these snow-melt influenced systems. Therefore, no restoration actions are being proposed to address this limiting factor.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on Chinook habitat through the following actions:
  1. Improve maintenance on approximately two miles of road;
  2. Replace one culvert to improve juvenile upstream migration at low flows.
- Protect and enhance riparian areas through the following actions:
  1. Construct protection fence on approximately two miles of stream to protect riparian areas from degradation by livestock;
  2. Develop up to five off-channel livestock watering sources;
  3. Relocate of up to six camp sites located adjacent to the riparian area.

Tributary Habitat Recovery Actions for Grande Ronde Steelhead MPG

Joseph Creek Steelhead Population

The ICTRT has determined that the overall viability rating for the Joseph Creek steelhead population is highly viable as a result of the Abundance/Productivity rating of very low risk and the Spatial Structure/Diversity rating of low risk (ICTRT 2007). Spawning is distributed broadly throughout the population boundaries including mainstem Chesnimnus Creek and tributaries, Crow, Elk, and Swamp creeks as well as in the lower subbasin in the Cottonwood drainage. Spawners are believed to be mostly all natural-origin fish as few hatchery fish have been observed in the population.

The primary factors limiting summer steelhead production in the Joseph Creek system are water temperature and excess fine sediment (Huntington 1994; GRMW 1995; Wallowa County–Nez Perce

Tribe 1999; Sondenaa and Kozusko 2002; NPCC 2004; USFS 2005; Wallowa County Community Planning Process Group (WCCPPG); Upper Joseph Creek Watershed Assessment 2005). Other factors limiting summer steelhead production include reduced wetted widths, frequency and quality of pools (lack of large wood and pools), degraded riparian areas, and hydrologic function (timing, duration, and quantity of peak flows; Huntington 1994; BLM and USFS 1998; BLM and USFS 2001; Sondenaa and Kozusko 2002; USFS 2005; WCCPPG 2005). Road construction, grazing, and timber harvest activities have been the primary threats contributing to degradation of riparian areas in the Joseph Creek system.

The recovery planning team has recommended that the highest priority for restoration actions be those that reduce stream temperatures and minimize sediment input on lower Chesnimnus Creek, Crow Creek, and upper Swamp Creek. The source of high stream temperatures and excess fine sediment in Chesnimnus and Joseph creeks is largely from degraded upstream conditions. It follows that restoration actions designed to increase stream shade, reconnect floodplains, restore wetlands, protect upland water sources (i.e., springs and seeps) from livestock grazing, eliminate road and livestock related sediment sources, and improve instream habitat complexity should be pursued in the upstream reaches as well as lower Chesnimnus Creek, Crow Creek, and upper Swamp Creek.

In the following reach discussions we recommend restoration actions for the Lower Grande Ronde steelhead population by reach that would address the known limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Joseph Creek Mainstem—Mouth to Confluence of Chesnimnus and Crow Creeks (JCS-1)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Excess Fine Sediment

Threats: Livestock Grazing; Roads; Timber Harvest; Agriculture

The EDT analysis indicates that this reach is the second highest priority in this population for restoration benefits. Priority action for this reach should be to protect existing riparian vegetation and function. Potential restoration actions within the Joseph Creek mainstem are limited. Water quality improvements and sediment reduction will likely depend on improving conditions higher in the watershed. The degree of improvement in summer water temperatures that can be expected in this reach is unknown. Periods of high temperatures likely occurred historically, even in pristine condition.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 15 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 20 acres of private land. This can include development and implementation of one grazing management plan;
    2. Move or fence (with adequate buffer) one feedlot to protect riparian areas;

3. Construct protection fence on approximately 0.5 miles of stream to protect riparian areas from degradation by livestock;
4. Develop two off-channel livestock watering sites;
5. Enroll approximately 0.5 miles of river front into CREP or a similar program.

Cottonwood Creek and Tributaries (JCS-2)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Excess Fine Sediment

Threats: Roads; Livestock Grazing

EDT analysis ranks this reach as moderate (sixth out of nine reaches) priority for restoration, but predicts that restoration actions would produce a 75 percent increase in abundance of steelhead (NPCC 2004). Actions to reduce impacts of roads on streams in the drainage and to restore and protect riparian areas and their function would likely result in increased abundance and productivity of summer steelhead in the Cottonwood Creek drainage (NPCC 2004).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission, obliterate, or relocate six miles of riparian road in the Broady Creek drainage;
  2. Improve maintenance on approximately 15 miles of road;
  3. Remove or repair two culverts in the Broady Creek system.
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 890 acres of private land. This can include development and implementation of two grazing management plans;
  2. Plant riparian vegetation in approximately 120 acres of riparian area, mostly in the Nez Perce Tribal Precious Lands.
- Improve fish passage by modifying or removing an irrigation diversion structure on private land in Horse Creek.

Joseph Creek Small Tributaries (JCS-3)

Primary Limiting Factors: Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and large wood)

Threats: Roads; Livestock Grazing

EDT analysis (NPCC 2004) ranked this reach as a low restoration benefit, suggesting only a slight improvement in steelhead abundance and productivity for the Joseph Creek population with restoration actions. Priority restoration actions for this area are protection of riparian areas from the effects of roads and livestock grazing. The benefits of relocation or obliteration of roads in Sumac, Cougar, and

Tamarack creeks should be investigated. Little information is available on steelhead abundance in these streams and we are uncertain how much production will be gained by restoration actions.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Improve maintenance on approximately two miles of road along lower Cougar Creek;
  2. Remove or repair one culvert on Tamarack Creek.
- Enhance and improve riparian areas through the following actions:
  1. Fence approximately 0.5 miles of Sumac Creek from livestock;
  2. Develop up to two off-channel water sites for livestock in lower Sumac Creek.

Swamp and Davis Creeks (JCS-4)

Primary Limiting Factors: Excess Fine Sediment; Water Quality (high summer stream temperatures; Degraded Riparian Condition

Threats: Livestock Grazing; Agriculture; Roads

EDT analysis ranks Swamp Creek as a moderate priority for restoration benefits, but predicts more than 75 percent increase in steelhead abundance with restoration actions.
Potential actions to improve abundance and productivity of summer steelhead in the Swamp Creek drainage are to continue riparian enhancement and protection and to restore functioning wet meadows. Primary areas for restoration efforts in Swamp Creek are the agricultural areas in the headwaters from around Beaver Creek upstream, and the meadow reaches between Forest Road 46 and the Chico Trail crossing. Lower Davis Creek (downstream of Chico Trail) would also benefit from reduced livestock use in the riparian area (USFS 2005), particularly in the meadow sections. Reduction of grazing impacts and removal of confining structures such as dikes and roads (Swamp Creek) would enhance the functioning of riparian areas and wetlands and improve habitat conditions for steelhead. Some planting of native shrubs may still be required in the meadow section of Swamp Creek to improve the diversity of woody species in the riparian areas.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 10 miles of road along Swamp and Davis creeks. Road obliteration or closure of the meadow sections of the Swamp Creek Road above the Cow Camp should be investigated.
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 72 acres of private land. This can include development and implementation of one grazing management plan;
  2. Construct protection fence on approximately two miles of stream in upper Swamp Creek (private land) to protect riparian areas from degradation by livestock;

3. Develop four additional off-channel livestock watering sites, two on private land and two on National Forest;
4. Plant riparian vegetation in approximately 20 acres of riparian area on private land in upper Swamp Creek;
5. Stabilize erosion along approximately 0.25 miles on Swamp Creek on the National Forest, where water gaps allow livestock access to the stream;
6. Noncommercially thin approximately 180 acres of forested riparian areas along five miles of Swamp Creek on the National Forest to promote future large wood recruitment.

Elk and Crow Creeks (JCS-5)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools and large wood); Degraded Riparian Condition

Threats: Roads; Livestock Grazing

EDT analysis ranks this reach as a moderate restoration benefit but suggests restoration actions could increase steelhead abundance about 75 percent in these streams (NPCC 2004). Significant sediment impacts have been observed in Crow Creek (NPCC 2004). Steelhead abundance and productivity in Elk and Crow creeks would be improved by reducing sediment input through expanding protection of riparian areas from livestock, and reducing road densities (and sediment input from roads). The primary draw-bottom roads along Elk and Crow creeks are major access routes to private and public lands in the Joseph Creek watershed. It may not be feasible to remove the influence of those roads from the riparian areas. However, it may be feasible to reduce road densities elsewhere in the watershed and improve the surface and drainage characteristics of main roads to address sediment delivery to Elk and Crow creeks. Improved stream bank stability through riparian enhancement would also reduce sediment problems.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Improve maintenance on approximately four miles of road;
  2. Decommission or relocate approximately 2.5 miles of road along Elk Creek;
  3. Replace one culvert on Little Elk Creek.
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 108 acres of private land. This can include development and implementation of one grazing management plan;
  2. Relocate or fence (with adequate buffer) one livestock feeding area;
  3. Construct protection fence on approximately four miles of stream on private land bordering Elk Creek to protect riparian areas from degradation by livestock;
  4. Develop five additional off-channel livestock watering sites;

5. Plant riparian vegetation in approximately 20 acres of riparian area on private land in upper Swamp Creek;
6. Stabilize erosion along approximately four miles on Crow Creek, and approximately 0.25 along Elk Creek, where water gaps allow livestock access to the stream;
7. Noncommercially thin approximately one mile of forested riparian areas along Elk Creek to promote future large wood recruitment.

- Improve instream habitat conditions by reconnecting approximately 0.25 miles of channelized stream to the floodplain.

Lower Chesnimnus Creek and Prairie Tributaries (JCS-6)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Excess Fine Sediment; Riparian Condition; Floodplain Connectivity; Habitat Quantity/Diversity (lack of pools and large wood)

Threats: Roads; Livestock Grazing; Agriculture; Stream Channelization

The EDT analysis ranks this reach as receiving the highest benefit from restoration actions within the Joseph Creek steelhead population. Abundance, productivity, and spatial structure of summer steelhead in the lower Chesnimnus Creek geographic area would be enhanced by actions to reduce water temperatures, improve channel condition and floodplain interaction, and reduce sediment delivery to streams. Specific actions include riparian enhancement and protection, removal of channel confining structures, and road reconstruction, relocation, and obliteration. The potential “trade-offs” between hydrologic effects and benefits to grazing management of the many small reservoirs in this geographic area should be investigated (BLM and USFS 1998).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Improve maintenance on approximately 20 miles of road along Pine, Alder, and Butte creeks. The three fords on these streams should be evaluated for possible reductions in sediment input;
  2. Replace one culvert at the mouth of Butte Creek.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 72 acres of private land. This can include development and implementation of one grazing management plan;
  2. Construct protection fence on approximately two miles of stream on middle Butte Creek (private land) to protect riparian areas from degradation by livestock;
  3. Plant riparian vegetation in approximately 50 acres of riparian area on private land in Pine Creek, on TNC lands;
  4. Stabilize erosion along approximately four miles of stream.

- Improve fish passage for juveniles by modifying or removing a barrier on Pine Creek.

Upper Chesnimnus Creek and Forest Tributaries (JCS7)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Excess Fine Sediment; Floodplain Connectivity; Habitat Quantity/Diversity (lack of pools and large wood); Water Quantity (low summer flows)

Threats: Roads; Livestock Grazing; Timber Harvest

The EDT analysis ranks this reach as providing a moderate benefit to the population from restoration actions. It is important however, to consider that the EDT analysis does not address the routing of impacts. Actions that reduce sediment input and lower stream temperatures in this reach will also provide valued benefit for all mainstem reaches downstream. This reach is one of the most heavily roaded geographic areas in the Grande Ronde Subbasin (NPCC 2004). Actions to address excess the effects of roads, excess fine sediment, high summer stream temperatures, channel conditions, and floodplain function, and fish passage at road crossings (ongoing), would benefit abundance, productivity and spatial structure of summer steelhead in upper Chesnimnus Creek and areas downstream.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission or obliterate approximately 122 miles of road (Upper Joseph Watershed Analysis);
  2. Improve maintenance on all roads that remain open to public use;
  3. Replace five culverts between S.F. Chesnimnus and E.F. Summit creeks, and Vance Draw.
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 72 acres of private land. This can include development and implementation of one grazing management plan.
  2. Construct protection fence on approximately 2.5 miles of stream on private land to protect riparian areas from degradation by livestock;
  3. Plant riparian vegetation in approximately 30 acres of riparian area on two private ranches;
  4. Stabilize erosion along approximately 2.5 miles of stream on two private ranches;
  5. Thin (noncommercially) forested riparian areas on approximately 160 acres to promote future large wood recruitment;
  6. Move one camp site in the riparian area in Vigne Campground.
- Improve instream habitat conditions by pursuing the following actions:
  1. Reconnect approximately one mile of channelized stream (Chesnimnus Creek) to its floodplain;
  2. Remove confinement structures (levees, dikes, etc) along approximately 0.5 miles of Chesnimnus Creek on private land.

Lower Grande Ronde River Steelhead Population

The ICTRT has not done a population viability assessment on the Lower Grande Ronde steelhead population due to lack of data. The Oregon portion of the Lower Grande Ronde River is designated as a Wild River under the Wild and Scenic Rivers Act, and is a migration corridor for all Grande Ronde subbasin steelhead populations.

Primary factors limiting summer steelhead in the Lower Grande Ronde River include water temperature, habitat diversity (primary pools, glides, spawning gravels), habitat quality/diversity (wood, hydrological modifications to the stream channel), sediment (Huntington 1994; GRMW 1995; BLM 1998; Wallowa County–Nez Perce Tribe 1999; BLM and USFS 2001; NPCC 2004a; ODEQ 2006), and low flows (WSCC 2002). The following reaches are on the ODEQ 303(d) list for temperature: Courtney Creek (RM 0-14.3), Grouse Creek (RM 0-RM1.4), Mud Creek (RM 0-23), Sickfoot Creek (RM 0-RM 7.5), Wallupa Creek (Wildcat Creek tributary, RM 0-RM 10.1), the Wenaha River (RM0-10.3), and the Wildcat Creek (RM 0-16) (ODEQ 2004). Courtney Creek is also listed as water quality limited, not needing a TMDL for flow modification). Lower Menatchee Creek is listed on the Washington State 303(d) list for temperature.

The limiting factors listed above can be primarily attributed to the degradation of stream channels and riparian areas resulting from homesteading, farming, ranching, livestock grazing, timber harvest, and road construction. Flow and temperature impairments are largely due to management activities upstream in the Grande Ronde River and its tributaries (WSCC 2002).

The recovery planning team determined that improving habitat conditions in the Lower Grande Ronde River (LGS1), Lower Grande Ronde River Tributaries (LGS2), and Wildcat/Mud/Courtney creeks (LGS5) through restoration activities that help increase habitat complexity and pool habitat, reduce sediment input, increase summer flows, moderate summer temperatures in tributary streams, reconnect floodplains and wet meadows, and improve riparian habitat condition would be a high priority for the Lower Grande Ronde River steelhead population. Restoration actions in the Middle and Upper Grande Ronde River that reduce stream temperatures and sediment input would also benefit this population. The continuation of the multi-agency integrated noxious weed management program is also a high priority for this population.

In the following reach discussions we recommend restoration actions for the Lower Grande Ronde steelhead population by reach that would address the known limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Grande Ronde River Mainstem, Mouth to Wenaha River (LGS1)

Primary Limiting Factors: Habitat Quantity/Diversity (lack of pools and large wood); Sediment; Water Quality (high summer temperature)

Threats: Agriculture; Livestock Grazing; Roads; Recreation; Residential Development

EDT analysis predicted less than 10 percent increase in steelhead abundance and less than 5 percent increase in productivity with restoration actions in the lower Grande Ronde River (NPCC 2004a). Actions that eliminate or reduce the above threats and associated limiting factors would have a limited effect on abundance, productivity, and possibly spatial structure of summer steelhead in the lower mainstem of the Grande Ronde River. In general there are limited opportunities for restoration in this section of the mainstem (NPCC 2004a).

Recommended restoration actions include continuing effort to control noxious weeds, restoring riparian vegetation, and protecting streambanks and riparian vegetation from the effects of livestock grazing. Reducing transport of sediment from upstream reaches would also benefit steelhead habitat within this reach.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 15 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 20 acres of private land by the development and implementation of one grazing management plan;
    2. Move or fence (with adequate buffer) one feedlot to protect riparian areas;
    3. Construct protection fence on approximately 0.5 miles of stream to protect riparian areas;
    4. Develop two off-channel livestock watering sites;
    5. Enroll approximately 0.5 miles of river front into CREP or a similar program.

Lower Grande Ronde River Tributaries (LGS2)

Primary Limiting Factors: Sediment; Water Quality (high summer stream temperatures); Riparian Condition; Habitat Quantity/Diversity (lack of pools and large wood); Water Quantity (late summer and fall low flow)

Threats: Agriculture; Livestock Grazing; Timber Harvest; Roads

These tributaries were identified as a priority for restoration of steelhead habitat through the EDT analysis, ranking second within this population (NPCC 2004a). Abundance and productivity of summer steelhead in the Lower Grande Ronde River tributaries would be enhanced by actions that reduce sediment delivery to streams and improve riparian vegetation. Reducing sediment in these small tributaries will not only improve habitat conditions in the tributaries themselves, it will also contribute to restoration of the mainstem habitat.

Recommended restoration actions include continuing efforts to control noxious weeds, restoring riparian vegetation, and protecting streambanks and riparian vegetation from the effects of livestock grazing. Due to the remote nature of these streams and the limited access to them, little is known about their condition and what specific restoration actions should be taken. Only one restoration action was

identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process to best address the current limiting factors and threats. It was to improve maintenance on approximately one mile of road to minimize the influence of roads on steelhead habitat.

Wenaha River Mainstem (LGS3)

Primary Limiting Factors: Habitat Quantity/Diversity (lack of pools and large wood)

Threats: Recreation

The EDT analysis indicates that restoration actions in the mainstem Wenaha River would result in a minimal change in abundance and productivity of summer steelhead (NPCC 2004a), and therefore is a low priority for restoration. Therefore, no restoration actions are recommended for the lower Wenaha River mainstem. The Wenaha River is considered a high priority for protection.

No restoration actions were identified by local natural resource professionals to address the current limiting factors and threats in this reach.

Wenaha River Forks and Tributaries (LGS4)

This reach of the Wenaha River is located within the Wenaha-Tucannon Wilderness Area, and data regarding habitat quality, threats, and limiting factors are limited. No limiting factors or threats have been identified.

The EDT analysis indicates that restoration actions would result in a minimal change in abundance and productivity of summer steelhead (NPCC 2004a), and is therefore ranked low for restoration. No restoration actions are recommended for the Wenaha River forks and tributaries. The Wenaha tributaries are considered a high priority for protection.

No restoration actions were identified by local natural resource professionals that can address the current limiting factors and threats in this reach.

Lower Grande Ronde River Mainstem, Wenaha River to Wallowa River (LGS5)

Primary Limiting Factors: Habitat Quantity/Diversity (lack of pools); Excess Fine Sediment; Water Quality (high summer temperature)

Threats: Agriculture; Livestock Grazing; Roads; Recreation

EDT analysis predicted less than a 5 percent increase in steelhead abundance and no increase in productivity with restoration actions in the lower Grande Ronde River between the Wenaha and Wallowa Rivers (NPCC 2004). Actions that eliminate or reduce the above threats and associated limiting factors would have a limited effect on abundance, productivity, and possibly spatial structure of summer steelhead in the lower mainstem of the Grande Ronde River. In general there are limited opportunities for restoration in this section of the mainstem (NPCC 2004).

Recommended restoration actions include continuing effort to control noxious weeds, restoring riparian vegetation, and protecting streambanks and riparian vegetation from the effects of livestock grazing.

Reducing transport of sediment from upstream reaches would also benefit steelhead habitat within this reach.

No specific restoration actions were identified by local natural resource professionals that would address the current limiting factors and threats in this reach.

Courtney, Mud, Grossman, and Wildcat Creeks (LGS6)

Primary Limiting Factors: Habitat Quantity/Diversity (lack of large wood); Sediment; Riparian Condition; Water Quality (high summer temperature); Water Quantity (high peak flows)

Threats: Livestock Grazing; Roads; Agriculture; Timber Harvest; Recreation (ATV use)

This reach contains Wildcat, Mud, Courtney, and Grossman creeks, which are ranked third, fourth, fifth, and sixth in restoration benefit for this population. These streams are the larger steelhead producing tributaries to the Lower Grande Ronde River. Abundance and productivity of summer steelhead would be enhanced by actions that improve riparian conditions, restore floodplain connectivity, and reduce the influence of roads on these streams. Such actions would affect spawning, incubation, rearing, and migration of summer steelhead.

High flows in these streams are a function of the "flashy" nature of these systems. There are no recommended actions, beyond those stated above, to address high flows in these tributaries. Continuation of the multi-agency integrated noxious weed management program is important for this reach.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission or relocate approximately 0.5 miles of road in riparian areas;
  2. Improve maintenance on approximately 15 miles of road;
  3. Replace four culverts between the Mud and Wildcat Creek systems.
- Protect and enhance riparian areas through the following actions:
  1. Develop two off-channel livestock watering sites;
  2. Plant riparian vegetation in approximately two acres of riparian area;
  3. Noncommercialy thin approximately 50 acres of forested riparian area to promote future large wood recruitment;
  4. Better manage ATV use to prevent riparian damage along approximately four miles of stream, primarily in the upper Mud Creek system;
  5. Restore approximately 10 acres wet meadows in the Mud Creek system;
  6. Restore meadows in approximately 25 acres in the Tope, Courtney, and Wildcat Creek systems.

Upper Tributaries of the Lower Grande Ronde River (LGS7)

Primary Limiting Factors: Habitat Quantity/Diversity; Sediment

Threats: Roads; Timber Harvest; Livestock Grazing; Agriculture

This reach contains Ward Canyon, Sickfoot, Elbow, Bear (2nd GR Bear Cr), Bear (3rd GR Bear Cr), Alder, Meadow, Clear, and Sheep creeks, which are smaller, mostly federally managed steelhead producing tributaries to the Lower Grande Ronde River. These streams are ranked low to moderate for restoration benefits. Abundance and productivity of summer steelhead in these streams would be enhanced by actions that reduce sediment produced by roads and livestock, primarily in the upper reaches.

Local natural resource professionals identified only one action for this reach:

- Improve fish passage by replacing one culvert

Wallowa River Steelhead Population

The Wallowa River steelhead population is rated as being at moderate risk of extinction within the next 100 years based on uncertainty in current abundance and productivity (ICTRT 2007). In this latest draft of the viability assessment for the population, the ICTRT determined that habitat conditions within some areas in the population have been significantly altered, and that the primary potential selective mortality factors are related to decreased flows and increased temperatures

Primary in-basin limiting factors for summer steelhead in the Wallowa River include water quality (sediment, temperature, and nutrients), water quantity, alteration of the hydrograph (from storage at Wallowa Lake, irrigation withdrawals, and other habitat modifications), instream habitat condition (loss of habitat complexity resulting from channelization, riparian area impacts, and low flow), and channel obstructions (primarily irrigation diversions and culverts) (Huntington 1994; GRMW 1995; R2 Resource Consultants, Inc. 1998; Wallowa County–Nez Perce Tribe 1999; HARZA Engineering Company 2001; NPCC 2004a; Fish Passage Assessment: Wallowa County, OR 2007).

The recovery planning team has concluded that restoration actions most needed in this population are those that: increase habitat complexity; decrease sediment input to streams; reconnect floodplains; increase summer flows, especially in the lower reaches of the Lostine River, Bear Creek, Hurricane Creek, and upper reach of the Wallowa River; and improve riparian conditions. The highest priority reaches for restoration actions that would increasing abundance and productivity in this population are the Lower Lostine River, Upper Wallowa River, Hurricane Creek, Middle Wallowa River, Lower Bear Creek, and Prairie Creek (NPCC 2004a).

In the following reach discussions we recommend restoration actions for the Wallowa River steelhead population by reach that would address the known limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Lower Wallowa River - mouth to Minam River (WRS-1)

Primary Limiting Factors: Water Quality (high summer water temperature, pH, coliform bacteria); Excess Fine Sediment; Floodplain Connectivity; Pathogens

Threats: Livestock Grazing; Timber Harvest; Roads (Railroad); Recreation

This reach is ranked forth (tied with Whiskey Creek) of 24 reaches in the EDT analysis for benefits from restoration actions. The Grande Ronde Subbasin Plan (NPCC 2004a) suggests that less than 10 percent improvement in steelhead abundance and productivity would result from restoration actions in the lower Wallowa River (NPCC 2004a). Opportunities for habitat restoration activities are limited in the lower Wallowa River. Water quality problems are mainly from activities upstream in the Wallowa Valley. The railroad along the lower Wallowa causes some channel confinement, lack of floodplain connectivity, and loss of riparian vegetation. However, the river flows through a confined canyon and floodplain area is naturally limited.

Priority actions for this reach should be to continue protections resulting from Wild and Scenic River designation, prevent degradation, and focus restoration actions in upstream reaches to address water quality issues.

There were no restoration actions identified by local natural resource professionals to address the current limiting factors and threats in this reach.

Lower Wallowa River Tributaries – Howard and Fisher Creeks (WRS-2)

Primary Limiting Factors: Water Quality (high summer water temperature); Riparian Condition; Excess Fine Sediment; Floodplain Connectivity; Habitat Quantity/Diversity

Threats: Roads; Livestock Grazing; Timber Harvest; Stream Channelization; Recreation (ATV use)

EDT analysis ranks restoration actions within the lower Wallowa River tributaries as providing a low benefit for this population (18th out of 24 reaches), suggesting that a less than 5 percent improvement in steelhead abundance and productivity may be expected with restoration actions (NPCC 2004a). Priority restoration actions for this area are to protect and improve riparian vegetation, reduce water temperature, and to reduce the influence of roads on riparian vegetation, channel complexity, floodplain connectivity, and sediment in Howard Creek.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by decommissioning or relocating approximately five miles of riparian road on private land.
- Protect and enhance riparian areas through the following actions:
    1. Noncommercially thin approximately 20 acres of forested riparian area to promote future large wood recruitment;
    2. Manage ATV use to minimize riparian impacts along approximately two miles of stream on private lands.

Wallowa River Canyon - Minam River to Dry Creek - and Tributaries (WRS3)

Primary Limiting Factors: Water Quality (high summer water temperature, pH, coliform bacteria); Riparian Condition; Excess Fine Sediment; Floodplain Connectivity; Habitat Quantity/Diversity (lack of pools and large wood); Fish Passage; Pathogens

Threats: Roads; Livestock Grazing; Timber Harvest; Barriers (weirs, culverts, and intake facilities); Stream Channelization; Recreation

EDT analysis ranked this reach as a moderate priority and predicted that restoration efforts would result in only slight improvement in steelhead abundance and productivity in Wallowa River canyon and tributaries (NPCC 2004a). Priority restoration actions for this area are to protect and restore riparian areas, reduce the influence of roads, and reestablish passage at barriers. Water quality issues in the Wallowa River will depend on restoration actions upstream of the Wallowa Canyon. It appears the best opportunity for enhancing steelhead abundance, productivity, and spatial structure is to address road issues (sediment and passage) in Deer Creek and Water Canyon.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Approximately eight miles of riparian road could be decommissioned or relocated on public and private land.
    2. Improve maintenance on approximately 15 miles of riparian road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 200 acres of private land.
    2. Develop and implement two grazing management plans;
    3. Relocate or fence (with adequate buffer) one livestock feeding operation on private land;
    4. Construct fencing on approximately one mile of stream to protect riparian areas from degradation by livestock;
    5. Construct four additional off-channel livestock watering sites, including two on private land and two on National Forest.
- Improve juvenile and adult fish passage by replacing culverts in Deer, Water Canyon, and Sage creeks, and modifying the weir at the acclimation facility on Deer Creek to improve juvenile passage.

Lower Minam River (downstream of Cougar Creek) and Tributaries (WRS-4)

Primary Limiting Factors: Water Quality (high summer water temperature); Excess Fine Sediment; Habitat Quantity/Diversity

Threats: Roads; Timber Harvest; Livestock Grazing

EDT analysis ranks restoration actions within the Lower Minam River as providing a low benefit for this population (14th out of 24 reaches), suggesting that a less than 5 percent improvement in steelhead abundance and productivity may be expected with restoration actions (NPCC 2004a). Priority

restoration actions for the lower Minam area are protection and enhancement of riparian vegetation and removal of stream-bottom roads.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate approximately five miles of riparian road;
  2. Improve maintenance on approximately eight miles of road;
  3. Replace one culvert.
- Improve riparian habitat conditions through the following actions:
  1. Improve grazing on approximately 75 acres of riparian area. This can include development and implementation of one grazing management plan;
  2. Develop approximately five off-channel water developments for livestock watering;
  3. Noncommercially thin approximately four miles of forested riparian area to promote future large wood recruitment;
  4. Improve management of ATVs along approximately two miles of stream on private land.
- Improve instream habitat conditions by adding structure to approximately two miles of stream.

Upper Minam River and Tributaries (Cougar, Trout, Murphy, and Elk Creeks, Little Minam and North Minam Rivers; WRS-5)

Primary Limiting Factors: Habitat Quantity/Diversity (naturally low pool frequencies)

Threats: Recreation

The Upper Minam River tributaries are rated a low priority for restoration, ranking 20 of 24 reaches in the EDT analysis. There is little opportunity for enhancement of the upper Minam River area. Habitat is relatively pristine although there are some legacy effects of logging and splash damming from the 1920's. There are also some impacts from past grazing by sheep and cattle and current use by recreationists and pack stock in a few specific areas of the upper Minam (Mays 1992). Priority recovery actions for the upper Minam River area are to maintain protection afforded by wilderness and wild and scenic designations.

There were no restoration actions identified by local natural resource professionals to address the current limiting factors and threats in this reach.

Mid-Wallowa River - Rock Creek to Lostine River (WRS-6)

Primary Limiting Factors: Water Quality (high summer water temperature, pH, coliform bacteria); Riparian Condition; Habitat Quantity/Diversity; Floodplain Connectivity; Water Quantity (low summer flows); Pathogens (whirling disease)

Threats: Water Diversion; Agriculture; Livestock Grazing; Residential Development

EDT analysis, conducted for subbasin planning, estimated approximately 10 percent improvement in steelhead abundance and 5 percent increase in productivity following restoration actions in the mid-Wallowa River (NPCC 2004a).

Abundance and productivity of summer steelhead in the mid-Wallowa River would benefit most from actions to restore and protect riparian areas, reestablish natural stream channels and floodplain connectivity, reduce inputs of nutrients and pollutants, and reduce surface water withdrawals for irrigation and stock watering.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Improve riparian habitat conditions through the following actions:
    1. Improve grazing on approximately 300 acres of riparian area. This can include development and implementation of three grazing management plan;
    2. Construct riparian fence along approximately one mile of stream to prevent livestock-related impacts;
    3. Develop approximately five off-channel water developments for livestock watering;
    4. Plant riparian vegetation in approximately 70 acres of riparian area;
    5. Reduce and minimize erosion along approximately 0.25 miles of stream.
- Improve instream habitat conditions through the following actions:
    1. Reconnect approximately one mile of channelized stream to the floodplain;
    2. Add structure to approximately two miles of stream;
    3. Remove confinement structures along approximately 1.5 miles of stream to reconnect the floodplain.
- Improve fish passage by modifying a diversion structure [where].

Rock and Dry Creeks (WRS-7)

Primary Limiting Factors: Excess Fine Sediment; Water Quality (high summer water temperature); Riparian Condition; Fish Passage (physical barriers and dewatered reaches in summer)

Threats: Roads; Livestock Grazing; Timber Harvest; Stream Channelization; Agricultural Development

EDT analysis conducted for subbasin planning suggested less than five percent improvement in steelhead abundance and productivity following restoration actions in the Dry Creek drainage (NPCC 2004a).

Priority restoration actions in Rock Creek and Dry Creek are riparian protection and enhancement, restoration of natural stream channels, and reconnection of floodplains. In several reaches (i.e. Reagin Gulch), restoration will require removing the influence of roads on stream channels and riparian areas.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the impact of roads on steelhead habitat by improving maintenance on approximately five miles of riparian road.

- Improve riparian habitat conditions through the following actions:
    1. Improve grazing on approximately 1,000 acres of riparian area. This can include development and implementation of up to 30 grazing management plans;
    2. Construct riparian fence along approximately 13 miles of stream to prevent livestock-related impacts;
    3. Develop approximately 50 off-channel water developments for livestock watering;
    4. Plant riparian vegetation in approximately 100 acres of riparian area;
    5. Enroll approximately 13 miles of stream on private land into CREP or other riparian protection program;
    6. Noncommercially thin forested riparian areas along up to 10 miles of stream to promote future large wood recruitment.

- Improve instream habitat conditions through the following actions:
    1. Reconnect approximately four miles of channelized stream to the floodplain;
    2. Add structure to approximately 13 miles of stream;
    3. Remove confinement structures along approximately one mile of stream to reconnect the floodplain.

Bear Creek and Tributaries (WRS-8)

Primary Limiting Factors: Water Quantity (low summer flows); Riparian Condition; Habitat Quantity/Diversity; Water Quality (high summer water temperature, nutrients); Excess Fine Sediment; Fish Passage (physical barriers and dewatered reaches in summer)

Threats: Stream Channelization; Water Diversion; Agriculture; Livestock Grazing; Roads; Residential Development; Recreation

EDT analysis conducted for subbasin planning suggested that restoration actions would produce little change in steelhead abundance and productivity in upper Bear Creek and would produce 5 to 10 percent increase in abundance and approximately 5 percent increase in productivity in lower Bear Creek (NPCC 2004a).

Priority restoration actions for Bear Creek are to reduce water demand and use in lower Bear Creek, reestablish natural channel courses and floodplain connectivity in Bear Creek downstream of Little Bear Creek, protect and restore riparian habitat conditions along Bear Creek and Little Bear Creek, and reduce the influence of roads on sediment and channel conditions in Bear Creek and Little Bear Creek Relocation of Boundary Campground should also be considered to improve riparian condition and reduce sediment.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the impact of roads on steelhead habitat by improving maintenance on approximately eight miles of riparian road.
- Improve riparian habitat conditions through the following actions:
    1. Relocate or fence (with adequate buffer) one livestock feeding operation;
    2. Develop one off-channel water development for livestock watering;
    3. Reclaim approximately eight cfs of streamflow for Bear Creek through improved irrigation system efficiencies, purchase of water, etc;
    4. Eliminate or relocate approximately four recreation sites located in riparian areas;
    5. Noncommercially thin approximately 30 acres of forested riparian area along approximately one mile of stream to promote future large wood recruitment.
- Improve instream habitat conditions through the following actions:
    1. Reconnect approximately four miles of channelized stream to the floodplain;
    2. Add structure to approximately 13 miles of stream;
    3. Remove confinement structures along approximately one mile of stream to reconnect the floodplain.
- Improve fish passage by modifying two diversion structures.

Whisky Creek (WRS-9)

Primary Limiting Factors: Excess Fine Sediment; Habitat Quantity/Diversity; Water Quality (high summer water temperature); Water Quantity (low summer flows); Floodplain Connectivity; Riparian Condition; Fish Passage (passage barriers and dewatered reaches in summer)

Threats: Roads; Livestock Grazing; Agriculture; Timber Harvest; Barriers

EDT analysis suggested less than five percent improvement in steelhead abundance and productivity following restoration actions in the Whisky Creek drainage (NPCC 2004a).

Priority restoration actions in Whisky Creek are riparian protection and enhancement, road obliteration or relocation, restoration of natural stream channels, and reconnecting of floodplains.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate approximately 15 miles of riparian area roads.
    2. Improve maintenance on approximately 20 miles of riparian area roads.

- Improve riparian habitat conditions by taking the following actions:
  1. Improve grazing practices on approximately 500 acres of privately owned riparian area. This can include the development and implementation of 15 grazing plans;
  2. Relocate or fence (with adequate buffer) one livestock feeding operation;
  3. Construct riparian fencing along approximately 20 miles of stream to prevent livestock-related riparian degradation;
  4. Develop approximately 20 off-channel water developments for livestock watering;
  5. Plant riparian vegetation in approximately 30 acres of riparian area;
  6. Enroll approximately 13 miles of stream on private land in CREP or similar riparian protection program;
  7. Noncommercially thin forested riparian area along approximately two miles of stream to promote future large wood recruitment.

- Improve instream habitat conditions through the following actions:
  1. Reconnect approximately two miles of channelized stream to the floodplain;
  2. Add structure to approximately four miles of stream;
  3. Remove confinement structures along approximately one mile of stream to reconnect the floodplain.

- Improve fish passage by modifying one diversion structure.

Lostine River (WRS-10)

Primary Limiting Factors: Excess Fine Sediment; Habitat Quantity/Diversity; Water Quality (high summer water temperature); Floodplain Connectivity; Water Quantity (low summer flows); Fish Passage; Pathogens

Threats: Water Diversion; Stream Channelization; Barriers; Roads; Residential Development; Livestock Grazing; Agriculture; Recreation

EDT predicted approximately 15 percent increase in abundance and productivity with restoration actions in the lower Lostine River, ranking it third priority of 24 Wallowa River steelhead population reaches. Little change would be gained with restoration in the upper Lostine River (above Silver Creek).

The highest priority restoration action for the Lostine is to continue to address water use and low flows in the lower Lostine River through conservation, improved efficiency, purchase/lease of water rights, enforcement, etc. Other restoration actions include restoration of natural stream channels and floodplain connectivity, protection and enhancement of riparian vegetation, and improved structure and operation of facilities at irrigation diversions for fish passage.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the impact of roads on steelhead habitat by improving maintenance on approximately 11 miles of riparian road.

- Improve riparian habitat conditions by taking the following actions:
    1. Improve grazing practices is approximately 10 acres of privately owned riparian area. This can include the development and implementation of two grazing plans;
    2. Construct riparian protection fence along approximately 0.5 miles of stream to prevent livestock-related riparian degradation;
    3. Develop two off-channel water developments for livestock watering;
    4. Reduce and minimize erosion along approximately 0.25 miles of river;
    5. Enroll approximately five miles of stream on private land in CREP or similar riparian protection program.

- Improve instream habitat conditions through the following actions:
    1. Reconnect approximately two miles of channelized stream to the floodplain;
    2. Add structure to approximately four miles of stream;
    3. Remove confinement structures along approximately three miles of stream to reconnect the floodplain;
    4. Reclaim approximately 25 cfs of streamflow for the Lostine River through improved irrigation system efficiencies, purchase of water, or other methods.

- Improve fish passage by modifying three diversion structures.

Hurricane Creek (WRS-11)

Primary Limiting Factors: Water Quantity (low summer flows); Excess Fine Sediment; Habitat Quantity/Diversity (lack of wood and pools); Floodplain Connectivity; Riparian Condition; Water Quality (pollution from agricultural runoff); Fish Passage

Threats: Water Diversion; Stream Channelization; Agriculture; Residential Development; Livestock Grazing; Roads

EDT analysis predicted approximately 10 percent increase in steelhead abundance and productivity following restoration actions in Hurricane Creek (NPCC 2004a).

Priority restoration actions for Hurricane Creek are to protect and enhance riparian vegetation (fencing and/or planting), reestablish natural stream channels and floodplain connectivity, improve fish passage at diversion structures, address water use and low flows through conservation, improved efficiency, purchase/lease of water rights, enforcement, etc. These priority actions, especially restoration of riparian areas and reduced water use/improved stream flow, should help reduce sediment effects on aquatic resources in Hurricane Creek. Additional actions that may need to be considered for sediment reduction include road surface and drainage improvements and construction of filter strips, settling basins, or off-channel wetlands to reduce sediment delivery from roads, feedlots, pastures, and fields (Wallowa County–Nez Perce Tribe 1999).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Improve riparian habitat conditions through the following actions:
  1. Improve grazing practices is approximately 50 acres of privately owned riparian area. This can include the development and implementation of 10 grazing plans;
  2. Construct riparian protection fence along approximately two miles of stream to prevent livestock-related riparian degradation;
  3. Develop 20 off-channel water developments for livestock watering;
  4. Reduce and minimize erosion along approximately 0.5 miles of stream;
  5. Enroll approximately four miles of stream on private land in CREP or similar riparian protection program;
  6. Plant riparian vegetation in approximately 10 acres of riparian area.

- Improve instream habitat conditions through the following actions:
  1. Add structure to approximately 0.5 miles of stream;
  2. Reclaim approximately 15 cfs of streamflow for Hurricane Creek through improved irrigation system efficiencies, purchase of water, or other methods.

- Improve fish passage by modifying the Moonshine/Alder Slope Ditch diversion structure (this would require screening as well, and would open only a short section of marginal habitat at a large price tag).

Prairie Creek (WRS12)

Primary Limiting Factors: Excess Fine Sediment; Riparian Condition; Habitat Quantity/Diversity; Channel Stability; Water Quantity (high flows due to irrigation ditch input); Water Quality (D.O.); Floodplain Connectivity; Fish Passage

Threats: Water Diversion; Agriculture; Livestock Grazing; Stream Channelization; Residential Development; Barriers

EDT analysis ranked Prairie Creek as the highest restoration benefit for this population, predicting approximately a 10 percent improvement in abundance and 10 percent increase in productivity of steelhead following restoration actions.

Priority restoration actions for Prairie Creek include protection and enhancement of riparian vegetation (fencing and/or planting), stabilizing eroding banks, reestablishing natural stream channels and floodplain connectivity, eliminating fish passage barriers, and addressing water demand through conservation, improved efficiency, purchase/lease of water rights, enforcement, etc. Additional actions may need to be considered to improve water quality including road surface and drainage improvements and construction of filter strips, settling basins, or off-channel wetlands to reduce sediment and nutrient delivery from roads, feedlots, pastures, and fields (Wallowa County–Nez Perce Tribe 1999). A thorough survey of irrigation diversions, road crossings, and other potential barriers to fish movements

in Prairie Creek has been completed (Christian R.L. 2007), and will help efforts to reestablish natural stream channels and their connectivity. Reestablishing connectivity will also necessitate screening of irrigation diversions in upper Prairie Creek. We also recommend investigation into alternative irrigation water management that would result in reduced irrigation return flows into Prairie Creek, and potentially, decrease water demands in other adjacent streams (e.g. the Wallowa River or Hurricane Creek).

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Reduce the impact of roads on steelhead habitat by replacing at least two culverts.
- Improve riparian habitat conditions through the following actions:
    1. Improve grazing practices is approximately 200 acres of privately owned riparian area. This can include the development and implementation of 20 grazing plans;
    2. Relocate or fence with adequate buffer, three livestock feeding operations;
    3. Construct riparian fence along approximately seven miles of stream to prevent livestock-related riparian degradation;
    4. Develop approximately 20 off-channel water developments for livestock watering;
    5. Reduce and minimize erosion along approximately 10 miles of stream;
    6. Enroll approximately 10 miles of stream on private land in CREP or similar riparian protection program;
    7. Plant riparian vegetation in approximately 50 acres of riparian area.
- Improve instream habitat conditions by taking the following actions:
    1. Reconnect approximately one mile of channelized stream to the floodplain;
    2. Add structure to approximately three miles of stream.
- Improve fish passage by removing one barrier and modify a diversion structure.

Upper Wallowa River (Upstream of Lostine River) and Small Tributaries (WRS-13)

Primary Limiting Factors: Water Quality (temperature, coliform bacteria, D.O., pH, nutrients); Excess Fine Sediment; Water Quality (low D.O.); Riparian Condition; Fish Passage; Floodplain Connectivity; Water Quantity (low flows); Habitat Quantity/Diversity; Pathogens; Competition (brook trout); Predation (brook trout)

Threats: Stream Channelization; Water Diversion; Barriers; Agriculture; Livestock Grazing; Residential Development; Roads

EDT analysis projected a greater than 15 percent increase in steelhead abundance and greater than 10 percent increase in productivity with restoration of habitat in the upper Wallowa River (NPCC 2004a). The Upper Wallowa River is ranked as second priority for restoration actions in this population.

Priority restoration actions for steelhead habitat in the upper Wallowa River include protection and restoration of riparian areas, reestablishing a more natural hydrograph, reducing water demand, reducing inputs of sediment and nutrients, removal of passage barriers, and reestablishing natural stream channels and floodplain connectivity. All aquatic species would benefit from establishment and maintenance of a minimum flow downstream of Wallowa Lake Dam. Riparian vegetation should respond to protection and enhancement within five years. We would expect some reduction in sediment and nutrients would accompany riparian restoration. However, additional actions may need to be considered to improve water quality including road surface and drainage improvements and construction of filter strips, settling basins, or off-channel wetlands to reduce sediment and nutrient delivery from roads, feedlots, pastures, and fields (Wallowa County–Nez Perce Tribe 1999). Improvements in municipal and residential waste water treatment may also be necessary.

Restoration actions identified by local natural resource professionals that can address the current limiting factors and threats in this reach are listed below.

- Improve riparian habitat conditions through the following actions:
    1. Improve grazing practices is approximately 200 acres of privately owned riparian area. This can include the development and implementation of 30 grazing plans;
    2. Relocate or fence with adequate buffer, three livestock feeding operations;
    3. Construct riparian fence along approximately 20 miles of stream to prevent livestock-related riparian degradation;
    4. Develop approximately 50 off-channel water developments for livestock watering;
    5. Reduce and minimize erosion along approximately one mile of river;
    6. Enroll approximately 15 miles of stream on private land in CREP or similar riparian protection program;
    7. Plant riparian vegetation in approximately 100 acres of riparian area.
- Improve instream habitat conditions by taking the following actions:
    1. Remove confinement structures on approximately five miles of channelized stream and reconnect to the floodplain;
    2. Add structure to approximately five miles of stream;
    3. Reclaim approximately 70 cfs of streamflow for the Wallowa River through improved irrigation system efficiencies, purchase of water, and/or other methods.
    4. Manage the Wallowa River Dam at establish a more natural hydrograph, especially to maintain spring flows.
- Improve fish passage modifying five diversion structures.

Upper Grande Ronde River Steelhead Population

The ICTRT has determined that the Upper Grande Ronde steelhead population can be considered as a candidate for a maintained population as a result of the Abundance/Productivity rating of moderate risk and the Spatial Structure/Diversity rating of moderate risk (ICTRT 2007). The current spawning

distribution is nearly identical to the historic distribution as represented by the intrinsic potential analysis.

The primary in-basin factors limiting summer steelhead in the Upper Grande Ronde drainage are (listed in order of magnitude) excess fine sediment, habitat quantity and diversity (primarily lack of pools), water quantity (low summer flow), and poor water quality (high summer water temperature) (NPCC 2004a). Most of these limiting factors can be attributed to stream channel modifications, riparian zone degradation, and water withdrawals for livestock and agriculture. Historic location and construction of roads, livestock grazing, and timber harvest are the primary threats contributing to degradation of riparian areas in the system (GRMW 1995; Huntington 1994; NPCC 2004a).

The Upper Grande Ronde River watershed is rated high priority for treatment under DEQ's WQMP for temperature, sediment, and flow (ODEQ 2000). The plan outlines management measures for permitted direct discharges (e.g., wastewater treatment plants and industrial facilities) and BMPs for non-point source (e.g., roads, forestry operations, agriculture, and municipal sources). Water quality issues addressed in the plan include pH, dissolved oxygen, nutrients, industrial effluent, temperature, shade, instream flows, and sediment (ODEQ 2000).

The recovery planning team recommends that the highest priority for this population is improving habitat conditions in the mainstem Grande Ronde River between the City of La Grande and Limber Jim Creek, the tributaries to the Grande Ronde River between La Grande and Meadow Creek, Phillips Creek and its tributaries, and Middle Catherine Creek. This can be done through restoration activities that help moderate summer temperatures, reduce sediment input, reconnect floodplains and wet meadows, improve riparian habitat and instream complexity, and increase flows.

In the following reach discussions we recommend restoration actions for the Upper Grande Ronde steelhead population by reach that would address the known limiting factors and threats. Recommendations have been compiled from available publications (e.g., the Grande Ronde River Subbasin Plan), and from meetings and discussions with local biologists and natural resource specialists from ODFW, USFS, BLM, NRCS, ODF, GRMW, NPT, CTUIR, NMFS, SWCD, and OWRD who are most familiar with this population.

Middle Grande Ronde River Mainstem, Wallowa River to Lookingglass Creek (UGS1)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high temperatures, nutrient levels and bacteria); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Predation

Threats: Timber Harvest; Livestock Grazing; Roads (railroad); Upstream Impacts (water diversions, agriculture, channelization, road construction/location, livestock grazing, etc.); Recreation

The EDT analysis ranks the restoration benefit of this reach as low (30th of 32 rankings). The limited potential of this reach for improving the Upper Grande Ronde steelhead population, combined with difficult access and limited restoration opportunities, make this reach a low priority for restoration within the Upper Grande Ronde steelhead population. This reach is also rated low priority for treatment under DEQ's WQMP; water quality improvements are dependent on upstream improvements (ODEQ 2000).

Restoration actions upstream of this reach (e.g., in reach UGS3) that reduce water withdrawal amounts and reduce upstream water quality impacts (i.e., roads, agriculture, livestock, and logging operations) would be of most benefit to this reach.

Priority actions for this reach should be to protect and restore riparian vegetation and function, and to reduce environmental impacts of grazing and logging operations (GRMW 1995; NPCC 2004a). ODEQ suggests restoration actions to reduce stream temperatures in this reach, including increasing shade cover, reducing bankfull channel widths to a maximum of 131 feet, maintaining or increasing instream flows during critical periods (July through September), and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).
Actions to limit the effects of recreation (ATV and boating use) on steelhead in this reach should also be pursued.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately four miles of railroad.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 300 acres of private land. This can include development and implementation of six grazing management plans.
    2. Construct protection fence on approximately two miles of stream to protect riparian areas from degradation by livestock.
    3. Develop up to 10 off-channel livestock watering sites.
    4. Stabilize erosion on approximately one mile of mainstem channel.
    5. Close or move two recreation sites located in riparian areas.

Middle Grande Ronde River Mainstem, Lookingglass Creek to Catherine Creek (UGS2)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high temperatures, pH, nutrients); Sediment; Riparian Condition (vegetation, streambanks); Pathogens; Predation; Habitat Quantity/Diversity (low pools, lack of diversity)

Threats: Livestock Grazing; Timber Harvest; Agriculture; Stream Channelization; Roads (railroad); Upstream Impacts (water diversions, agriculture, channelization, road construction/location, livestock grazing, etc.)

This reach exhibits moderate potential for increasing the abundance of summer steelhead (NPCC 2004a), and is rated low priority for treatment under DEQ's WQMP. Water quality improvements are dependent on upstream improvements (ODEQ 2000).

Restoration actions upstream of this reach that reduce water withdrawal amounts (e.g., in reach UGS3), and reduce upstream water quality impacts (i.e., roads, agriculture, livestock, and logging operations) would be a high priority for this reach.

Priority actions within this reach should be to protect and restore riparian vegetation and function, reduce irrigation withdrawals, and reduce environmental impacts of grazing and logging operations (GRMW 1995; NPCC 2004a). Suggested restoration actions by ODEQ to reduce stream temperatures in this reach include increasing shade cover, reducing bankfull channel widths to a maximum of 115 feet, maintaining/increasing instream flows during critical periods (July through September), and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 15 miles of railroad.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 1100 acres of private land. This can include development and implementation of 30 grazing management plans.
    2. Move or fence (with adequate buffer) five livestock feeding operations away from riparian areas.
    3. Construct protection fence on approximately 10 miles of stream to protect riparian areas from degradation by livestock.
    4. Develop up to 50 off-channel livestock watering sites.
    5. Plant riparian vegetation in approximately 60 acres of riparian area.
    6. Enroll approximately eight miles of river into CREP or similar riparian protection program.
    7. Stabilize erosion on approximately one mile of mainstem channel.
    8. Close or move one recreation site located in a riparian area.
- Improve instream habitat through the following actions:
    1. Reconnect approximately one mile of channelized river to its floodplain
    2. Add structure to approximately two miles of river.

Middle Grande Ronde River Mainstem, Grande Ronde Valley (UGS3)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high temperatures, pH, nutrients); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Habitat Quantity/Diversity (low pools, lack of diversity)

Threats: Water Diversions; Stream Channelization; Livestock Grazing; Agriculture; Recreation; Residential Development

This reach exhibits relatively high potential for increasing the abundance of Upper Grande Ronde summer steelhead. The EDT analysis ranks this reach forth of 32 rankings in the Upper Grande Ronde River spring Chinook population for restoration benefit (NPCC 2004a). This reach is also rated a high priority for treatment under DEQ's WQMP (ODEQ 2000).

Increasing summer low flows and increasing the frequency of pools should be the priority restoration actions for this reach; other restoration actions include protecting and restoring riparian vegetation and function and reducing environmental impacts of agriculture, grazing, and development projects (GRMW 1995; NPCC 2004a). Suggested treatments by ODEQ to reduce stream temperatures include increasing shade cover, reducing bankfull channel widths to a maximum of 98 feet, maintaining/increasing instream flows during critical periods (July through September), and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000). Actions that increase summer low flows and actions to reduce stream temperatures and sediment input will benefit this reach and all downstream mainstem reaches; where low flows, sediment, and temperatures are primary concerns.

Irrigation withdrawals could be ameliorated by identifying "rate and duty" requirements to alleviate the overuse of water at specific diversions, thereby returning some flow or diverting the lawfully appropriated right.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately one mile of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 1300 acres of private land. This can include development and implementation of five grazing management plans.
    2. Move or fence (with adequate buffer) three livestock feeding operations away from riparian areas.
    3. Construct protection fence on approximately 10 miles of stream to protect riparian areas from degradation by livestock.
    4. Develop up to 50 off-channel livestock watering sites.
    5. Plant riparian vegetation in approximately 215 acres of riparian area.
    6. Enroll approximately 15 miles of river into CREP or similar riparian protection program.
    7. Stabilize erosion on approximately 20 miles of mainstem channel.
    8. Close or move one recreation site located in a riparian area.
    9. Manage forested riparian areas to promote large wood recruitment along approximately two miles of river.
    10. Improve management of recreational use along approximately two miles of river (ATV use and non-motorized recreation).
- Improve instream habitat through the following actions:
    1. Reconnect approximately one mile of channelized river to its floodplain
    2. Add structure to approximately two miles of river.

3. Approximately three cfs could be saved through improved irrigation efficiencies and facilities.

- Improve fish passage through the following actions:
  1. Remove one passage barrier.
  2. Modify two diversion structures to allow fish passage.

Upper Grande Ronde River Mainstem, Upstream End of Grande Ronde Valley to Meadow Creek (UGS4)

Primary Limiting Factors: Water Quantity (low flows); Water Quality (high temperatures); Sediment; Riparian Condition (vegetation, streambanks); Pathogens; Habitat Quantity/Diversity (low pools, lack of diversity)

Threats: Livestock Grazing; Timber Harvest; Roads (Interstate Hwy 82, State Hwy 244, and the railroad)

Based on EDT analysis results, this reach ranks highest of the Upper Grande Ronde summer steelhead population reaches for potential increases in abundance from restoration actions (NPCC 2004). This reach is also rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Restoration activities within the reach should focus on increasing pool habitat, improving environmental management practices (e.g., following federal standards and guidelines where applicable) within logging and grazing operations, and protecting and restoring riparian vegetation (GRMW 1995; NPCC 2004a). Suggested treatments by ODEQ to reduce stream temperatures include increasing shade cover, maintaining/increasing instream flows during critical periods (July through September), reducing bankfull channel widths to a maximum of 98 feet, and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration actions that focus on reducing impacts higher in the watershed and tributaries, e.g., identifying and eliminating sources of sediment and thermal pollution, would also benefit this reach.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately one mile of road. This can include working with ODOT to manage to add structural habitat components to the river (e.g., large woody debris and large boulders), and to curtail input of road debris and gravel to the river (sidecasting).
- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 1,100 acres of private land. This can include development and implementation of 10 grazing management plans.
  2. Move or fence (with adequate buffer) one livestock feeding operation away from riparian areas.
  3. Construct protection fence on approximately eight miles of stream to protect riparian areas from degradation by livestock.

4. Develop up to 40 off-channel livestock watering sites.
5. Plant riparian vegetation in approximately 90 acres of riparian area.
6. Enroll approximately two miles of river into CREP or similar riparian protection program.
7. Stabilize erosion on approximately one mile of mainstem channel.
8. Close or move six recreation sites located in riparian areas.

- Improve instream habitat through the following actions:
  1. Reconnect approximately two miles of channelized river to its floodplain.
  2. Remove confinement structures (levees, dikes, etc) along approximately eight miles of river and reconnect this area to the floodplain.
  3. Add structure to approximately 15 miles of river.

Lookingglass Creek and Tributaries (UGS5)

Primary Limiting Factors: Excess Fine Sediment; Riparian Condition (Low levels of stream shading); Habitat Quantity/Diversity (primarily pools and large wood)

Threats: Roads; Livestock Grazing; Timber Harvest

The Grande Ronde subbasin plan identifies the three reaches within the Lookingglass Creek drainage as having widely varying potential for increases in abundance and productivity of summer steelhead (NPCC 2004a). Little Lookingglass Creek has moderate potential (ranking 12th of 32 reaches) for benefiting summer steelhead through restoration activities (NPCC 2004a). Upper and Lower Lookingglass Creek ranked low to moderate (25th and 19th respectively of 32 reaches) for restoration benefit (NPCC 2004a). This reach is rated low to medium priority for treatment under DEQ's WQMP (ODEQ 2000).

Restoration efforts should be focused in Little Lookingglass Creek. Restoration actions with the potential to increase summer steelhead abundance include restoring and protecting riparian areas, improving environmental management practices within timber harvest operations, relocating roads from riparian areas, and installing large wood in strategic locations.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission or relocate approximately five miles of road within riparian areas.
  2. Improve maintenance on approximately 10 miles of riparian road.
  3. Replace four culverts.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 1020 acres of private land. This can include development and implementation of 10 grazing management plans.

2. Move or fence (with adequate buffer) two livestock feeding operations away from riparian areas.
3. Construct protection fence on approximately eight miles of stream above the hatchery facility to protect riparian areas from degradation by livestock.
4. Develop up to 40 off-channel livestock watering sites.
5. Plant riparian vegetation in approximately 200 acres of riparian area.
6. Enroll approximately four miles of private river front into a BPA or similar riparian protection program.
7. Stabilize erosion on approximately five miles of mainstem channel.
8. Close or move 15 recreation sites located in riparian areas.
9. Manage forested riparian areas on approximately 300 acres along seven miles of stream to promote future large wood recruitment.
10. Better manage motorized recreation (ATVs) along approximately two miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:
  1. Remove confinement structures (levees, dikes, etc) along approximately three miles of stream and reconnect this area to the floodplain.
  2. Add structure to approximately four miles of Lookingglass Creek above Jarboe Creek.

Phillips, Clark, Cabin and Gordon Creeks, Duncan and Rysdam Canyons, and tributaries (UGS6)

Primary Limiting Factors: Riparian condition (vegetation, streambanks); Habitat quantity/diversity (key habitat quantity); Excess Fine Sediment; Water quality (high summer temperature); Water quantity (low summer flows)

Threats: Agriculture; Grazing; Timber Harvest; Roads

The Grande Ronde subbasin plan identifies restoration activities within the Phillips Creek drainage as having very high potential (3rd of 32 reaches) for improving abundance in the Upper Grande Ronde summer steelhead population (NPCC 2004a). The other Grande Ronde River tributaries in this reach rank much lower for restoration (27th) and protection (18th). An EDT analysis was not conducted on Clark Creek, therefore such detail is not available; however, based on similarities in location, size, and limiting factors, it may be similar to Phillips Creek in restoration value to the population. Phillips Creek is rated low priority for treatment under DEQ's WQMP; Clark Creek is rated high priority (ODEQ 2000).

Restoration projects with the potential to increase summer steelhead abundance include restoring and protecting additional riparian areas, improving environmental management practices within grazing and logging operations, relocating roads from riparian areas where possible, continuing to increase habitat diversity through large wood placement, and improving passage at barriers on both Phillips and Clark creeks (NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission or relocate approximately 32 miles of road within riparian areas (five miles on private land and seven on public land).
  2. Improve maintenance on approximately 100 miles of riparian road (private and public roads).
  3. Replace approximately 20 culverts. There are approximately15 on private land and five on public land (three on Clark Creek, one on N.F. Cabin Creek, and one on S.F. Cabin Creek).

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 5800 acres of private land. This can include development and implementation of 75 grazing management plans.
  2. Move or fence (with adequate buffer) 20 livestock feeding operations away from riparian areas.
  3. Construct protection fence on approximately 60 miles of stream above the hatchery facility to protect riparian areas from degradation by livestock.
  4. Develop up to 300 off-channel livestock watering sites.
  5. Plant riparian vegetation in approximately 485 acres of riparian area.
  6. Enroll approximately 30 miles of private stream front into CREP or similar non-forested riparian protection program.
  7. Enroll approximately 30 miles of private stream front into a BPA or similar forested riparian protection program.
  8. Stabilize erosion on approximately 30 miles of stream channel.
  9. Close or move 25 dispersed recreation sites located in riparian areas.
  10. Manage forested riparian areas on approximately 1300 acres (100 ac on public land and 1200 ac on private land) along 18 miles of stream to promote future large wood recruitment.
  11. Manage motorized recreation (ATVs) along approximately 10 miles of stream to protect riparian areas.
  12. Manage non-motorized recreation along approximately five miles of riparian area to protect harassment of spawning steelhead.

- Improve instream habitat through the following actions:
  1. Reconnect approximately two miles of channelized stream to its floodplain;
  2. Remove confinement structures (levees, dikes, etc) along approximately seven miles of stream and reconnect this area to the floodplain;
  3. Add structure to approximately 30 of stream;
  4. Save approximately two cfs of flow through improvement in irrigation efficiency and facilities.

Indian Creek and Tributaries (UGS7)

Primary Limiting Factors: Water Quality (high temperatures, low D.O.); Water Quantity (low flows); Excess Fine Sediment; Riparian Condition (vegetation, streambanks); Habitat Quantity/Diversity (low pools, low wood, lack of diversity)

Threats: Water Diversion; Livestock Grazing; Roads; Agriculture; Timber Harvest

The Grande Ronde subbasin plan identifies Lower Indian Creek as having moderate potential (ranked 17th of 32 reaches) for increasing abundance and productivity of summer steelhead through restoration activities (NPCC 2004a). Restoration potential within Upper Indian Creek ranked significantly lower (24th); however, it ranked first for benefit generated by protection (NPCC 2004a). Lower Indian Creek also ranked relatively high for protection value (6th of 32 reaches) (NPCC 2004a). Lower Indian Creek is rated medium priority and Upper Indian Creek is rated low to medium priority for treatment under DEQ's WQMP; efforts should focus on protecting high quality water and habitat (ODEQ 2000).

Future restoration actions should focus on the lower portions of the Indian Creek drainage, a highly impacted area in private ownership. The Oregon Water Resource Department (OWRD) has designated the mouth of Indian Creek as a flow restoration priority (NPCC 2004a).

Restoration actions likely to increase summer steelhead abundance and productivity include increasing summer low flows, restoring and protecting riparian areas (to reduce summer rearing temperatures), improving environmental management practices within grazing and logging operations (e.g., following federal standards and guidelines where applicable), and reducing road density (to reduce sediment delivery to streams) (NPCC 2004a). The riparian areas should receive protection from livestock grazing.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
    1. Decommission or relocate approximately five miles of road within riparian areas;
    2. Improve maintenance on approximately 37 miles of riparian road;
    3. Replace approximately six culverts.

- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 1,090 acres of private land. This can include development and implementation of 10 grazing management plans.
    2. Move or fence (with adequate buffer) five livestock feeding operations away from riparian areas.
    3. Construct protection fence on approximately 12 miles of stream on private land to protect riparian areas from degradation by livestock.
    4. Develop up to 60 off-channel livestock watering sites.
    5. Plant riparian vegetation in approximately 50 acres of riparian area.

6. Enroll approximately 24 miles of private stream front into CREP or similar non-forested riparian protection program.
7. Stabilize erosion on approximately five miles of private stream channel.
8. Close or move four recreation sites located in riparian areas along Indian Creek.
9. Manage forested riparian areas on approximately 873 acres on private land to promote future large wood recruitment.
10. Manage motorized recreation (ATVs) along approximately seven miles of stream to protect riparian areas.
11. Improve trail maintenance along approximately two miles of riparian area.

- Improve instream habitat through the following actions:
  1. Reconnect approximately three miles of channelized stream to its floodplain;
  2. Add structure to approximately 17 of stream (15 miles on private and two miles on public land);
  3. Save approximately two cfs of flow through improvement in irrigation efficiency and facilities.
- Improve fish passage by modifying a diversion structure at the old power plant in the City of Elgin

Willow Creek and Tributaries (UGS8)

Primary Limiting Factors: Low Summer Flows; Habitat Quantity/Diversity; Water Quality (temperature); Excess Fine Sediment; Predation

Threats: Livestock Grazing; Agriculture; Roads

The Grande Ronde Subbasin Plan identifies Upper Willow Creek as having moderate potential (ranked 15th of 32 reaches) for increases in abundance and productivity of summer steelhead through restoration; Lower Willow Creek ranked slightly lower (18th) (NPCC 2004a). Upper Willow Creek also ranks relatively high for protection benefit (10th), but Lower Willow Creek is again relatively lower at 26th (NPCC 2004a). Consequently, protection actions should focus on the upper portions of the Willow Creek drainage, while restoration should focus on the entire drainage. This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Restoration actions likely to increase summer steelhead abundance and productivity include increasing summer low flows, restoring and protecting additional riparian areas, reducing the environmental impact of agriculture and grazing operations, and reducing road impacts (NPCC 2004a). If Willow Creek maintains suitable water quality and flow, it not only will benefit conditions and alleviate limiting factors within its own drainage but will also benefit downstream conditions in the mainstem Grande Ronde. Lower Willow Creek in particular could provide a localized cool water refuge for rearing juveniles and/or holding adults during periods when low flows and elevated temperatures would otherwise preclude use of the mainstem Grande Ronde.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Improve maintenance on approximately 16 miles of riparian road (10 miles on Dry Cr. and six miles on Pumpkin Ridge rd.).
  2. Replace approximately 20 culverts. This includes two on Dry Creek, and 10 on End /Hunter creeks. There are also numerous problem (sediment and/or fish passage) culverts on farm roads and pivot crossings.

- Protect and enhance riparian areas through the following steps:
  1. Improve grazing practices on approximately 1,500 acres of private land. This can include development and implementation of approximately 100 grazing management plans.
  2. Move or fence (with adequate buffer) 30 livestock feeding operations away from riparian areas.
  3. Construct protection fence on approximately 15 miles of stream on private land to protect riparian areas from degradation by livestock.
  4. Develop up to 75 off-channel livestock watering sites.
  5. Plant riparian vegetation in approximately 150 acres of riparian area.
  6. Enroll approximately 30 miles of private stream front into CREP or similar non-forested riparian protection program.
  7. Stabilize erosion on approximately 15 miles of stream channel. This includes most of Dry Creek and about half of Mill Creek.
  8. Close or move two recreation sites located in riparian areas.
  9. Manage forested riparian areas on approximately 365 acres on private land to promote future large wood recruitment.
  10. Manage motorized recreation (ATVs) along approximately 15 miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:
  1. Reconnect approximately five miles of channelized stream in Willow, McDonald, and Dry creeks to their floodplains.
  2. Remove confinement structures in approximately two miles of stream in Willow and Dry creeks.
  3. Reconnect approximately five miles of down cut tributary streams to their floodplain.
  4. Add structure to approximately four miles of stream.
  5. Save approximately five cfs of flow through improvement in irrigation efficiency and facilities between Smith, Dry, Fir, End, Mill, and Willow creeks.

- Improve fish passage by modifying four diversion structures between Willow and Dry creeks.

7.4.2.9 Lower Catherine Creek and Tributaries (UGS9)

Primary Limiting Factors: Water Quantity (low summer flows); Water quality (elevated summer temperatures, low dissolved oxygen levels); Habitat Quantity/Diversity (lack of pool habitat); Fish Passage; Excess Fine Sediment; Riparian Conditions (vegetation, streambanks); Predation

Threats: Agriculture; Water Diversions; Roads

The Grande Ronde subbasin plan identifies Lower Catherine Creek and tributaries as having relatively low potential for increases in abundance and productivity of summer steelhead (NPCC 2004a), ranking it 22nd. Additionally, it ranks near the bottom for protection benefit (NPCC 2004a). However, this reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000). This is due to the potential for increasing summer low flows, which would have downstream benefits, e.g., improving water quality and alleviating passage issues. Other priority actions for this reach should be to protect and restore existing riparian vegetation and improve environmental management practices within agricultural areas (GRMW 1995; NPCC 2004a).

Fish passage barriers include two culverts: one on Mill Creek at (WWNF 2006).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
  1. Decommission or relocate 15 miles of roads located in riparian areas. These include Mill and Little creeks.
  2. Improve maintenance on approximately 60 miles of riparian road. This includes Ladd Canyon and Little Creek.
  3. Replace approximately 10 culverts. This includes three on Little Creek, four on Ladd Creek, two on Mill Creek, and Hwy 82 on Ladd Creek.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 4,050 acres of private land. This can include development and implementation of approximately 68 grazing management plans.
  2. Move or fence (with adequate buffer) 35 livestock feeding operations away from riparian areas.
  3. Construct protection fence on approximately 40 miles of stream on private land to protect riparian areas from degradation by livestock.
  4. Develop up to 200 off-channel livestock watering sites.
  5. Plant riparian vegetation in approximately 390 acres of riparian area.
  6. Stabilize erosion on approximately 15 miles of stream channel. This includes three miles on Catherine Creek and 12 on tributary streams.
  7. Enroll approximately 73 miles of private stream front into CREP or similar non-forested riparian protection program.

8. Manage forested riparian areas on approximately 432 acres on private land along six miles of tributary streams to promote future large wood recruitment (particularly Ladd Creek).
9. Close or move four recreation sites located in riparian areas.
10. Manage motorized recreation (ATVs) along approximately 10 miles of stream to protect riparian areas.
11. Maintain the trailhead at the head of Mill Creek to minimize erosion.

- Improve instream habitat through the following actions:
  1. Reconnect approximately 21 miles of channelized stream in Catherine Creek and tributary streams (particularly Ladd and lower Little creeks) to their floodplains.
  2. Remove confinement structures in approximately 29 miles of stream in Catherine Creek (25 miles) and Little Creek (four miles, above Union).
  3. Add structure to approximately 25 miles of stream in Catherine Creek (five miles) and tributary streams (15 miles).
  4. Save approximately seven cfs of flow through improvement in irrigation efficiency and facilities between Little, Mill, and Ladd creeks.

- Improve fish passage through the following actions:
  1. Provide passage at six structures that are currently passage barriers. These include Cove Hydroelectric in Mill Creek, two on Ladd Creek, and another in Ladd Marsh.
  2. Modify 19 diversion structures to provide passage for all life stages of steelhead. These include four on Catherine Creek, nine in Little Creek, and others.

Middle Catherine Creek and Tributaries, Little Creek to North and South Forks (UGS10)

Primary Limiting Factors: Water Quantity (low summer flows); Water quality (high summer stream temperatures, D.O.); Excess Fine Sediment; Pathogens; Predation; Habitat Quantity/Diversity (low abundance of pool habitat, lack of channel complexity); Riparian Conditions (vegetation, streambanks); Passage

Threats: Agriculture; Grazing; Water diversions; Timber Harvest; Roads; Residential Development

The Grande Ronde Subbasin Plan ranks the mainstem of the Middle Catherine Creek reach 4th of 32 reaches for restoration benefit (NPCC 2004a). The tributaries within this reach rank lower at 13th for restoration (NPCC 2004a). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).
Based on this analysis, restoration efforts should focus on the mainstem, which should be a top priority for restoration efforts within the Upper Grande Ronde summer steelhead population (NPCC 2004a). Although not providing as much benefit, protection efforts also are worthy of pursuit within this reach.

Priority restoration actions for this reach should include protecting existing riparian vegetation and function, reducing irrigation withdrawals, improving environmental management practices within agricultural, grazing, and logging areas, increasing channel complexity through large wood placement, and restoring riparian areas (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate six miles of roads located in riparian areas. These include two miles on Catherine Creek and four miles on tributaries.
  2. Improve maintenance on approximately 24 miles of riparian road. This includes four miles on Catherine Creek and 20 miles on tributaries.
  3. Replace five culverts. This includes one on Scout Creek, one on Milk Creek, one on Little Catherine Creek, and two associated with ponds on Pyles Creek.

- Protect and enhance riparian areas through the following steps:
  1. Improve grazing practices on approximately 1760 acres of private land. This can include development and implementation of approximately 23 grazing management plans.
  2. Move or fence (with adequate buffer) 15 livestock feeding operations away from riparian areas. This includes 10 on Catherine Creek and five on tributaries.
  3. Construct protection fence on approximately 15 miles of stream on private land to protect riparian areas from degradation by livestock. This includes 10 on Catherine Creek and five on tributaries.
  4. Develop up to 75 off-channel livestock watering sites.
  5. Plant riparian vegetation in approximately 354 acres of riparian area.
  6. Stabilize erosion on approximately two miles of stream channel. This includes one mile on Catherine Creek and one mile on tributary streams.
  7. Enroll approximately 24 miles of stream into CREP or similar non-forested riparian protection program. This includes 15 miles on main Catherine Creek and nine miles on tributaries.
  8. Manage forested riparian areas on approximately 365 acres on private land along six miles of tributary streams to promote future large wood recruitment (particularly Catherine and Scout creeks).
  9. Close or move eight recreation sites located in riparian areas. This includes five on Catherine Creek, one on Collins Creek, one on Pole Creek, and one on Prong Creek.
  10. Manage motorized recreation (ATVs) along approximately one mile of riparian area.

- Improve instream habitat through the following actions:
  1. Reconnect approximately three miles of channelized stream in Catherine and Pyles creeks to their floodplains.
  2. Add structure to approximately eight miles of stream in Catherine Creek (four miles) and tributary streams (four miles).
  3. Save approximately 10 cfs of flow through improvement in irrigation efficiency and facilities on Catherine Creek.

- Improve fish passage through the following actions:
    3. Provide passage at three structures that are currently passage barriers. These include one on Catherine Creek and two ponds on Pyles Creek.
    4. Modify five diversion structures on Catherine Creek to provide passage for all life stages of steelhead.

South Fork Catherine Creek (UGS11)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (low abundance of pool habitat); Riparian Conditions (vegetation, streambanks)

Threats: Grazing; Timber Harvest; Roads; Water Diversions

Based on EDT results, restoration within SF Catherine Creek would have relatively little benefit for Upper Grande Ronde steelhead (the drainage ranks 31st of 32 reaches within the population (NPCC 2004a). This reach is rated medium priority for treatment under DEQ's WQMP (ODEQ 2000).

Future actions for this portion of the watershed should include protecting existing riparian vegetation and function, assessing the impact of the water withdrawal of the South Fork Catherine Creek Ditch, continuing to implement appropriate standards and guidelines within areas used for grazing and timber production, and increasing pool habitat through large wood placement (GRMW 1995; NPCC 2004a).

Proposed restoration actions on national Forest lands include road obliteration with relocation away from the stream (Road 7700600) (WWNF 2006), and removal of one fish passage barrier on South Fork Catherine Creek (Collins Creek at Road 7700065) (WWNF 2001).
Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate 12 miles of roads located in riparian areas.
    2. Improve maintenance on approximately 30 miles of riparian road.
    3. Replace three culverts. This includes one each on Corral, Prong, and Collins creeks.

- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately eight miles of stream to protect riparian areas from degradation by livestock.
    2. Develop up to 40 off-channel livestock watering sites.
    3. Manage forested riparian areas on approximately 1200 acres of riparian area to promote future large wood recruitment.
    4. Close or move three recreation sites located in riparian areas.
    5. Manage motorized recreation (ATVs) along approximately 10 miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:
    1. Add structure to approximately three miles of stream in South Fork Catherine, Pole, and Corral creeks.
    2. Save approximately two cfs of flow through improvement in irrigation efficiency and facilities.

North Fork Catherine Creek (UGS12)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (low abundance of pool habitat); Riparian Conditions (vegetation, streambanks)

Threats: Grazing; Timber Harvest; Roads

Based on EDT results, restoration within North Fork Catherine Creek would have relatively little benefit for the Upper Grande Ronde summer steelhead population (the drainage ranks 28th of 32 reaches within the population) (NPCC 2004a). This reach is rated medium priority for treatment under DEQ's WQMP (ODEQ 2000).

Priorities for future restoration and protection within this portion of the watershed include protecting existing riparian vegetation and function, continuing to implement appropriate standards and guidelines within areas used for grazing and timber production, and increasing pool habitat through large wood placement (GRMW 1995; NPCC 2004a).

Proposed restoration actions on North Fork Catherine Creek include replacing an existing ford (passage barrier) with a new bridge, and reconstructing three miles of draw-bottom road for sediment reduction (WWNF 2006).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate four miles of roads located in riparian areas.
    2. Improve maintenance on approximately 30 miles of riparian road.

- Protect and enhance riparian areas through the following steps:
    1. Construct protection fence on approximately eight miles of stream to protect riparian areas from degradation by livestock.
    2. Develop up to 40 off-channel livestock watering sites.
    3. Manage forested riparian areas on approximately 1600 acres of riparian area to promote future large wood recruitment.
    4. Close or move five recreation sites located in riparian areas.
    5. Manage motorized recreation (ATVs) along approximately 10 miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:

1. Add structure to approximately one mile of stream in the Middle Fork Catherine Creek.

- Improve fish passage by replacing two culverts on Buck Creek. This would open approximately one mile of steelhead habitat.

Five Points Creek, Ordell Ditch, and Tributaries (UGS13)

Primary Limiting Factors: Water Quality (elevated temperature); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools); Riparian Conditions (vegetation, streambanks); Water Quantity (low summer flows)

Threats: Grazing; Timber Harvest; Roads

Based on EDT results, restoration within upper Five Points Creek would have relatively low benefit for Upper Grande Ronde steelhead (the drainage ranks 23rd of 32 reaches within the population) (NPCC 2004a). Restoration benefit within lower Five Points Creek is within the mid-range of providing benefit for the steelhead population (17th of 32 reaches) (NPCC 2004a). This reach is rated medium priority for treatment under DEQ's WQMP (ODEQ 2000).

Future actions within the Five Points Creek drainage should protect existing riparian vegetation and function, continue to implement appropriate BMPs such within areas used for grazing and timber harvest, and increase pool habitat through large wood placement (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate 16 miles of roads located in riparian areas.
  2. Improve maintenance on approximately 50 miles of riparian road
  3. Replace 10 culverts. This includes two on Pelican Creek, one on California Gulch, five on Conley Creek, and two others.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 290 acres of private land. This can include development and implementation of approximately 10 grazing management plans.
  2. Move or fence (with adequate buffer) four livestock feeding operations away from riparian areas.
  3. Construct protection fence on approximately four miles of stream to protect riparian areas from degradation by livestock. This includes two miles on Conley Creek and two miles between Five Points and Pelican creeks.
  4. Develop up to 30 off-channel livestock watering sites.
  5. Plant riparian vegetation in approximately 121 acres of riparian area.
  6. Stabilize erosion along approximately 10 miles of stream, primarily in Conley and Pelican creeks.

7. Manage forested riparian areas on approximately 200 acres along five miles of stream to promote future large wood recruitment.
8. Manage motorized recreation (ATVs) along approximately 55 miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:
  1. Reconnect approximately five miles of channelized stream, from Mt. Glenn to the Grande Ronde River, to the floodplain.
  2. Remove confinement structures (old RR grade) in approximately five miles of stream in Five Points Creek below Camp 1.
  3. Add structure to approximately 12 miles of stream.
  4. Save approximately 0.2 cfs of flow in Ordell Ditch and Conley creeks through improvement in irrigation efficiency and facilities.

Meadow Creek and Tributaries (UGS14)

Primary Limiting Factors: Water Quality (high temperatures, D.O., alkalinity, ammonia, chloride, pH); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools); Riparian Condition (vegetation, streambanks); Water Quantity (low flows)

Threats: Roads; Timber Harvest (historic splash damming, old RR grade)

Based on EDT results, restoration within upper Meadow Creek would have moderate to high benefit for Upper Grande Ronde steelhead (ranking 9th of 32 reaches) (NPCC 2004a). Restoration benefit within lower Meadow Creek is within the mid-range of providing benefit for the steelhead population (15th of 32 reaches) (NPCC 2004). This reach is rated high priority for protection and restoration (ODEQ 2000; NPCC 2004a). Based on EDT results, the entire Meadow Creek drainage has potential to benefit the Upper Grande Ronde steelhead population and should be a mid- to upper-range priority within the population.

Future actions within the Meadow Creek drainage should focus on reducing irrigation withdrawals, protecting and restoring existing riparian vegetation and function, implementing appropriate standards and guidelines (e.g. BMPs such as riparian fencing or PACFISH/INFISH) within areas used for grazing and timber production, and increasing pool habitat through large wood placement (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate 16 miles of roads located in riparian areas, distributed between Meadow, Burnt Corral, Bear, Waucup, and Peet creeks.
  2. Improve maintenance on approximately 125 miles of riparian road.
  3. Replace 15 culverts.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 694 acres of private land. This can include development and implementation of approximately 10 grazing management plans.
  2. Construct protection fence on approximately three miles of stream to protect riparian areas from degradation by livestock.
  3. Develop up to 15 off-channel livestock watering sites.
  4. Plant riparian vegetation in approximately 60 acres of riparian area.
  5. Stabilize erosion along approximately one mile of stream.
  6. Manage forested riparian areas on approximately 210 acres along six miles of stream to promote future large wood recruitment.
  7. Enroll approximately five miles of stream into CREP or a similar program to protect riparian areas.
  8. Close or move 16 dispersed recreation sites located in the riparian area.
  9. Manage motorized recreation (ATVs) in approximately 60 miles of stream to protect riparian areas.

- Improve instream habitat by taking the following actions:
  1. Reconnect approximately 3.5 miles of channelized stream to the floodplain.
  2. Remove confinement structures (include an old RR grade) along approximately four miles of stream and reconnect the streams to their floodplain.
  3. Add structure to approximately 28 miles of stream.

- Improve fish passage by removing a barrier.

McCoy Creek, Dark Canyon, and Tributaries (UGS15)

Primary Limiting Factors: Water Quality (high temperatures); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools); Riparian Condition (vegetation, streambanks); Low flows

Threats: Roads; Timber Harvest (historic splash damming and old RR grade)

Based on EDT results, restoration within McCoy Creek and Dark Canyon would have moderate to high benefit for Upper Grande Ronde steelhead (the drainage ranks 10th of 32 reaches within the population). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Future actions within the McCoy Creek drainage should protect and restore existing riparian vegetation and function, continue to implement appropriate standards/guidelines and BMPs within areas used for grazing and timber harvest increase pool habitat through large wood placement, and relocate streamside roads where practical (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate six miles of roads located in riparian areas, primarily on upper McCoy and Dark Canyon creeks.
  2. Improve maintenance on approximately 95 miles of riparian road.
  3. Replace five culverts distributed between McCoy and Dark Canyon creeks.

- Protect and enhance riparian areas through the following actions:
  1. Improve grazing practices on approximately 218 acres of private land. This can include development and implementation of approximately four grazing management plans.
  2. Develop up to 20 off-channel livestock watering sites.
  3. Plant riparian vegetation in approximately 40 acres of riparian area.
  4. Stabilize erosion along approximately one mile of McCoy Creek.
  5. Manage forested riparian areas on approximately 218 acres along three miles of stream to promote future large wood recruitment.
  6. Enroll approximately three miles of stream into CREP or a similar program to protect riparian areas along middle McCoy Creek.
  7. Close or move five dispersed recreation sites located in the riparian areas of Dark Canyon and McCoy creeks.
  8. Manage motorized recreation (ATVs) in approximately two miles of stream to protect riparian areas.

- Improve instream habitat through the following actions:
  1. Reconnect approximately one mile of channelized stream in McCoy Creek to its floodplain.
  2. Remove confinement structures (include an old RR grade) along approximately one mile of McCoy Creek and reconnect it to the floodplain.
  3. Add structure to approximately 10 miles of stream.

- Improve fish passage by removing one passage barrier at Indian Lake on Ensign Creek.

Rock, Whiskey, Spring, Jordan, Bear, and Beaver Creeks and Tributaries (UGS16)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (lack of pools); Water Quality (temperature); Riparian conditions (vegetation, streambanks)

Threats: Grazing; Roads; Timber Harvest (including historic splash damming)

Based on EDT results, restoration within Whiskey, Spring, Jordan, and Beaver creeks is ranked as a high priority (2nd of 32 reaches within the UGR population). The Rock Creek drainage (ranked 16th) would have moderate benefit for Upper Grande Ronde steelhead (NPCC 2004a). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Future actions within this reach should protect and restore existing riparian vegetation and function, continue to implement appropriate standards/guidelines and BMPs (including those in the Upper Grande Ronde River WQMP) within areas used for grazing and timber harvest, and increase pool habitat through large wood placement.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate 13 miles of roads located in riparian areas.
    2. Improve maintenance on approximately 75 miles of riparian road, including approximately 50 miles on private land and 25 miles of public land.
    3. Replace 15 culverts.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 2180 acres of private land. This can include development and implementation of approximately 10 grazing management plans.
    2. Move or fence (with adequate buffer) three livestock feeding operations on Rock Creek.
    3. Construct riparian protection fencing along approximately 20 miles of stream, primarily Rock Creek.
    4. Enroll approximately 20 miles of stream into a BPA easement or a similar program to protect forested riparian areas.
    5. Manage forested riparian areas on at least 218 acres along up to 50 miles of stream to promote future large wood recruitment.
    6. Close or move five recreation sites located in the riparian areas of Jordan and Beaver creeks.
    7. Manage motorized recreation (ATVs) in approximately 15 miles of stream to protect riparian areas.
    8. Maintain trails to reduce sediment input to streams along approximately three miles of stream.
- Improve instream habitat by taking the following actions:
    1. Reconnect approximately three miles of channelized stream to its floodplain.
    2. Remove confinement structures along approximately five miles of stream and reconnect it to the floodplain.
    3. Reconnect approximately 10 miles of downcut channel to its floodplain.
    4. Add structure to approximately 37 miles of stream (25 miles on private land and 12 miles on public land).
- Improve fish passage by removing one passage barrier at the La Grande Reservoir on Beaver Creek.

Upper Grande Ronde Mainstem, Meadow Creek to Limber Jim Creek (UGS17)

Primary Limiting Factors: Water Quantity (low summer flows); Excess Fine Sediment; Water Quality (high summer temperatures, pH); Habitat Quantity/Diversity (lack of pools and large wood)

Threats: Livestock Grazing; Roads; Timber Harvest

Based on EDT results, restoration within this portion of the Grande Ronde River would have relatively high benefit for Upper Grande Ronde steelhead (the drainage ranks 5th of 32 reaches within the population). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Future restoration should focus on reducing sediment load, improving water quality (particularly temperature), and increasing pools and large wood structure. Examples of potential restoration activities include improving, closing, and/or relocating roads, replanting riparian areas, continuing to implement appropriate standards/guidelines and BMPs within timber harvest and grazing operations, and installing large wood structures within strategic portions of the stream.

ODEQ has suggested treatments to reduce stream temperatures including increasing shade cover, maintaining/increasing instream flows during critical periods (July through September), reducing bankfull channel widths to a maximum of 82 to 98 feet, and increasing sinuosity in unconfined channels to 1.7 or to a wetted width-to-depth ratio of 20 or less (ODEQ 2000).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Decommission or relocate the draw-bottom road on Warm Springs Creek.
  2. Improve maintenance on approximately four miles of riparian road.
  3. Replace three culverts: two culverts on Winter Canyon; and one culvert on an unnamed tributary
- Protect and enhance riparian areas through the following steps:
  1. Improve grazing practices on approximately 732 acres of private land. This can include development and implementation of one grazing management plan.
  2. Move or fence (with adequate buffer) two livestock feeding operations.
  3. Construct riparian protection fencing along approximately 15 miles of stream.
  4. Develop up to 75 off-channel water developments to protect streams and riparian areas from livestock damage.
  5. Stabilize erosion along approximately one mile of stream.
  6. Enroll approximately 10 miles of stream into a CREP or a similar program to protect non-forested riparian areas.
  7. Manage forested riparian areas on approximately 30 acres of riparian area to promote future large wood recruitment.

8. Close or move five recreation sites located in the riparian areas.

- Improve instream habitat through the following actions:
  1. Reconnect approximately one mile of channelized stream to its floodplain.
  2. Remove confinement structures along approximately one mile of stream and reconnect it to the floodplain.
  3. Add structure to approximately 15 miles of the river between Starkey and Vey Meadows.

Upper Grande Ronde River Mainstem, Limber Jim Creek to Clear Creek (UGS18)

Primary Limiting Factors: Excess Fine Sediment; Water Quality (high summer temperature); Habitat Quantity/Diversity (lack of pools and woody debris); Degraded Riparian Conditions

Threats: Mining (primarily historic); Livestock Grazing; Timber Harvest; Roads

The Subbasin Plan's EDT analysis indicates this reach has moderate potential for increasing the abundance, productivity, and diversity of Upper Grande Ronde summer steelhead through protection and restoration activities (rankings of 13th and 21st, respectively) (NPCC 2004a). This reach is rated high priority for treatment under DEQ's WQMP (ODEQ 2000).

Future restoration should focus on reducing sediment load, improving water quality (particularly temperature), and increasing pools and large wood structure. Examples of potential restoration activities include improving, closing, and/or relocating roads, replanting riparian areas, continuing to implement appropriate standards and guidelines or BMPs within timber harvest and grazing operations, and installing large wood structures within strategic portions of the stream.
Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Improve maintenance on approximately three miles of riparian road.

- Protect and enhance riparian areas through the following steps:
  1. Improve grazing practices on approximately 37 acres of private land. This can include development and implementation of one grazing management plan.
  2. Construct riparian protection fencing along approximately 0.5 miles of stream.
  3. Develop up to two off-channel water developments to protect streams and riparian areas from livestock damage.
  4. Stabilize erosion along approximately one mile of stream.
  5. Enroll approximately 0.5 miles of stream into a CREP or a similar program to protect non-forested riparian areas.
  6. Manage forested riparian areas on approximately 33 acres of riparian area along 0.5 miles of stream to promote future large wood recruitment.
  7. Close or move five recreation sites located in the riparian areas.

- Improve instream habitat through the following actions:
    1. Reclaim approximately one mile of river channelized by historic mining and restore it to its floodplain.
    2. Add structure to approximately two miles of stream.

Upper Grande Ronde River Mainstem, Clear Creek to Tanner Gulch and East Fork Grande Ronde (UGS19)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (pools); Degraded Riparian Conditions

Threats: Mining (mostly historic); Timber Harvest

The subbasin plan's EDT analysis indicates this reach has limited potential for increasing the abundance, productivity, and diversity of Upper Grande Ronde summer steelhead through protection and restoration activities (rankings of 24th and 26th, respectively) (NPCC 2003). Restoration projects implemented to date within reaches above East Fork Grande Ronde River are likely to provide some benefit within this reach (WWNF 2004).

Future restoration should focus on improving, closing, and/or relocating roads, replanting riparian areas, continuing to implement appropriate standards and guidelines within timber harvest and mining operations, and installing large wood structures within strategic portions of the stream. This reach is rated low priority for treatment under DEQ's WQMP; efforts should focus on protecting high quality water and habitat (ODEQ 2000).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate approximately 2.5 miles of riparian road.
    2. Improve maintenance on approximately three miles of riparian road.
    3. Replace one culvert each on Muir Creek and East Fork Grande Ronde River.
- Protect and enhance riparian areas through the following steps:
    1. Plant riparian vegetation in approximately 18 acres of riparian area along the Grande Ronde River.
    2. Manage forested riparian areas on approximately 30 acres of riparian area to promote future large wood recruitment.
    3. Close or move five recreation sites located in the riparian areas.
    4. Accomplish meadow rehabilitation project on tributaries between Tanner Gulch and East Fork Grande Ronde River.
- Improve instream habitat through the following actions:

1. Accomplish headcut stabilization project on tributaries between Tanner Gulch and East Fork Grande Ronde River.
2. Add structure to approximately one mile of river between Muir Creek and East Fork Grande Ronde River.

Limber Jim Creek and Tributaries (UGS20)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (lack of pools); Water Quality (high temperatures); Riparian Condition

Threats: Roads; Timber Harvest

Based on EDT results, restoration within this reach would have moderate benefit for Upper Grande Ronde steelhead (the drainage ranks 20th of 32 reaches within the population) (NPCC 2004a). The Limber Jim Creek drainage should be a mid-range priority for restoration and protection within the Upper Grande Ronde summer steelhead population (NPCC 2004a). This reach is rated low priority for treatment under DEQ's WQMP; efforts should focus on protecting high quality water and habitat (ODEQ 2000).

Future actions in this reach should protect and restore existing riparian vegetation and function, continue to implement appropriate standards and guidelines within areas used for timber harvest, increase pool habitat through large wood placement, and decommission, obliterate, or improve roads.

Few restoration actions have been identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach.

- Improve fish passage by replacing the following culvert:
  1. North Fork Limber Jim Cr, replace two culverts;
  2. South Fork Limber Jim Cr, replace two culverts.

Fly Creek and Tributaries (UGS21)

Primary Limiting Factors: Water Quality (high summer stream temperatures); Sediment; Habitat Quantity/Diversity (lack of pools); Riparian Condition (vegetation, streambanks)

Threats: Livestock Grazing; Roads; Timber Harvest

Based on EDT results, restoration within the Fly Creek drainage would have a moderate to high benefit for the Upper Grande Ronde steelhead population (the drainage ranks 8th of 32 reaches within the population) (NPCC 2004a). Consequently, restoration should be a mid- to high priority for restoration activities within the Upper Grande Ronde summer steelhead population (NPCC 2004a). Lower Fly and Little Fly creeks are rated high priority for treatment under DEQ's WQMP; Upper Fly Creek is rated low priority (ODEQ 2000).

Future actions should protect and enhance existing riparian vegetation and function, continue to implement appropriate standards/guidelines and BMPs within areas used for grazing and timber production, increase pool habitat through large wood placement, and decommission, obliterate, or improve roads (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Improve instream habitat conditions through the following actions:
  1. Instream addition of large woody debris (from the mouth to RM5).
  2. Headcut stabilization and rehabilitation in Little Fly Creek.

- Improve fish passage by replacing the following culverts:
  1. Fly Creek, replace two culverts;
  2. Little Fly Creek, replace one culvert;
  3. East Fork Little Fly Creek, replace one culvert;
  4. Lookout Creek, replace one culvert;
  5. Umapine Creek, replace one culvert;
  6. Unnamed Tributary, replace one culvert;
  7. Squaw Creek, replace one culvert.

Sheep Creek and Tributaries (UGS22)

Primary Limiting Factors: Water Quality (high temperatures); Excess Fine Sediment; Habitat Quantity/Diversity (lack of pools); Riparian Conditions (vegetation, streambanks)

Threats: Livestock Grazing; Roads; Timber Harvest

Based on EDT results, restoration within the Sheep Creek drainage would have relatively high benefit for the Upper Grande Ronde steelhead population (the drainage ranks 7th of 32 reaches within the population. Consequently, this reach should be a high priority for restoration within the Upper Grande Ronde summer steelhead population (NPCC 2004a). Lower Sheep Creek is rated high priority for treatment under DEQ's WQMP; Upper Sheep Creek is rated low priority (ODEQ 2000).

Future actions should protect and enhance existing riparian vegetation and function, continue to implement appropriate standards/guidelines and BMPs within areas used for grazing and timber harvest, increase pool habitat through large wood placement, and decommission, obliterate, or improve roads (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
  1. Obliterating a draw bottom road on East Fork Sheep Creek and relocating it away from the stream.

- Improve fish passage by replacing the following culverts:

1. Sheep Creek, replace two culverts;
2. Dry Creek, replace culvert;
3. Chicken Creek, replace one culvert;
4. Indiana Creek, replace one culvert;
5. Unnamed tributary to Chicken Creek, replace one culvert;
6. Unnamed tributary to West Chicken Creek, replace one culvert;
7. Unnamed Tributary, replace one culvert;
8. Unnamed Tributary, replace one culvert;
9. Unnamed Tributary, replace one culvert;
10. East Sheep Creek, replace one culvert.

Clear Creek and Tributaries (UGS23)

Primary Limiting Factors: Sediment; Habitat Quantity/Diversity (lack of pools); Riparian conditions (vegetation, streambanks)

Threats: Livestock Grazing; Roads; Timber Harvest; Mining (historic)

Based on EDT results, restoration within the Clear Creek drainage would have moderate benefit for the Upper Grande Ronde steelhead population (the drainage ranks 21st of 32 reaches within the population) (NPCC 2004a). Consequently, this reach should be a mid-range priority for restoration within the Upper Grande Ronde summer steelhead population (NPCC 2004a). Clear Creek is rated low priority for treatment under DEQ's WQMP. Efforts should focus on protecting high quality water and habitat (ODEQ 2000).

Future actions should protect and enhance existing riparian vegetation and function, continue to implement appropriate standards and guidelines within areas used for livestock grazing, timber harvest and mining, increase pool habitat through large wood placement, and decommission, obliterate, or improve roads (GRMW 1995; NPCC 2004a).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by taking the following actions:
    1. Decommission or relocate approximately 1.5 miles of road within riparian areas.
    2. Improve maintenance on approximately five miles of riparian road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 366 acres of private land. This can include development and implementation of one grazing management plan.
    2. Construct protection fence on approximately two miles of stream on private land to protect riparian areas from degradation by livestock.

3. Develop up to 10 off-channel livestock watering sites.
4. Plant riparian vegetation in approximately 58 acres of riparian area.
5. Enroll approximately five miles of private stream front into CREP or similar non-forested riparian protection program.
6. Close or move eight recreation sites located in riparian areas.
7. Manage forested riparian areas on approximately 20 acres along approximately two miles of stream to promote future large wood recruitment.

- Improve fish passage by replacing a culvert on East Fork Clear Creek.

Tributary Habitat Recovery Actions for Imnaha Steelhead MPG

Imnaha River Steelhead Population

The Imnaha steelhead population can be considered as a candidate for a maintained population as a result of an unknown Abundance/Productivity rating and a moderate rating for Spatial Structure/Diversity (ICTRT 2007). Estimates of abundance and productivity for a six-mile section of Camp Creek are the only source of long-term estimates in this population. It is critical that population abundance estimation methods are developed and implemented in the future to provide data needed to assess abundance and productivity (ICTRT 2007).

Primary factors limiting summer steelhead in the Imnaha River population include high stream temperatures, poor riparian condition, excessive fine sediment, and fish passage (NPCC 2004b; Huntington 1994; GRMW 1995; Wallowa County–Nez Perce Tribe 1999; ODEQ 2006; USFS 2002; Christian 2007). These limiting factors can be attributed to the degradation of stream channels and riparian areas resulting from livestock grazing practices, timber harvest, road construction, and water withdrawals.

The ICTRT (2007) concluded that there does not appear to be any within basin habitat changes which would pose significant selective mortality on adult or juvenile life stages. The Snake River Oregon Expert Panel (2007) determined that low stream flows due to irrigation withdrawals (which physically reduce the amount of available habitat and increase stream temperatures) are a key factor affecting summer parr in tributary habitat.

The Snake River Oregon recovery team concluded that a high priority for the Imnaha River steelhead population would be to improve habitat conditions in the lower to middle reaches of Big Sheep Creek and Little Sheep Creek, and the Imnaha River below Freezeout Creek through restoration activities that improve riparian conditions, help moderate summer temperatures, and reduce fine sediment. This could be done by decommissioning sediment producing roads and improving road maintenance, reconnecting floodplains and wet meadows, improving grazing practices, improving riparian habitat and instream complexity, and increasing summer flows in Big and Little Sheep creeks. Providing fish passage at the Gumboot Weir, and irrigation diversions on lower Grouse and Summit creeks should also be accomplished.

Lower Imnaha River Mainstem (IRS1)

Primary Limiting Factors: Water Quality (high stream temperatures); Excess Fine Sediment; Water Quantity (low flows)

Threats: Livestock Grazing/Feeding Operations; Roads; Agriculture; Upstream Impacts (water diversions)

This portion of the Imnaha River has been ranked moderate for restoration actions (NPCC 2004b). Due to the size and location of the river, treatment of problems such as high temperatures, low flows, and sediment will be most effective if they were to occur in upstream areas (NPCC 2004b), such as Big and Little Sheep creeks. The Imnaha Subbasin Plan (NPCC 2004b) recommends starting in the upper watersheds of the subbasin and working downstream with recovery actions.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 15 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately one mile of stream to protect riparian areas.
    2. Develop approximately 15 off-channel livestock watering sites.
    3. Plant riparian vegetation in approximately 100 acres of riparian zone.
    4. Enroll approximately three miles of river front into CREP or a similar program.

Lower Imnaha River Smaller Tributaries (IRS2)

Primary Limiting Factors: Water Quality (high temperatures); Riparian Condition; Excess Fine Sediment; Fish Passage

Threats: Livestock Grazing/Feeding Operations; Roads; Barriers

The streams in this reach of the Imnaha River are ranked moderate to high for restoration (NPCC 2004b).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 15 miles of road, and relocating riparian roads where possible.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately one mile of stream to protect riparian areas.
    2. Develop approximately five off-channel livestock watering sites.
    3. Enroll approximately three miles of river front into CREP or a similar program.
- Improve fish passage in this reach through the following actions:

1. Replace one culvert on Fence Creek (Lower Imnaha road).
2. Replace one culvert on Corral Creek (Lower Imnaha road).

Cow, Lightning, and Horse Creeks (IRS3)

Primary Limiting Factors: Water Quality (high temperatures); Channel Stability; Excess Fine Sediment

Threats: Livestock Grazing; Roads

Lightning and Horse creeks are ranked a moderate priority for restoration actions, and Cow Creek a high priority (NPCC 2004b).

Channel instability in these streams is primarily a function of naturally occurring high flow events. Addressing the threats causing high temperatures here will also promote healthy riparian areas and more stable streambanks.

Only two restoration actions have been identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process for this reach.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 13 miles of road.
- Relocate roads away from riparian areas where possible.

Upper Imnaha River Mainstem (IRS4)

Primary Limiting Factors: Water Quality (high temperatures)

Threats: Roads; Livestock Grazing; Agriculture; Timber Harvest (historic)

Little information is available on steelhead abundance in this section of river and we are uncertain how much production would be gained by restoration actions. The Imnaha River Subbasin Plan ranks this portion of the mainstem Imnaha River as moderate to low priority for restoration actions, and high for protection (NPCC 2004b).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 35 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately eight miles of stream to protect riparian areas from.
    2. Develop approximately eight off-channel livestock watering sites.

3. Plant riparian vegetation in approximately 20 acres of riparian zone.
4. Enroll approximately three miles of river front into CREP or a similar program.
5. Remove or relocate and rehabilitate 10 dispersed recreation sites from riparian areas.

- Improve fish passage in this reach by modifying the weir at the Gumboot Acclimation Facility on the Imnaha River.

Upper Imnaha River Tributaries (IRS5)

Primary Limiting Factors: Water Quantity (high and low flows); Water Quality (high temperatures); Channel Stability; Riparian Condition; Fish Passage; Excess Fine Sediment (roads)

Threats: Roads; Livestock Grazing; Timber Harvest; Water Diversion

The streams in this reach are ranked low to moderate priority for restoration actions (NPCC 2004b).

High flows in these streams are a function of the flashy nature of these snow-melt influenced systems. Channel instability in these streams is primarily caused by naturally occurring high flow events. There are no recommended actions to address high flows in these tributaries. Addressing the threats causing high temperatures here will also promote more stable streambanks.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

Irrigation diversion structures present passage barriers to juvenile movement in the lower reach of both Grouse Creek and Summit Creek. Both of these structures, especially the Summit Creek diversion should be examined to determine a solution. The Summit Creek ditch supplies water to a single landowner. This ditch could be converted to a pipe which would conserve water and eliminate the current diversion of nearly all of the Summit Creek flow during the summer months. Reconstruction of the diversion structure would also eliminate the current inadequate return system for trapped juveniles.

- Protect and enhance riparian areas through the following actions:
  1. Construct protection fence on approximately eight miles of stream to protect riparian areas.
  2. Develop approximately 10 off-channel livestock watering sites.
  3. Enroll approximately three miles of river front into CREP or a similar program.

- Improve fish passage through the following actions:
  1. Replace three culverts on Gumboot Creek;
  2. Replace one culvert on Blackhorse Creek;
  3. Replace two culverts on Skookum Creek;
  4. Replace two culverts on Dry Creek;
  5. Replace one culvert on North Fork Dry Creek.

- Improve instream habitat by saving approximately 12 cfs for instream flows through increased efficiency and control of flow at irrigation diversions.

Lower Big Sheep and Little Sheep Creek Mainstem (IRS6)

Primary Limiting Factors: Water Quality (high stream temperatures); Water Quantity (low flows); Excess Fine Sediment; Riparian Condition; Habitat Quantity/Diversity (Lack of pools and large wood); Fish Passage

Threats: Livestock Grazing; Agriculture; Roads; Timber Harvest; Barriers

The Imnaha River Subbasin Plan ranks this reach as high to moderate for restoration actions (NPCC 2004b).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately 25 miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately 400 acres of private land. This can include the implementation of five grazing management plans.
    2. Remove or fence (with adequate buffer) five livestock feeding operations.
    3. Construct protection fence on approximately eight miles of stream to protect riparian areas.
    4. Develop up to 10 off-channel water developments for livestock.
    5. Stabilize erosion on approximately one mile of stream.
    6. Enroll approximately eight miles of stream on private land into CREP or a similar riparian protection program.
- Improve instream habitat by reconnecting one mile of channelized stream back to the floodplain.
- Improve fish passage in this reach through the following actions:
    1. Modify two diversions at the steelhead acclimation facility on Little Sheep Creek.
    2. Replace two culverts on Little Sheep Creek.

Lower Big Sheep and Little Sheep Creek Tributaries (IRS7)

Primary Limiting Factors: Water Quality (high stream temperatures); Water Quantity (high and low flows); Excess Fine Sediment; Riparian Condition; Channel Stability; Fish Passage

Threats: Agriculture; Livestock Grazing; Roads; Timber Harvest; Barriers

The QHA analysis rates Bear Gulch and Lower Camp Creek high for restoration, while the other streams in this reach rated low to moderate (NPCC 2004b).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

To minimize the influence of roads on steelhead habitat, improved maintenance could be accomplished on approximately two miles of road. Opportunities for decommissioning of riparian roads should be investigated.

- Protect and enhance riparian areas through the following actions:
    1. Construct protection fence on approximately one mile of stream to protect riparian areas.
    2. Develop one off-channel water development for livestock.
    3. Plant riparian vegetation in approximately 10 acres of riparian area.
- Improve instream habitat through the following projects:
    1. Reconnect approximately four miles of channelized stream back to the floodplain.
    2. Remove confinement structures along approximately five miles of stream and reconnect it to the floodplain.
- Improve fish passage in this reach through the following actions:
    1. Replace two culverts on Camp Creek (Camp Cr Road, Johnson Lane, and other private road);
    2. Modify two irrigation diversions in Camp Creek;
    3. Replace at least one culvert on Trail Creek, a tributary to Camp Creek (Camp Cr road);
    4. Replace one culvert on Griffith Creek;
    5. Replace 10 culverts on Lightning Creek (9 crossings and one associated w/earthen dam);
    6. Replace one culvert on an unnamed tributary to Lightning Cr.

Upper Big and Little Sheep Creek Mainstems (IRS8)

Primary Limiting Factors: Water Quantity (high and low flows); Water Quality (high temperatures); Fish Passage; Excess Fine Sediment

Threats: Water Diversions; Barriers; Roads; Timber Harvest; Livestock Grazing

The QHA analysis rates Big and Little Sheep Creek upper mainstems high for needing restoration actions (NPCC 2004b).

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat by improving maintenance on approximately six miles of road.
- Protect and enhance riparian areas through the following actions:
    1. Improve grazing practices on approximately five acres of private land.
    2. Construct protection fence on approximately two miles of stream to protect riparian areas.
    3. To improve instream habitat, approximately 10 cfs could be saved for instream flows between Big and Little Sheep creeks by improving irrigation efficiencies and modifying diversion structures.
- Improve fish passage at the WVIC diversions at the South Fork Big Sheep confluence and on Little Sheep Creek at RM 26.5. The WVIC diversion at the South Fork Big Sheep confluence presents a migration barrier to adult and juvenile steelhead, and reduces summer flows downstream. The dry channel directly below the diversion (during the irrigation season) reduces available rearing habitat and presents a passage barrier to juvenile steelhead. The WVIC diversion on Little Sheep Creek at RM 26.5 is a passage barrier to both juvenile and adult steelhead, and reduces summer flows downstream. Modification of these two diversions should be a high priority in this reach. This would include screening of the ditch.
- To further improve fish passage, replace two culverts (pair) on Little Sheep Creek.

Upper Big and Little Sheep Creek Tributaries (IRS9)

Primary Limiting Factors: Water Quantity (high and low flows); Excess Fine Sediment; Fish Passage

Threats: Roads; Water Diversions; Timber Harvest; Livestock Grazing; Barriers

Within the upper Big Sheep and Little Sheep Creek tributaries, Carrol and Ferguson creeks are rated high for needing restoration actions (NPPC 2004). Lick Creek is rated moderate. McCully is rated low because of its high quality habitat on National Forest Lands. However, this rating does not consider the fish passage barrier where the WVIC intercepts the McCully Creek flow.

Potential actions to improve abundance and productivity of summer steelhead in the upper Big and Little Sheep Creek tributaries include actions that would reduce sediment delivery to streams, and provide more summer flow and improve passage in McCully and Ferguson creeks.

Restoration actions identified by local natural resource professionals in limiting factors and threats discussions and the economic analysis process that best address the current limiting factors and threats in this reach are listed below.

- Minimize the influence of roads on steelhead habitat through the following actions:
    1. Decommission or relocate approximately eight miles of riparian road.
    2. Improve maintenance on approximately 15 miles of road.
- Protect and enhance riparian areas through the following actions:

1. Construct protection fence on approximately two miles of stream to protect riparian areas.
2. Develop up to five off-channel water developments for livestock watering.
3. Eliminate or relocate six camp sites within the riparian area at Lick Creek Campground.

The WVIC diversions on Salt, Canal, Ferguson, Redmont, and McCully creeks limit summer flows and present fish passage barriers within these streams. Little useable habitat is available in Salt, Cabin, Canal, Redmont, and Ferguson creeks above the canal due to their small size and steep gradient (approximately 0.25 – 0.5 miles per stream). Therefore little change in steelhead productivity would be gained by eliminating these barriers. However, McCully Creek contains several miles of useable, historic habitat above the canal which would be made available for spawning and rearing if passage were allowed at the WVIC.

- Improve fish passage in this reach through the following actions:
    1. Replace one culvert on Canal Creek;
    2. Replace one culvert on Ferguson Creek;
    3. Replace one culvert on Redmont Creek;
    4. Replace one culvert on Lick Creek;
    5. Replace one culvert on Mud Springs Cr (Lick Cr trib);
    6. Replace two culverts on Carrol Creek;
    7. Remove one culvert on Echo Canyon;
    8. Remove or replace five culverts on Salt Creek and tributaries.

Appendix B
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Appendix C

Tributary Habitat Actions Cost Analysis Spreadsheet

Appendix E Table 11-2 Tributary Habitat Actions Cost Analysis Spreadsheet.

	Roads			Livestock Management						Riparian Restoration		
	Close/Relocate Roads (Miles)	*Improve Mtnce* (Miles)	*Replace Culverts* (# Replaced)	*Improve Grazing Mgmt* (Acres)	*Develop Mgmt Plans* (# of Plans)	*Move Feedlots* (# Moved)	*Filter Strips* (# Needed)	*Fence Riparian* (Stream Miles)	*Improve Watering* (# Needed)	*Planting* (Acres)	*Stabilize Erosion* (Stream Miles)	*CREP, Etc* (Str Miles)
Unit Costs	$ 3,002	$ 41,177	$ 93,448		$ 3,000	$ 29,940	$ 10,396	$ 10,396	$ 3,805	$ 1,554	$ 153,088	$ 50,755
Catherine Cr Chinook												
Project Total	17	27	5	3600	39	21	21	49	245	348	4.25	64
CCC Total Cost	$51,034	$1,111,779	$467,240	$0	$117,000	$628,740	$218,316	$509,404	$932,225	$540,792	$650,624	$3,248,320
Imnaha/Big Sheep Ch												
Project Total	3	106	3	405	5	5	5	24	43	120	1	17
IRC Total Cost	$9,006	$4,364,762	$280,344	$0	$15,000	$149,700	$51,980	$244,306	$163,615	$186,480	$153,088	$862,835
Imnaha R. Steelhead												
Project Total	16	169	42	405	5	5	5	31	54	130	1	20
IRS Total Cost	$48,032	$6,958,913	$3,924,816	$0	$15,000	$149,700	$51,980	$322,276	$205,470	$202,020	$153,088	$1,015,100
Joseph Cr. Steelhead												
Project Total	130.5	0	10	1314	7	1	1	16	34	320	13.75	11.5
JCS Total Cost	$391,761	$0	$934,480	$0	$21,000	$29,940	$10,396	$166,336	$129,370	$497,280	$2,104,960	$583,683
Lwr GR Steelhead												
Project Total	0.5	66	5	20	1	1	1	0.5	2	5	0	0.5
LGS Total Cost	$1,501	$2,717,682	$467,240	$0	$3,000	$29,940	$10,396	$5,198	$7,610	$7,770	$0	$25,378
Lookingglass Cr. Ch												
Project Total	5	10	4	1018	10	2	2	8	40	200	5	4
LCC Total Cost	$15,010	$411,770	$373,792	$0	$30,000	$59,880	$20,792	$83,168	$152,200	$310,800	$765,440	$203,020
Minam R. Chinook												
Project Total	5	8	1	75	1	0	0	0	5	0	0	0
MRC Total Cost	$15,010	$329,416	$93,448	$0	$3,000	$0	$0	$0	$19,025	$0	$0	$0
Upper GR Chinook												
Project Total	8.25	42.05	2	5612	69	11	11	49.75	248	573.5	25.25	46.75
UGC Total Cost	$24,767	$1,731,493	$186,896	$0	$207,000	$329,340	$114,356	$517,201	$943,640	$891,219	$3,865,472	$2,372,796
Upper GR Steelhead												
Project Total	134	698	116	23535	374	125	125	240.5	1232	2492	129	284.5
UGC Total Cost	$402,268	$28,741,546	$10,839,968	$0	$1,122,000	$3,742,500	$1,299,500	$2,500,238	$4,687,760	$3,872,568	$19,748,352	$14,439,798
Wallowa/Lostine Ch												
Project Total	8	34	5	960	64	5	5	26.5	90	211	12	34
WLC Total Cost	$24,016	$1,400,018	$467,240	$0	$192,000	$149,700	$51,980	$275,494	$342,450	$327,894	$1,837,056	$1,725,670
Wallowa R. Steelhead												
Project Total	33	67	6	2535	113	9	9	64.5	175	361	12	65
WRS Total Cost	$99,066	$2,758,859	$560,688	$0	$339,000	$269,460	$93,564	$670,542	$665,875	$560,994	$1,837,056	$3,299,075
Wenaha R. Chinook												
Project Total	0	15	0	20	1	1	1	0.5	2	5	0	0.5
WRC Total Cost	$0	$617,655	$0	$0	$3,000	$29,940	$10,396	$5,198	$7,610	$7,770	$0	$25,378
All Populations Total	$1,081,471	$51,143,893	$18,596,152	$0	$2,067,000	$5,568,840	$1,933,656	$5,299,361	$8,256,850	$7,405,587	$31,115,136	$27,801,051

Total Cost of All Actions	**$ 299,576,026**
Total Cost Steelhead	**$214,022,969**
Total Cost Chinook	**65,856,468**

Instream Restoration				Irrigation		Vegetation Mgmt		Recreation Mgmt			Fish Passage			
Reloc Channelized (Stream Miles)	*Remove Confinement Str* (Stream Miles)	*Reconnect Floodplain* (Stream Miles)	*Add Structure* (Str Miles)	*Restore Instrm Flow* (CFS Saved)	*Irrig Information* (Classes Offrd)	*Manip Spp/ Density* (Acres)	*Maint LWD* (Stream Miles)	*Reloc Riparian Sites* (# Sites Moved)	*Motorized Use* (Stream Miles)	*Non Motorized* (Stream Miles)	*Remove Barriers* (# Removed)	*Modify Diversions* (# modified)	Chinook	Steelhead
$ 200,201	$ 200,201	$ 200,201	$ 21,022	$ 41,841	$ 24,870	$ 139	$ 139	$ 38,315		$ 2,108	$ 183,069	$ 99,000		
9	25	29	11	12	0	2000	2	11	0	0	1	9		
$1,801,809	$5,005,025	$5,805,829	$231,242	$502,092	$0	$278,000	$278	$421,465	$0	$0	$183,069	$891,000	$23,595,283	
1	1	1	0	13	2	0	0	16	0	1	4	4		
$200,201	$200,201	$200,201	$0	$543,933	$49,740	$0	$0	$613,040	$0	$2,108	$732,276	$396,000	$9,418,816	
5	6	6	0	22	0	0	0	16	0	0	2	5		
$1,001,005	$1,201,206	$1,201,206	$0	$920,502	$0	$0	$0	$613,040	$0	$0	$366,138	$495,000		$18,844,492
2	0.75	2	1	0	0	340	6	2	0	0	1	3		
$400,402	$150,151	$400,402	$21,022	$0	$0	$47,260	$834	$76,630	$0	$0	$183,069	$297,000		$6,445,975
0	0	0	0	0	0	72	0	0	4	0	12	0		
$0	$0	$0	$0	$0	$0	$10,008	$0	$0	$0	$0	$2,196,828	$0		$5,482,551
3	3	3	4	0	0	300	7	15	2	0	1	1		
$600,603	$600,603	$600,603	$84,088	$0	$0	$41,700	$973	$574,725	$0	$0	$183,069	$99,000	$5,211,236	
0	0	0	2	0	0	0	4	5	2	20	0	0		
$0	$0	$0	$42,044	$0	$0	$0	$556	$191,575	$0	$42,160	$0	$0	$736,234	
12.75	23	20.75	57.5	5	0	193	13.75	39	2	2	3	2		
$2,552,563	$4,604,623	$4,154,171	$1,208,765	$209,205	$0	$26,827	$1,911	$1,494,285	$0	$4,216	$549,207	$198,000	$26,187,952	
58.5	77	80.5	223.5	33.2	97	7394	142	136	199	38	21	32		
$11,711,759	$15,415,477	$16,116,181	$4,698,417	$1,389,121	$2,412,390	$1,027,766	$19,738	$5,210,840	$0	$80,104	$3,844,449	$3,168,000		$156,490,739
11	9.5	9.5	18.5	118	0	30	1	5	0	2	1	12		
$2,202,211	$1,901,910	$1,901,910	$388,907	$4,937,238	$0	$4,170	$139	$191,575	$0	$4,216	$183,069	$1,188,000		
17	11.5	12.5	37.5	118	0	30	37	5			1	13		
$3,403,417	$2,302,312	$2,502,513	$788,325	$4,937,238	$0	$4,170	$5,143	$191,575	$0	$0	$183,069	$1,287,000		$26,758,940
0	0	0	0	0	0	0	0	0	0	0	0	0		
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$706,947	
$23,873,969	$31,381,507	$32,883,014	$7,462,810	$13,439,329	$2,462,130	$1,439,901	$29,572	$9,578,750	$0	$132,804	$8,604,243	$8,019,000	$65,856,468	$214,022,696

Appendix E Table 11-3 Tributary Habitat Action Unit Cost Data.

Actions	Average Cost	Cost Metric
Road Obliteration	$ 7,303	road obliterated/mile (from 5 LAG projects)
Road Decommission/Closure	$ 1,647	road decommission-closure/mile (from 2 WAV projects)
Road Maintenance	No Cost Avail	Road maintenance/mile
Road Closure	No Cost Avail	roads closed/mile
Treat or Maintain roads to prevent adverse effects to streams	$ 41,177	road treated/mile
Culvert Replacement (w/bridges and culverts) at stream/road crossings	$ 93,448	cost/crossing improvement
Improve Grazing Practices	No Cost Avail	
Develop Grazing Plans	No Cost Avail	
Treat or Relocate Feedlots (that impact streams)	$ 29,940	cost/project
Construct Feedlot Filter Strip (stream fencing)	$ 10,396	fence built/mile
Stream Fencing	$ 10,396	fence built/mile
Improve Watering (livestock water improvements, spring development, etc)	$ 3,805	cost/development
Riparian Planting	$ 1,554	planting/acre
Streambank Stabilization	$ 153,088	bank stabilized/mile
Conservation Programs (CREP, etc.)		
Relocate Channelized Channel (stream channel reconstruction)	$ 200,201	channel reconstructed/mile
Remove Confinement Structures	No Cost Avail	
Reconnect Channel with Floodplal/Hist Channel (stream channel reconstruction)	$ 200,201	channel reconstructed/mile
Add Inchannel Structure (boulders, large woody debris, etc.)	$ 21,022	habitat enhanced/mile
Reduce Irrigation Withdrawals (irrigation efficiency projects)	$ 41,841	cost/project
Promote Efficient Irrigation thru Educations (educational programs)	$ 24,780	cost/program
Thin Riparian Areas	$ 139	cost/acre
Maintain Existing LWD thru Forestry Practices (thin riparian areas)	$ 139	cost/acre
Improve or Relocate Campgrounds in riparian areas	$ 38,315	cost/project
Motorized Recreation - eliminate ATV use in riparian areas	No Cost Avail	
Improve or Relocate Trails in riparian areas	$ 2,108	cost/mile
Remove Barriers (irrigation diversion rebuild to improve fish passage)	$ 183,069	cost/structure rebuilt
Irrigation Diversion Modification(to improve fish passage)	$ 99,000	cost/structure modified
Lease or Purchase Water	No Cost Avail	cost/cfs for irrigation season
Install fish screens	No Cost Avail	screens installed

Appendix D

2014 Ecosystem Diagnostic and Treatment (EDT) Analysis Results

This chapter presents an analysis of a range of actions that were identified in Chapter 7 for recovery purposes within the Grande Ronde subbasin. All of the actions are intended to address limiting factors within the subbasin affecting Grande Ronde River populations of spring Chinook and summer steelhead. Projections of action effectiveness and benefits to the salmon and steelhead populations are presented here based on several modeling tools. Results are provided for eight different strategy types, comprising a total of 23 separate actions, to help inform recovery planners about action priorities and sequencing.

The Ecosystem Diagnostic and Treatment (EDT) model (Mobrand et al. 1997; Blair et al. 2009), has been used extensively in the Pacific Northwest to analyze potential habitat restoration actions for purposes of salmon recovery (e.g., Carmichael and Taylor 2009; Thompson et al. 2009). In the Columbia Basin, the EDT model has been used primarily to analyze habitat conditions within the subbasins, being applied in nearly every subbasin that currently supports anadromous salmonids. It was the principal modeling tool used to formulate many of the subbasin plans developed in the early 2000s, including one for the Grande Ronde subbasin (NPPC 2004). It was used to complete an earlier draft of this recovery plan (November 2010).

8.1 Methods

This description of methods is given in two parts: 1) the EDT model setup for use in the Grande Ronde subbasin and associated habitat characterization, and 2) formulation of action effectiveness.

The methods are in many respects identical to those applied by Carmichael and Taylor (2009) for analyzing subbasin actions in formulating the recovery plan for Oregon steelhead populations in the Mid-Columbia steelhead DPS—though some notable differences exist. Some procedures were modified from those employed for the Mid-Columbia DPS to address the different manner in which habitat actions were defined in the Grande Ronde subbasin. In general, habitat actions were defined with a greater degree of specificity in the Grande Ronde subbasin. This called for formulating analytical procedures that tied effectiveness to the various ways in which actions were scaled in the Grande Ronde subbasin.

8.1.1 EDT Model Setup and Habitat Characterization

The EDT model is a habitat-based model developed to estimate salmonid population performance measures as determined by characteristics of the aquatic habitat (Blair et al. 2009). All of the elements of habitat—including both abiotic and biotic elements—are incorporated in

the assessment.[1] While it considers conditions at all life stages—producing population parameters for the entire life cycle—it was originally built to address factors that affect freshwater survival. The model derives the population parameter estimates based entirely on the habitat characteristics that serve as the model inputs with the exception that certain demographic characteristics are also required.[2]

This analysis focuses on how smolt capacity (at departure from the subbasin) and intrinsic productivity at the smolt stage would be affected by habitat actions taken within the subbasin. The EDT model also produces performance measures for a population for both spawners and smolts at the equilibrium abundance level, i.e., the expectation for the long-term average under steady-state conditions. We focus here on smolt capacity and productivity to enable comparisons to be made to results from other modeling tools that estimate these same parameters. Neither smolt capacity nor productivity at that stage is affected by out-of-subbasin survival factors, and therefore comparisons between results can be made without incorporating those factors.[3]

Aspects of past EDT analyses for the Grande Ronde populations, done for subbasin planning in 2004 (NPPC 2004), were incorporated into the limiting factors assessment presented in Chapter 5 of this plan, as well as into this chapter's analysis. The stream reach and habitat characterizations used in those analyses were applied as part of the baseline conditions for the analysis presented herein, with several exceptions as described below. These baseline conditions in the Grande Ronde subbasin are the average conditions that existed for some period of years prior to and including the time when the EDT database was formulated for use in the subbasin planning process. It is reasonable to assume, therefore, that the baseline conditions applied herein are representative of the 1990s and early 2000s. Any changes to habitat conditions as a result of habitat restoration actions carried out since the subbasin plan was developed (i.e., 2004) would not be included as part of the baseline. Generally, habitat changes resulting from those actions can be assumed to be included within the prospective actions being modeled as part of this plan.[4]

All of the data inputs completed as part of the subbasin planning process were unchanged for use as the baseline scenario in the analysis reported herein with three exceptions. First, the spawning

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[1] A total of 46 habitat attributes are available in EDT to characterize habitat condition (Blair et al. 2009). These include those that are most frequently considered as habitat elements, such as wood load, water temperature, and pool quantity, but also include biotic elements that comprise habitat condition. Biotic elements include exotic fish species that are present, fish community richness (i.e., number of fish species present), and the extent of hatchery fish releases into the area. The biotic elements affect ecological interactions, which in turn can affect the performance of the population being modeled. It is noted that these biotic attributes were used in characterizing habitat in the Grande Ronde subbasin.

[2] / While the model's estimates of population performance are driven largely by habitat characteristics captured in the data inputs, average marine survival, age structure, spawner sex ratio, and eggs per adult spawner by age are also required as part of the modeling process. No population data on abundance are incorporated into the model.

[3] / Technically, there can be some indirect effect of out-of-subbasin survival factors on smolt capacity and productivity because the cumulative effect of all survival factors over the full life cycle can affect age structure and fecundity, which in turn can affect both capacity and productivity at the smolt stage.

[4] / No attempt has been made to separate out actions that were implemented in the late 2000s from those included as part of the recovery plan actions. The number and extent of actions already implemented are small compared to the those analyzed herein and not yet implemented.

distributions of some populations had not been defined consistent with the ICTRT's delineations; therefore, in these cases, spawning distributions were updated to match those given by the ICTRT. Second, habitat attributes characterized for the subbasin planning process incorporated only a few of the many man-made barriers to fish passage (for either juveniles or adults) in the Grande Ronde subbasin. The actions described in Chapter 7 of this plan call for correcting a large number of barriers to fish passage. Therefore, we updated the EDT database to add approximately 100 more documented barriers to provide a truer depiction of the baseline. The passage effectiveness values of these barriers were incorporated based on information contained in Oregon State, U.S. Forest Service, and Nez Perce tribal databases.

The third way that we changed the EDT model setup for this application was to update the water temperature characterization. As part of a review of an earlier draft of this chapter, Rich Carmichael of ODFW found that temperatures in some stream reaches in the subbasin appeared to have been characterized as unrealistically low. Water temperatures have been documented as being a critical limiting factor to salmon performance in many stream reaches (see Chapter 5). Following the ODFW review, water temperature data sets were assembled from 80 different sites in the subbasin and inspected for completeness.[5] Data sets were deemed to be sufficiently complete to update the EDT characterization at 52 sites spread over the subbasin. Many of the individual datasets included multiple years of data, some having more than ten years of data.

A short description of how, and the extent to which, the temperature characterization was updated is informative. Most EDT attributes are characterized using ratings on a scale of 0 to 4, spanning a spectrum of conditions (Lestelle et al. 2004). Generally, there is a consistent direction to the attribute ratings, where 0 or low values will tend to correspond with environmental conditions that are either benign or beneficial to salmon while higher values tend toward degraded conditions that can adversely affect salmon survival. An attribute rating of 0 would correspond to a condition having no reduction in biological performance, whereas a value of 4 could cause a severe reduction in performance. The index rating system provides for continuous values for the attributes, i.e., values do not have to be whole integers. For the maximum water temperature attribute, definitions for the 0 to 4 ratings are listed below:

Index 0	Index 1	Index 2	Index 3	Index 4
Warmest day < 10 C	Warmest day>10 C and <16 C	> 1 d with warmest day 22-25 C or 1-12 d with >16 C and <22 C	> 1 d with warmest day 25-27.5 C or > 4 d (non-consecutive) with warmest day 22-25 C or >12 d with >16 C	> 1 d with warmest day 27.5 C or 3 d (consecutive) >25 C or >24 d with >21 C

EDT employs a standard algorithm to convert continuous data on water temperature to derive a month by month rating for maximum water temperature. The 52 water temperature datasets were used to compute the EDT maximum water temperature ratings by month for the stream reaches

[5] / Datasets were obtained from three sources: USFS, La Grande office; Grande Ronde Model Watershed office; Oregon DEQ LASAR web site.

where the data were collected. In addition, the results were then extrapolated to other reaches in the watershed based on the overall pattern of water temperatures from monitored sites and other information (tributary locations, flow patterns, and land use). Table 8-1compares ratings that were used during subbasin planning to those derived from the 52 datasets. The ratings at most sites increased, many by a substantial margin. Based on this comparison, we concluded that the persons who formulated the EDT database developed during subbasin planning used relatively few empirical datasets to derive the EDT water temperature ratings and/or they were uncertain how to convert empirical data to the EDT temperature ratings. Because there was generally close agreement between the subbasin planning ratings and the updated values for sites within the Grande Ronde valley, it appears likely that the empirical datasets that were used were only from that vicinity.[6]

The EDT model was designed for analyzing effects of habitat actions on salmonid population performance. As part of its setup, it requires characterizations of both historic and existing habitat conditions for all stream reaches used by the population of interest (see Lichatowich et al. 1995). This provides a simple, logical framework for considering the effectiveness of future habitat actions. The Scenario Builder tool, one of the suites of EDT modeling tools, is then used to explicitly define the extent that an action might be expected to move reach-specific habitat characteristics back toward the pre-development state (Thompson et al. 2009). Scenario Builder also allows for defining actions that represent future watershed development, as would occur over time with human population growth. In that case, the tool can be used to identify the extent that reach characteristics move further away from the pre-development state and toward a fully developed one (buildout). This aspect of the tool is used extensively as part of recovery planning in areas where human population growth is rapidly increasing, such as in the Puget Sound region (Thompson et al. 2009), but it was not applied here. Growth is expected to be relatively slow in the geographic area of interest and patterns of future development are not well defined. Actions intended to give protection against further habitat loss can be analyzed with Scenario Builder when habitat loss actions are also defined.

[6] / The process used to characterize habitat as part of subbasin planning (NPPC 2004) involved a group of individuals knowledgeable of conditions within the watershed and in many cases it relied on the professional judgments of those individuals for rating habitat. The process was intended to employ empirical data wherever it was available, but constraints on time are known to have limited the extent that empirical data sets were assembled and used.

Table 8-1. Locations where empirical temperature datasets were collected, corresponding EDT reaches, and a comparison between the ratings for maximum temperature used in subbasin planning (NPPC 2004) and revisions made for the analysis presented herein.

Site location	Corresponding EDT reach	Original rating	Revised rating
Lower Clear Cr (Upper GR)	Clear Cr-1 (2nd GR)	1.0	2.0
U Grande Ronde R above Clear Cr	Grande Ronde-51	1.0	2.7
U Grande Ronde R below Clear Cr	Grande Ronde-50	2.0	2.4
Limberjim Cr	Limber Jim Cr-1	1.0	2.9
W Chicken Cr	Chicken Cr W	1.0	3.3
Upper Sheep Cr	Sheep Cr-3 (2nd GR)	2.0	3.5
Grande Ronde R below Vey Meadows	Grande Ronde-47	2.0	3.5
Grande Ronde R Below 5115 Bridge (Upper GR)	Grande Ronde-47	2.0	3.5
UGR above Fly Cr	Grande Ronde-47	2.0	3.5
Lower Fly Cr	Fly Cr-1	2.0	3.5
Upper Fly Cr	Fly Cr-1	2.0	3.5
Lower Meadow Cr	Meadow Cr-1 (2nd GR)	2.0	3.8
Lower 5 Pts Cr	Five Points Cr-1	2.0	3.8
Upper 5 Pts Cr	Five Points Cr-2	1.0	3.2
Upper NF Catherine Cr	Catherine Cr NF-3	1.0	3.0
U Grande Ronde R at Jordan Cr	Grande Ronde-41	3.8	3.8
U Grande Ronde R at Hilgard	Grande Ronde-39	3.8	3.2
U Grande Ronde R at State Ditch	Grande Ronde-35_A	3.8	3.8
Catherine Cr at 10 St	Catherine Cr-6	3.0	3.3
Catherine Cr at Hwy 203	Catherine Cr-6	3.0	3.3
Catherine Cr at Davis Dam pool	Catherine Cr-3	3.8	3.6
Catherine Cr below Davis Dam	Catherine Cr-3	3.8	3.6
DEQ Catherine Cr at Hwy 203	Catherine Cr-6	3.0	3.3
DEQ GRR at Hwy 82 Elgin	Grande Ronde-31	3.0	3.8
DEQ GRR above Wallowa R	Grande Ronde-26	2.5	3.1
DEQ GRR at OR-WA border	Grande Ronde-10	2.0	3.0
Minam R at Minam	Minam-1	1.0	3.3
Wallowa R near Vale	Wallowa-4	2.8	3.0
Wallowa R above Fisher Cr	Wallowa-3	2.0	3.3
Howard Cr	Howard Cr	2.0	3.2
Wallowa R below Water Canyon	Wallowa-6	2.8	3.3
Wallowa R below Lostine R	Wallowa-10	2.8	3.1
Wallowa R above Lostine R	Wallowa-11	2.8	3.2
Wallowa R below start XCountry Ditch	Wallowa-12	2.8	3.5
Wallowa R above start XCountry Ditch	Wallowa-12	2.8	3.5
Wallowa R below lake dam	Wallowa-19	2.0	3.3
Bear Cr (Wallowa R) at mouth	Bear Cr-1 (Wallowa)	2.8	3.3
Bear Cr (Wallowa R) at RM 5.8 - Garden Gulch	Bear Cr-2 (Wallowa)	2.0	3.1
Bear Cr (Wallowa R) at Getchel Meadows at RM 6.1	Bear Cr-2 (Wallowa)	2.0	3.1
Lostine R at RM 1.4	Lostine-3	2.0	3.2
Lostine R at RM 6.4	Lostine-5	2.8	3.1
Lostine R at RM 10.2	Lostine-6	2.0	2.7
Wildcat Cr	Wildcat Cr-1	3.0	3.3
Mud Cr	Mud Cr-1	3.0	3.3
Courtney Cr at RM 0.5	Courtney Cr-1	3.0	3.3
Wenaha R lower	Wenaha-1	3.0	3.3
Wenaha R Mid	Wenaha-2	1.0	2.9
Joseph Cr above Cottonwood Cr	Joseph Cr-2	2.5	3.6
Cottonwood Cr at mouth	Cottonwood Cr-1 (Joseph)	2.5	3.1
Joseph Cr above Swamp Cr	Joseph Cr-4	2.8	3.8
Crow Cr at mouth	Crow Cr-1	3.5	3.6
Chesnimnus Cr at mouth	Chesnimnus Cr-1	2.8	3.8

Two prospective habitat scenarios were modeled using the EDT model for each set of actions, representing two different future time periods for projected results, 25 and 100 years in the future. Each scenario assessed projected outcomes—at either 25 or 100 years—associated with the implementation of a set of actions aimed at improving habitat conditions for the affected populations. The individual actions were defined in terms of specific amounts of change that would occur to some feature that could affect habitat condition in particular stream reaches. For example, a riparian fencing action was defined by the number of miles of fences that would be built within some portion of a stream drainage to protect the stream corridor. Each scenario also assumed that all of the actions being modeled would be implemented in year one of the plan. Thus, all actions would have been operative for either 25 years or 100 years at the end of the period for each scenario.

The standard output from EDT consists of Beverton-Holt population parameters for smolt yield (leaving subbasin during smolt migration window) and spawners (successfully spawning). The parameters are intrinsic productivity (progeny per parent at low density), carrying capacity, and equilibrium abundance (long-term average under steady state conditions). (Appendix 8-A provides an overview of some of the properties of the Beverton-Holt relationship that make it particularly useful within the EDT model.) The number of repeat steelhead spawners are not computed in the EDT model, but the amount of repeat spawning is believed to be very small for Snake River steelhead (<5%; Narum et al. 2008).

Parameter values produced for each prospective habitat scenario were used to compute the percent change in the parameter compared to the baseline. We used these relative changes to assess the potential benefits to population performance corresponding to each habitat scenario. We do not present herein the actual parameter values for any scenario, choosing instead to present everything as relative change. We avoid the question of how well EDT output parameters represent actual performance levels if performance was to be measured accurately over a sufficient period of time (e.g., as addressed by Rawding 2004[7]).

Another EDT output is referred to as life history diversity and is a measure of the distribution of life cycle pathways through time and space determined to be successfully completed within the modeled environment. The model creates a multitude of diverse time-space pathways (or trajectories) through the environment consistent with the species' known life history patterns (incorporating seasonal movement patterns, rates of movement, and age structure), computing life cycle productivity and capacity parameter values for each pathway under each scenario modeled (including the historic and baseline condition scenarios). This modeling device allows for the modeled population to use—and be affected by—different areas of the watershed in a way that simulates how the real population uses the watershed. The various segments of the population can thereby be affected by the many stream reaches in the system in a wide variety of

[7] / Rawding (2004) compared EDT model output with observed data for several salmon and steelhead populations in the lower Columbia River. He concluded that spawner-recruit performance results were comparable between observed data and EDT outputs when recruits were measured as smolts (EDT does not incorporate variation in marine survival).

ways. Thus, actions that target a particular section of the river system might affect habitats that are used little or extensively by the population as a whole.

The percentage of life cycle pathways that are able to be completed successfully (i.e., having a productivity ≥1) of the entire set of modeled pathways is reported in the output as the % life history diversity.[8] A value of 100% means that all modeled pathways would be expected to support completed life histories over the entire life cycle. In contrast, for example, a value of 20% would mean that only 20% of the pathways would support successful life histories—indicating that 80% of the pathways encountered such poor conditions for survival at some times or places (or were blocked by barriers) that life cycle completion was not possible. Typically, modeling of the undeveloped environment (historic condition) produces values for this metric at or near 100%. Modeling of severely degraded environments yields values much reduced—in severe cases <20% of the pathways might be successful. A large reduction in this metric compared to the undeveloped state usually means that significant portions of habitat no longer support sustainable production. Moreover, because older aged life history patterns are subject to greater marine mortality, they become unsustainable at a greater rate as habitat quality diminishes than those representing younger aged patterns. The underlying concept of the metric is that it will reflect a real change in diversity of life history pathways relative to the undeveloped state that can be supported under the habitat conditions being modeled. Applying it to action analysis, if the current condition scenario yields a value of 20% for this metric, then how much would the metric change under a prospective action scenario? In this case, a large increase in the metric associated with an action scenario would mean that a significant expansion has occurred in life history distribution with improved habitat.

We report the results for this life history diversity metric to reflect only one aspect of how life history diversity would be expected to change due to an action set. The ICTRT is also concerned about life history diversity at a larger scale than represented in the EDT measure, where patterns of distribution, movement, and age structure are considered. The EDT metric is not an equivalent measure, though it reflects all of these higher scale patterns to some extent.

8.1.2 Tributary Habitat Effectiveness

The effectiveness values of various types of habitat actions are input into the EDT model through the Scenario Builder. This tool captures assumptions about action effectiveness in altering attributes of freshwater habitat. EDT habitat characterizations consist of ratings of 46 environmental attributes (flow, sediment, temperature, etc.) that describe the conditions of each stream reach delineated within a river system. The characterizations are meant to represent an average state of conditions within a time period, i.e., current period, pre-development period, or a future period corresponding to the outcome of one or more habitat actions.

The Scenario Builder tool serves as the interface for assembling the effectiveness assumptions, then moving them to the EDT server (http://www.edt.icfi.com/edt/) for use in the EDT model.

[8] / A productivity value <1 indicates that a spawner is not able to replace itself over its entire life cycle, resulting in extinction.

The tool does not prescribe how the effectiveness assumptions are to be set for the various actions. That task remains the responsibility of the analyst who is evaluating the actions. No standard set of actions and effectiveness values exist in the modeling tools to be applied throughout a region, such as in the Columbia basin, because of the uniqueness of watersheds and the various circumstances under which actions might be considered.

While many actions are the same between watersheds in recovery planning, such as riparian fencing, the intensity (or scale) at which the action might be applied can vary significantly within and among watersheds. For a given intensity of application (e.g., as measured by the number of stream miles fenced), the potential effectiveness of an action such as riparian fencing might reasonably be assumed to be comparable between watersheds—but the realized effectiveness across the entire stream system would be determined by how many miles of stream are fenced.

Although the overall approach to analyzing action effectiveness herein is largely the same as that used by Carmichael and Taylor (2009) for Mid-Columbia steelhead, the way in which tributary actions were characterized for this plan differs. In the Mid-Columbia plan, tributary actions were identified as taking place in specific streams or regions of streams. But the intensity of actions within a stream had not been specified when the actions were described. An assumption, therefore, was required to be made about the level of intensity for a given type of action. The same intensity level of application was assumed for each type of action between all streams where the action was prescribed. Moreover, the same level of intensity was assumed among all subbasins for the same action type, although the overall scale of application of the action differed on the basis of which streams were called out to receive the action.

In this plan, the intensity of each action has been defined with a high level of specificity. For example, intensity for various actions are defined herein either by the numbers of stream miles to be treated, miles of road to be affected, or acres of land to be treated. The locations of where actions would be applied, although not precisely given, were identified to stream (or region of stream in the case of large streams) or groups of streams. This information provided the means of formulating rules for deriving effectiveness values for the actions as they might be implemented in each stream or subwatershed.

A total of 23 distinct actions within eight strategy types was assembled from Chapter 7 into a library of actions for processing.[9] Aspects of several actions in Chapter 7 overlapped substantially with others, and therefore a few were not carried over into the analysis.

The action library is listed in Table 8-2 showing which actions were applied within the geographic boundaries used to delineate the spawning populations of Chinook and steelhead in the Grande Ronde subbasin. If an action would be implemented in the headwater regions of streams closely associated with a population, it was considered to directly affect that population, although its effects might also benefit other populations downstream. The actions in Chapter 7,

[9] / Two of the actions are redundant with one another, and therefore, only 22 actions were actually applied. Which one of the two was used differs between geographic areas because neither one was consistently characterized for all geographic areas in Chapter 7.

as defined there, were listed for each population, but it is important to recognize that the actions are the same (as well as action intensity levels) between species within a common geographic area. Hence, across the entirety of the Grande Ronde subbasin, there is one set of tributary actions. This action set was applied to both species.

It should be noted that the action modeling as reported herein was performed to a much greater extent than in the draft chapter of November 2010. In that earlier analysis, all actions were modeled together—thus there was no way to distinguish which actions were providing the greatest benefit to a population. In this updated chapter, action groups have been modeled by strategy. Thus, the eight strategies were modeled separately, and then all were combined and modeled together.

Table 8-2. Tributary habitat actions applied directly within the geographic areas that encompass each Chinook and steelhead population in the Grande Ronde subbasin.

Strategy and action	Spring Chinook						Steelhead			
	Wenaha	Wal - Lost	Minam	Looking	Catherine	UGR	Joseph	LGR	Wallowa	UGR
1. Road management										
Close/relocate roads		x	x	x	x	x	x	x	x	x
Improve road maintenance		x	x	x	x	x	x	x	x	x
Replace culverts		x	x	x	x	x	x	x	x	x
2. Livestock management										
Improve grazing management		x	x	x	x	x	x	x	x	x
Move feedlots		x		x	x	x	x	x	x	x
Riparian fencing		x		x	x	x	x	x	x	x
Off-site watering		x	x	x	x	x	x	x	x	x
3. Riparian restoration										
Riparian plantings		x		x	x	x	x	x	x	x
Stabilize streambank erosion		x		x	x	x	x		x	x
CREP (or related) programs		x		x	x	x	x	x	x	x
Riparian thinning		x						x	x	
Riparian species alteration [1/]					x	x				x
LWD maintenance program [1/]		x	x	x	x	x	x		x	x
4. Meadow restoration										
Restore wet meadows						x		x		x
5. Instream restoration										
Relocate channelized stream		x			x	x	x		x	x
Remove channel confinement		x			x	x	x		x	x
Reconnect floodplain				x	x	x	x			x
Add channel structure		x	x	x	x	x	x		x	x
6. Irrigation management										
Restore instream flows		x			x	x			x	x
7. Recreation management										
Relocate riparian recreational sites		x		x	x	x	x		x	x
Limit motorized use within riparian zone		x	x	x	x	x		x	x	x

Limit non-motorized recreational activities					x	x				x
8. Fish passage restoration										
Remove or modify barriers		x		x	x	x	x	x	x	x

1/ Only one of the two actions indicated by the footnote was actually applied for any given geographic area.

The actions—as listed in Chapter 7—were described for streams (or portions thereof) or groups of streams associated with geographic areas within the boundaries of each of the spawning populations. For the purpose of this analysis, we define the streams or groups of streams that identify where actions would be implemented as macro-reaches. These macro-reaches determine the geographic scale at which the effectiveness of most of the tributary actions is determined. Table 8-3 lists the number of macro-reaches within the boundaries for each population, as well as the corresponding number of stream reaches applied within the EDT model.

Effectiveness values were determined separately for each action. All of the actions except two were addressed by formulating rules based on the intensity measures prescribed in Chapter 7. The two exceptions were flow restoration through irrigation management and correction/removal of fish passage barriers. The amounts of flow to be restored through irrigation management, as well as the number of fish passage barriers targeted for correction, were specified in Chapter 7—these targets were applied directly in modeling. Descriptions of the procedures used in incorporating these action effects are given below.

Table 8-3. The numbers of macro-reaches and associated EDT stream reaches delineated within the geographic boundaries encompassing each of the Grande Ronde subbasin populations. Macro-reaches delineate the geographic areas where the intensity (or scale) of tributary habitat actions were defined. EDT stream reaches that define specific sites of barriers to fish passage are not included here.

Geographic area		Macro reaches	EDT reaches
Entire subbasin		50	564
Species	**Population**		
Chinook	Wenaha	2	26
	Wallowa -Lostine	11	90
	Minam	2	25
	Lookingglass	1	16
	Catherine	7	89
	Upper Grande Ronde	13	133
Steelhead	Joseph	7	65
	Lower Grande Ronde	7	116
	Wallowa	13	115
	Upper Grande Ronde	23	268

All Actions Except Irrigation Management and Fish Passage Barrier Correction

The effectiveness values of all actions except for flow restoration through irrigation management and the correction of fish passage barriers were derived through a set of rules. The procedure consisted of explicitly defining distinct elements—or factors—used to compose the overall effectiveness values.

Four elements of action effectiveness were recognized (Figure 8-1), each acting as a scalar to determine how effective an action would be in moving an attribute's current baseline rating back toward the undeveloped state. Combined, these scalars produce the realized effectiveness $REffect$ for action *i*, at lag time *t*, for attribute *a* used in modeling the action as follows:

$$REffect_{i,t,a} = Effect_i \times Intensity_i \times Lag_{i,t} \times Attribute_{a,i}$$

where $Effect_i$ is the potential effectiveness of action *i*

$Intensity_i$ is a scalar for defining the scale at which action *i* is to be applied

$Lag_{i,t}$ is a scalar that defines how much of the potential effectiveness of action *i* will be achieved at time *t* in the future (25 or 100 years in the future)

$Attribute_{a,i}$ is a scalar that defines whether the potential effectiveness of action *i* for attribute *a* is the full amount (scalar of 1) or reduced due to an attribute effect. A scalar of 0 would indicate that the attribute is not affected by action *i*.

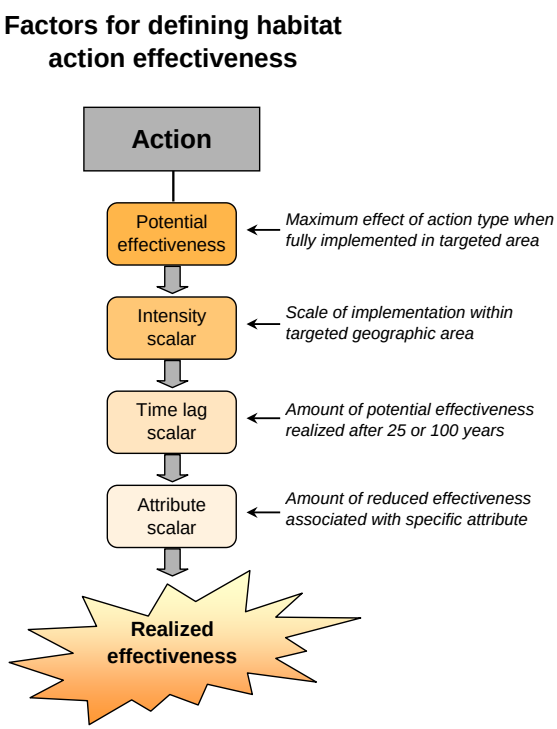


Figure 8-1. Action effectiveness elements.

An action's potential effectiveness ($Effect_i$) identifies the magnitude of effect that might reasonably be expected when the action would be implemented as fully as feasible within a geographic area. For example, how much of a stream reach 5 miles in length might reasonably be treated with a riparian restoration action (such as Riparian Plantings in Table 8-2) if the action was focused on that reach—and, in turn, to what extent would the action restore attributes largely tied to the riparian condition in the pre-altered state? If the action remained in effect until its full benefit was to be realized—for this action perhaps 100 years—what would be its measured effectiveness at that time? In this case, we could reasonably argue that most or all of the stream reach could be treated and that after 100 years certain attributes (e.g., temperature, wood loading) might be restored completely, or nearly so, to their pre-altered state. This result would only occur, however, if the entirety of the riparian zone was given 100% protection against any form of land use, which is not specified as part of the action. We assumed, therefore, that a potential effectiveness value of approximately 50% would be reasonable, given that some level of utilization would continue, as well other constraints that would likely limit overall effectiveness.

The potential effectiveness defines the maximum, yet reasonable, extent of effectiveness that might occur for the action of that type. Considering this aspect of an action's effectiveness provides a straightforward way of identifying a base effectiveness, to which the other scalars can then be applied. The potential effectiveness value assigned to each action is an assumption, since there is usually limited empirical data for defining the value with high degree of certainty. The assignment of effectiveness values to actions in recovery planning is often done through a team effort, either by consensus or as an average of values from different individuals (Mobrand Biometrics Inc 2003; Thompson et al. 2009). Here, in this recovery planning process, the values were developed by one person using information from many previous efforts and who has facilitated a wide variety of team-oriented approaches in the Pacific Northwest.[10] This provided a consistent means of assigning effectiveness values for the entire set of actions applied here. To simplify the task of assigning potential effectiveness values, selections were made from six different levels, ranging between no effect to very high (Table 8-4). (See Appendix 8-B for details.) These are the same effectiveness levels applied in Carmichael and Taylor (2009). Generally, actions were assigned values between low and moderately high.

Table 8-4. Potential effectiveness levels assigned to actions.

Effectiveness level	Definition	Effect
1	Very high	0.80
2	Moderately high	0.56

[10] / Effectiveness modeling here was performed by Larry Lestelle, one of the principal architects of EDT who has facilitated numerous EDT analyses in many watersheds of the Pacific Northwest. The perspective gained and actual effectiveness values used in those recovery planning efforts, in which the extent and causes of habitat degradation were assessed from pre-development conditions, gave an informed, consistent way of considering effectiveness of moving habitat conditions back toward their prior state.

3	Moderate	0.32
4	Low	0.08
5	Negligible	0.01
6	No effect	0.00

The intensity scalar ($Intensity_i$) defines the scale at which an action would actually be projected to be applied to the areas identified for treatment. In most cases, we would not expect actions to be applied at the maximum extent possible, given land ownership patterns, land use patterns, and costs. In Chapter 7, the scale for each action's application within a geographic area (associated with a macro-reach) was prescribed—numbers of miles of roads to be closed, stream miles to be fenced, acres of land for modified grazing practices, and so on. These measures specify the intensity level for each action to be analyzed. Rules were formulated to derive the intensity scalar values for each action and associated geographic areas based on these intensity levels.

One of two measures of overall scale was used to derive the intensity scalars for each action: the total miles of roads within the area delineated by the HUC6[11] subwatershed boundaries that encompass the macro-reaches (including, where appropriate, any HUC6 units that extend to adjacent headwaters) or the number of stream miles (corresponding to EDT stream reaches) associated with each macro-reach. The rules formulated based on these measures represent hypotheses about how effectiveness would be scaled by the level of the action treatment. Many of the rules assume that action effectiveness would operate within a corridor of land closely surrounding stream reaches. These corridors are assumed to encompass the riparian zone and to sometimes extend somewhat beyond.

The rules for each action are outlined in Table 8-5.

Table 8.5. Descriptions of intensity scalar rules.

Action	Unit of measure	Intensity scalar rule
Close/relocate roads	road miles	Scalar = miles of road closed or relocated ÷ total road miles in area encompassed by associated HUC6 units. (Potential effectiveness set at 0.56.)
Improve road maintenance	road miles	Scalar = miles of improved road maintenance ÷ total road miles in area encompassed by associated HUC6 units. (Potential effectiveness set at 0.32.)
Replace culverts	# of sites	It is assumed that maximum effectiveness would occur when 1 culvert is replaced for every 2 miles of road. This assumes that aging and failing culverts are relatively widespread. (Potential effectiveness set at 0.08.)
Improve grazing management	acres	It is assumed that grazing improvements are aimed at lands in relatively close proximity to stream channels. Scalar = acres of land with improved grazing practices ÷ total acres of land within a 1000 ft wide stream corridor (based on length of EDT stream channels within the macro-reach). (Potential effectiveness set at 0.32.)

[11] / Hydrologic Unit Code (HUC) at the 6th level in the classification system of hydrologic units on the landscape.

Action	Unit of measure	Intensity scalar rule
Move feedlots	# of sites	It is assumed that maximum effectiveness would occur when 1 feedlot is moved per mile of stream (i.e., 1 per side within 2 miles of stream, based on length of EDT stream channels x 2 within the macro-reach). This assumes that feedlots are relatively abundant. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. It is assumed that feedlots are also located along these smaller streams. (Potential effectiveness set at 0.32.)
Riparian fencing	stream miles	Scalar = miles of stream fenced ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. It is assumed that miles of streams to be fenced includes these smaller streams. (Potential effectiveness set at 0.56.)
Off-site watering	# of sites	It is assumed that maximum effectiveness would require 4 off-site watering stations per mile of stream (2 on each side of the stream per mile). Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. It is assumed off-site watering stations would also be located along these smaller streams. (Potential effectiveness set at 0.32.)
Riparian plantings	acres	It is assumed that riparian plantings would extend far enough from the stream channel to re-establish significant riparian forests. Scalar = acres of land targeted from plantings ÷ total acres of land within a 400 ft wide stream corridor (based on length of EDT stream channels within the macro-reach). (Potential effectiveness set at 0.56.)
Stabilize streambank erosion	stream miles	It is assumed that miles of stream prescribed for treatment encompass both streambanks. Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams would be part of the treatment. (Potential effectiveness set at 0.32.)
CREP (or related) programs	stream miles	It is assumed that miles of stream prescribed for treatment encompass both streambanks. Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams would be part of the treatment. (Potential effectiveness set at 0.32.)
Riparian thinning	acres	It is assumed that riparian thinning would extend far enough from the stream channel to re-establish significant riparian or stream corridor forests. Scalar = acres of land targeted from thinning ÷ total acres of land within a 400 ft wide stream corridor (based on length of EDT stream channels within the macro-reach). (Potential effectiveness set at 0.08.)
Riparian species alteration	acres	It is assumed that the action would extend far enough from the stream channel to re-establish native species/densities consistent with healthy stream corridor forests. Scalar = acres of land targeted for manipulation ÷ total acres of land within a 1000 ft wide stream corridor (based on length of EDT stream channels within the macro-reach). (Potential effectiveness set at 0.32.)
LWD maintenance program	stream miles	It is assumed that miles of stream prescribed for treatment encompass both streambanks. Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.32.)
Restore wet meadows	acres	It is assumed that restoration of wet meadows would be fully effective if their characteristics were restored within a 300 ft stream corridor when ¼ of a 1 mile long corridor contains such features. This amounts to 9 acres of wet meadow along a 1 mile length of stream. This action would only target areas where wet meadows have historically existed. (Potential effectiveness set at 0.56.)
Relocate channelized stream	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.32.)

Action	Unit of measure	Intensity scalar rule
Remove channel confinement	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.32.)
Reconnect floodplain	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.32.)
Add channel structure	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.32.)
Relocate riparian recreational sites	# sites	It is assumed that maximum effectiveness would need to relocate 1 site mile of stream in areas where recreational use is heavy. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. (Potential effectiveness set at 0.08.)
Limit motorized use within riparian zone	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.08.)
Limit non-motorized recreational activities	stream miles	Scalar = miles of stream treated ÷ total stream miles within the macro-reach. Note: Stream miles here is the number of EDT reach miles x 2, recognizing that many small streams are not accounted for in the EDT reach set. These smaller streams could be part of the treatment. (Potential effectiveness set at 0.08.)

The lag scalar ($Lag_{i,t}$) defines how much of the potential effectiveness of an action would be achieved after a period of some number of years into the future. The full effectiveness of some actions would be realized immediately upon implementation (e.g., barrier removal), while others would require a lengthy time period to realize full effectiveness, such as riparian restoration. Two time lags were analyzed: 25 and 100 years into the future. All actions were assumed to be fully effective (lag scalar = 1) after 100 years, whereas the scalar was <1 at 25 years for those actions requiring a longer period to achieve full effectiveness. (See Appendix 8-B for details.) Actions that would mature in effectiveness over time are those associated with maturing of native vegetation, channel and floodplain reformation and stabilization, and the gradual restoration of more normative hydrographs as the new aspects of land management are instituted and realized.

The attribute scalar ($Attribute_{a,i}$) defines whether the potential effectiveness of an action would be the full amount (scalar = 1) or reduced due to an attribute effect. Some actions will have no effect on some attributes (scalar = 0). For each action, attributes were identified as being affected or not affected. We assigned the scalar to be 1 for any attribute that would be affected except for those that characterize some aspect of sediment, flow, and temperature. We set the scalar for these to be <1, recognizing that these attributes are broadly affected by watershed conditions and can be more difficult to influence than attributes driven mainly by site-specific conditions. Carmichael and Taylor (2009) applied a value of 0.75 for this scalar. Here, we used two values (0.25 and 0.75) to bound a range to reflect uncertainty in how these attributes would be affected

in the Grande Ronde subbasin. In this subbasin, the condition of attributes that characterize aspects of sediment, flow, and temperature have generally been severely and widely degraded. Therefore, we report the modeling results as a range, as determined by use of a scalar of 0.25 and 0.75. The results reported in this manner reflect both a somewhat more conservative assumption than applied by Carmichael and Taylor (2009) and uncertainty in how certain attributes would be affected by the actions.

An example of how the scalars combine for one geographic area (as defined for segment UGS10 for upper Grande Ronde steelhead in Chapter 7) is illustrated below. The example shows the derivation of effectiveness that would operate on the attribute maximum water temperature within the geographic area with 354 acres of riparian plantings at 25 years into the future with both an attribute scalar value of 0.25 and 0.75:

Effectiveness element	Low end of range	Upper end of range
Potential effectiveness	0.56	0.56
Intensity scalar	0.24	0.24
Lag scalar at 25 years	0.7	0.7
Temperature attribute scalar	0.25	0.75
Realized effectiveness at 25 years	= 0.56 x 0.24 x 0.6 x 0.25	= 0.56 x 0.24 x 0.6 x 0.75
	= 0.024	= 0.071

The resulting realized effectiveness values are calculated to be 0.024 and 0.071 for the two values of the attribute scalar, meaning that in the affected stream reaches the maximum water temperature rating would be moved either 2.4% or 7.1% of the distance between the current and the pre-altered (i.e., historic) ratings for the two scalar values.[12]

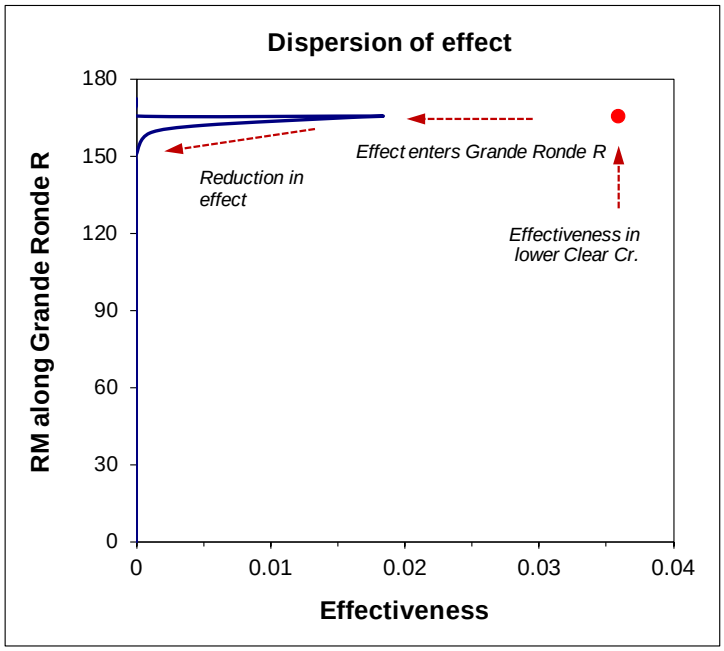
Carmichael and Taylor (2009) applied one additional scalar, called the Implementation Schedule Scalar, in analyzing action effectiveness for Oregon steelhead populations within the Mid-Columbia DPS. This scalar was meant to capture the expected schedule when actions might realistically be implemented following the initiation of the recovery plan. It was recognized that not all of the tributary habitat actions could truly be implemented in the first year of the plan. Hence a schedule was described that specified in approximate terms when various actions might be expected to be implemented over a 25 year period. Actions implemented near the end of the 25 year period would in actuality be much less effective at 25 years into the plan than those initiated at the beginning of the plan. This level of detail was not prescribed for the Grande

[12] / To further illustrate the effect, the current condition for maximum water temperature within a stream reach might have a rating of 3.5, which is equivalent to peak temperatures reaching 22-25 C on multiple occasions during a month. If the historic temperature—given what can reasonably be assumed about riparian condition, wet meadows, flow, etc—was much cooler, here having a rating of 1.0 meaning that temperatures normally did not exceed 16 C during the month, then the action would result in a rating of 3.32, i.e., (3.5 – 1) x (1 – 0.071) + 1 = 3.32, with an attribute scalar value of 0.75, a relatively small improvement from the current condition. The effect would be smaller with the attribute scalar set to 0.25. The ratings for each attribute are used in the EDT rules to compute survival effects by life stage and species (see Lestelle et al. 2004).

Ronde subbasin actions. Therefore, all actions were assumed to be fully implemented at the beginning of the plan in this analysis.

The procedures described above for deriving effectiveness result in direct effects of actions within the EDT reaches encompassed by the macro-reaches. There are also dispersed effects that extend downstream to stream reaches outside those macro-reaches. A procedure was formulated for dispersing effects by assuming that effectiveness would continue downstream but it would decline as a function of the increase in watershed size draining to each reach.[13] The concept is that effectiveness should decline through dilution or as the effects of other conditions recur (such as from other sources of adverse effects). This gave a relatively simple, straightforward way of routing dispersed effects in a manner believed to provide reasonable approximations. An example of routing the effects of one action applied in one macro-reach is illustrated in Figure 8-2. It shows how realized effectiveness of one action for one attribute is dispersed out of lower Clear Creek, a tributary to the upper Grande Ronde, then down the Grande Ronde River.

It is noted that the extent of the dispersion effect has been reduced substantially from the extent applied in the 2010 draft of this chapter based on review by ODFW and other parties. The revision incorporated here set the dilution rate to zero when the computed dilution factor (as a function of the increase in watershed size) attained a level of 17.5%, meaning that once an effect was diluted to 17.5% of its original strength, it was assumed to then reach a *de minimis* level. This mechanism served to essentially end dispersal after between 3-10 miles depending on the size of the stream and the amount of inflow expected from tributaries.



[13] / A simpler approach was applied in Mid-Columbia subbasins in Carmichael and Taylor (2009) due primarily to how an action's intensity was assumed to be the same throughout the subbasins.

Figure 8-2. Illustration of action effectiveness dispersal in a downstream direction along the Grande Ronde River. The example is for one action (riparian fencing) occurring in Clear Creek in the upper Grande Ronde River. The action's effectiveness (adjusted by the action's intensity) was 0.035 in lower Clear Creek, then dropped to 0.018 as it entered the Grande Ronde River, then continued to decline as the size of the upstream watershed increased with downstream distance from the location of the action.

Flow Increase Associated with Irrigation Management Actions

One action is aimed at restoring some portion of flow through changes in irrigation management. Chapter 7 of the plan specifies that a total of 151 cfs would be restored over the entirety of the subbasin, as well as the approximate locations for where it would be recovered. This information was used to determine effectiveness at restoring two EDT attributes, wetted channel width and another that defines a characteristic of flow. The changes in these attribute characteristics were computed directly from the prescribed increase in flow that would occur for each reach in the subbasin.

The computations for the EDT attributes were made by estimating the total amount of flow that would exist in all stream reaches of interest with the addition of the recovered flow. In EDT, wetted channel width is characterized for all stream reaches both for historic and current conditions. These widths can be converted into estimates of flow in each reach, taking into account channel confinement, using equations in Lestelle (2004).[14] We converted the channel width estimates into flow levels, added in the recovered flow amounts, and then routed these flows downstream to obtain the new, restored flow levels for all stream reaches. These restored flow levels were then used to estimate the new wetted channel widths for all reaches with the irrigation management action operative. The restored flow levels were also used to adjust those EDT attributes that characterize flow conditions relative to the unmanaged state as defined in Lestelle (2004).

Barrier Removal/Correction Action

The actions described in Chapter 7 call for correcting a large number of barriers to fish passage. Three barrier databases—formulated by Oregon State, U.S. Forest Service, and the Nez Perce Tribe—were used to identify and characterize potential passage barriers for use in the EDT database. The barrier databases were used to identify the precise locations of potential barriers relative to the EDT stream reaches. By comparing the information in Chapter 7 to these databases, approximately 100 additional barriers were added to the EDT database over what had been previously used in the subbasin planning process.

The effectiveness of passage was assumed to be 100% for all passage barriers identified in the EDT database under the action calling for removal/correction of barriers.

[14] / These same equations were used to estimate channel widths from estimated flow in some areas of the Grande Ronde River in the EDT characterization used during the subbasin planning process.

8.2 Results of Tributary Habitat Actions

Results of the tributary action analysis are presented for each population below. The levels of coverage of actions implemented within the boundaries of the HUC6 areas encompassing the populations are first summarized, followed by projected changes in performance for each population as a result of the habitat actions.

The level of intensity associated with each habitat action differs greatly in application among the six Chinook populations and four steelhead populations. Tables 8-7 and 8-8 summarize intensity levels for each action as they would be applied within the HUC6 areas encompassing spring Chinook and summer steelhead populations respectively. Table 8-9 then compares several indices of relative intensity within the action coverage areas to aid the reader in generally understanding how action intensities vary between areas and populations. The indices shown in Table 8-9 are meant only to give a crude sense of how intensities vary between areas associated with the spawning populations since they do not reflect differences among types of actions. Also, the indices do not take into account water savings associated with changes in irrigation management.

Figure 8-3 graphically compares the weighted average intensity scalar values corresponding to each of the spawning populations. The four spawning populations that generally were associated with the highest levels of action intensity were Catherine Creek spring Chinook, Lookingglass Creek spring Chinook, and upper Grande Ronde River spring Chinook and steelhead. Extremely low intensity levels (or none) were associated with lower Grande Ronde River steelhead and Minam and Wenaha river spring Chinook.

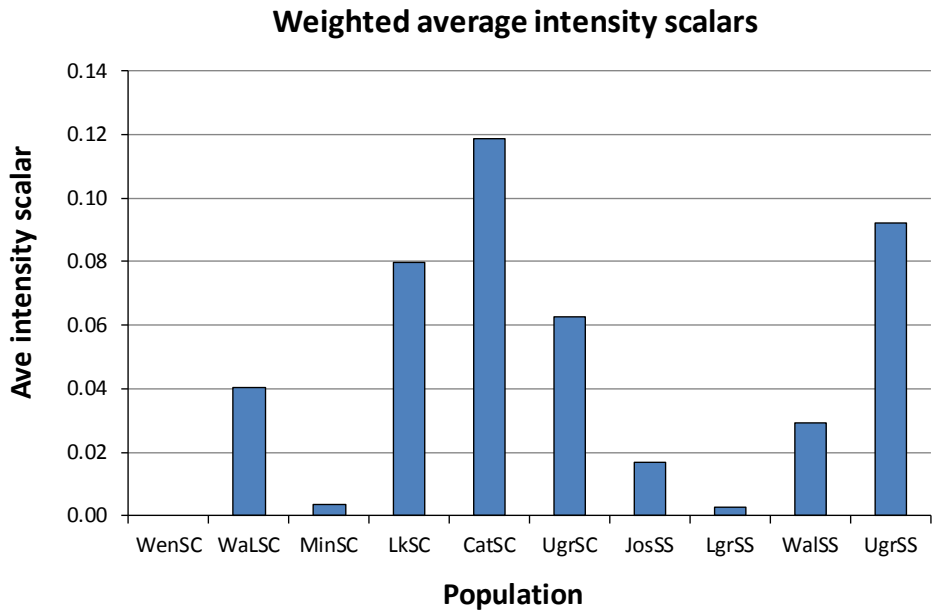


Figure 8-3. Average intensity scalar values weighted by the size of the macro-reaches that delineate the ten spawning populations (values listed in Table 8-9).

The effects of the actions were assessed by modeling the action group associated with each strategy separately (eight strategy types) for each population, then all actions were modeled together to assess the combined effect of all actions on a population. Separate model runs were required for each attribute scalar (0.25 and 0.75) and for each time lag (25 and 100 years). Hence a total of 36 model runs were made for each population for a grand total of 360 model runs for all populations. Results are summarized in graphic and tabular formats for each population separately.

The results are presented as percent changes in performance parameters compared to the baseline period for each strategy and for all actions combined. The performance parameters summarized are capacity, productivity, and the index of life history diversity. In addition, results are given for the relative amount of the habitat potential (i.e., the historic performance measure) achieved by each strategy (as a percent). This second set of results is helpful as it shows how much more performance might be gained with more habitat restoration.

Results are presented in the following order:

1. Wenaha River spring Chinook;
2. Wallowa & Lostine rivers spring Chinook;
3. Minam River spring Chinook;
4. Lookingglass Creek spring Chinook;
5. Catherine Creek spring Chinook;
6. Upper Grande Ronde spring Chinook;
7. Joseph Creek summer steelhead;
8. Lower Grande Ronde summer steelhead;
9. Wallowa River summer steelhead; and
10. Upper Grande Ronde River summer steelhead.

A series of supplemental graphic summary reports are presented in Appendix 8-C to aid the reader in better understanding how the habitat actions are projected to affect the populations. These graphics are extracted from output produced by EDT. All of the summary reports utilize geographic areas referred to as diagnostic units. A diagnostic unit consists of a series of stream reaches in relatively close proximity; the units were delineated in a manner to inform planners about prioritization of geographic areas for restoration and protection actions for each population. If the results were to be presented at the reach scale, the sheer volume of material would be overwhelming to the reader. Diagnostic units and associated stream reaches are listed and described in Appendix 8-D.

Three different supplementary summary reports are provided for each population in Appendix 8-C. The first report—the Baseline Diagnostic Report—summarizes basic diagnostic information for each population under baseline habitat conditions within the relevant subbasin. The report summarizes the limiting factors analysis produced by the EDT model and presents the results summarized by relevant geographic area.

The second supplemental report—the Scenario Profile Report—summarizes the extent of changes to the habitat factors projected to result from a habitat action scenario once implemented

within a subbasin. This report presents results only for all actions combined, while the main body of the report presents comparisons of results among the separate strategy types as well as all actions combined. The supplemental results are limited only to the all-actions combined scenarios. This summary identifies the relative gain (or loss in some cases) in population performance that would occur as a result of the scenario's effect within the subbasin at the diagnostic unit scale. The extent of changes to population performance are shown for the scenario's effects within each geographic areas associated with the population in the same format as in the Baseline Diagnostic Report. This report is presented using only the attribute scalar of 0.75.

The third supplemental report—the Scenario Diagnostic Report—is like the baseline diagnostic report, only instead of comparing the baseline to the pre-development state, it compares the habitat scenario (all actions combined) to the pre-development condition. It identifies the geographic areas and habitat factors that would be expected to still be inhibiting population performance after action implementation relative to the pre-development habitat condition. The report is essentially a limiting factors analysis of the habitat as it is predicted to exist following implementation and maturation of effects of the habitat scenario. As such, it helps identify areas/factors where additional habitat actions might be considered in addition to those already identified for the plan. Hence, it can serve to further refine proposed actions as a part of future planning efforts.

Additional information on how to interpret the supplemental reports is given in the introduction to Appendix 8-C.

Table 8-7. Action intensity levels applied within the geographic boundaries used to delineate each Grande Ronde spring Chinook population. Intensities levels for each action are measured either in units of miles, acres, or number of sites.

Strategy and action	Units	Spring Chinook					
		Wenaha	Wal - Lost	Minam	Looking	Catherine	UGR
1. Road management							
Close/relocate roads	Miles	-	28	5	5	42	58
Improve road maintenance	Miles	-	59	8	10	212	362
Replace culverts	Sites	-	2	1	4	44	50
2. Livestock management							
Improve grazing management	Acres	-	2,460	75	1,020	9,500	6,917
Move feedlots	Sites	-	6	-	2	90	13
Riparian fencing	Miles	-	65	-	8	108	63
Off-site watering	Sites	-	170	5	40	540	222
3. Riparian restoration							
Riparian plantings	Acres	-	361	-	200	1,004	602
Stabilize streambank erosion	Miles	-	12	-	5	38	35
CREP (or related) programs	Miles	-	60	-	4	159	61
Riparian thinning	Acres	-	20	-	-	-	-

Riparian species alteration	Acres	-	-	-	-	4,038	60
LWD maintenance program	Miles	-	13	4	7	12	69
4. Meadow restoration							
Restore wet meadows	Acres	-	-	-	-	-	10
5. Instream restoration							
Relocate channelized stream	Miles	-	14	-	-	30	17
Remove channel confinement	Miles	-	13	-	-	31	16
Reconnect floodplain	Miles	-	-	-	3	8	21
Add channel structure	Miles	-	45	2	4	60	127
6. Irrigation management							
Restore instream flows	CFS	-	118	-	-	26	5
7. Recreation management							
Relocate riparian recreational sites	Sites	-	4	-	15	27	57
Limit motorized use within riparian zone	Miles	-	2	2	2	53	134
Limit non-motorized recreational activities	Miles	-	-	-	-	3	3
8. Fish passage restoration							
Remove or modify barriers	Sites	-	31	-	1	28	28

Table 8-8. Action intensity levels applied within the geographic boundaries used to delineate each Grande Ronde summer steelhead population. Intensities levels for each action are measured either in units of miles, acres, or number of sites.

Strategy and action	Units	Steelhead			
		Joseph	LGR	Wallowa	UGR
1. Road management					
Close/relocate roads	Miles	131	1	33	137
Improve road maintenance	Miles	106	31	67	688
Replace culverts	Sites	10	5	3	118
2. Livestock management					
Improve grazing management	Acres	1,234	20	2,535	23,537
Move feedlots	Sites	2	1	6	125
Riparian fencing	Miles	12	1	65	241
Off-site watering	Sites	33	4	175	1,112
3. Riparian restoration					
Riparian plantings	Acres	240	2	361	2,291
Stabilize streambank erosion	Miles	11	-	12	109
CREP (or related) programs	Miles	7	1	60	284
Riparian thinning	Acres	-	50	20	-
Riparian species alteration	Acres	-	-	-	4,098
LWD maintenance program	Miles	6	-	17	106
4. Meadow restoration					
Restore wet meadows	Acres	-	35	-	10
5. Instream restoration					
Relocate channelized stream	Miles	1	-	14	47
Remove channel confinement	Miles	1	-	13	54
Reconnect floodplain	Miles	1	-	-	34
Add channel structure	Miles	1	-	47	221
6. Irrigation management					
Restore instream flows	CFS	-	-	118	33
7. Recreation management					
Relocate riparian recreational sites	Sites	1	-	4	124
Limit motorized use within riparian zone	Miles	-	4	4	199
Limit non-motorized recreational activities	Miles	-	-	-	11
8. Fish passage restoration					
Remove or modify barriers	Sites	3	8	31	62

Table 8-9. Comparison of relative intensity indices of actions directly applied within the geographic areas that delineate each Grande Ronde population. The relative intensity indices are meant only to show in a very general way how action intensity differed between geographic areas associated with each population. The actual calculation of intensity scalars was based on the rules described in Table 8-5. Adjusted action effectiveness is the potential effectiveness multiplied by the intensity scalar.

		Chinook						Steelhead			
Population:	**Basin wide**	**Wen**	**Wal - Lost**	**Minam**	**Look**	**Cath**	**UGR**	**Joseph**	**LGR**	**Wall**	**UGR**
Total EDT stream miles linked to spawning population:	1,563	80	210	94	40	225	343	227	335	303	697
Total HUC6 acres linked to spawning population:	2,990,600	227,077	475,561	173,406	60,995	388,501	567,041	397,996	780,194	648,967	1,163,443
Total road miles within HUC6 boundaries:	12,089	4	1,880	265	37	1,872	3,991	1,816	1,747	2,145	6,381
No. of separate actions:	23	0	20	8	16	21	22	17	13	19	22
Cumulative stream miles treated:	1578.3	0.0	222.5	8.0	33.0	502.0	543.5	39.3	5.0	230.5	1303.5
Ratio stream miles treated to total EDT miles:	1.01	0.00	1.06	0.09	0.82	2.23	1.58	0.17	0.01	0.76	1.87
Cumulative acres treated:	34,433	0	2,841	75	1,220	14,542	7,589	1,474	107	2,916	29,936
Ratio acres treated to HUC6 acres:	0.012	0.000	0.006	0.000	0.020	0.037	0.013	0.004	0.000	0.004	0.026
Ratio acres treated to EDT stream miles:	22.0	0.0	13.5	0.8	30.4	64.7	22.1	6.5	0.3	9.6	43.0
Cumulative miles of road treated:	1,193	0	87	13	15	254	420	237	32	100	825
Ratio road miles treated to HUC6 road miles:	0.10	0.00	0.05	0.05	0.40	0.14	0.11	0.13	0.02	0.05	0.13
Cumulative no. sites treated:	1,693	0	207	6	60	639	357	47	17	213	1,416
Ratio sites treated to EDT miles:	1.08	0.00	0.99	0.06	1.49	2.84	1.04	0.21	0.05	0.70	2.03
Ave potential action effectiveness:	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309
Weighted ave action intensity scalar: 1/	0.049	0.000	0.040	0.003	0.080	0.119	0.062	0.017	0.003	0.029	0.092
Weighted ave adjusted action effectiveness: 1/	0.016	0.000	0.015	0.001	0.024	0.039	0.018	0.006	0.001	0.011	0.029

1/ Weighted by size of the macro reaches that delineate the population.

8.2.1 Wenaha River Spring Chinook

Level of Action Coverage
No actions have been proposed to be carried out within the geographic area encompassing the Wenaha River spring Chinook population (Tables 8-7 and 8-9). Nearly the entirety of this area is located within the Wenaha-Tucannon Wilderness. Few alterations to habitat have occurred within the area due to human activities. There are no on-going land use activities other than dispersed recreation.

Actions performed in other geographic areas targeting other populations have some indirect effects on the Wenaha spring Chinook population due to the dispersal of some effects to the lower Grande Ronde River.

Projected Changes to Population Performance
Estimated percent changes in population performance of Wenaha River spring Chinook from tributary actions targeting other populations are shown in Figures 8-4 and 8-5 and Tables 8-10 and 8-11. Results are given with the attribute scalar value set to both 0.25 and 0.75.

Increases in population performance resulting from restoration actions are predicted to be very small (<2%) for all of the performance parameters for each time period lag and each strategy. The single strategy that has the largest effect, though still very small, is Road Management. This strategy would have its greatest effect in the lower Grande Ronde River downstream of the Wenaha confluence on aspects of the flow regime, affecting both low flow and high flow characteristics, which in turn would affect quantity of key habitats and habitat quality in the mainstem river reaches, particularly in the immediate vicinity of tributary confluences. In addition, we also conclude that the small effects of the other strategies would also act primarily through changes in the flow regime (in turn affecting key habitats and habitat quality) to benefit this population, though only slightly.

We note that the strategy that would have the greatest effect on the amount of flow in Grande Ronde River downstream of the Wenaha River is Irrigation Management, which would increase the mainstem river flow in late summer by nearly 150 cfs. While adding a substantial amount of water to the river, water quality associated with this action would likely not be benefitted in the lower Grande Ronde River. Table 8-10 indicates that a slight drop in productivity is projected for this strategy, whereas a small increase in capacity is projected. Capacity is increased slightly for life histories that utilize the mainstem Grande Ronde River for rearing (more flow during late summer), which has the effect of reducing the overall population's productivity slightly because these life histories are given a little more weight in computing productivity.[15] Life histories that use the Grande Ronde River for summer rearing have a lower productivity than those that rear entirely within the Wenaha River.

[15] / Each life history trajectory used in modeling has a productivity and capacity value. The population's productivity and capacity is a weighted average of all trajectory values, weighted by trajectory capacities; see Blair et al. (2009).

It is noteworthy that the modeling shows that the baseline performance, as well as performance for the various scenarios, would be approximately 50 and 80% of the habitat potential (i.e., historic potential) for capacity and productivity respectively (Figure 8-5 and Table 8-11). This means that the loss in performance compared to historic conditions would be almost entirely due to changes in conditions in the mainstem Grande Ronde River downstream of the Wenaha River. Because habitat within the Wenaha watershed is largely pristine, the loss in performance would necessarily be due to changes downstream of the Wenaha River, but upstream of the Snake River (all modeling is done with the historic conditions in the Snake and Columbia rivers equal to baseline conditions). It is evident because of the much greater loss in capacity than productivity in the baseline performance that the largest changes in habitat condition must be due to a decline in the quantity of key habitats in the mainstem Grande Ronde River rather than in habitat quality (see Diagnostic Summaries in Appendix 8-C, Appendix pages 8-24 to 8-29).

We confirmed that the EDT habitat database for the baseline conditions shows that quantity of pools for the entirety of the mainstem Grande Ronde downstream of the Wenaha River had been reduced as part of the subbasin planning process to a small fraction of the historic level. The effect of characterizing the mainstem river habitat like this is that it produces nearly a 50% loss in smolt capacity of Wenaha River spring Chinook compared to the historic capacity. We think it is likely that this was an unintentional mistake by the persons who formulated the EDT habitat database in 2004 because it is believed by biologists in the Grande Ronde subbasin that little change has occurred to the quantity of key habitat in the lower river relative to the historic period.

In 1997, Mobrand and Lestelle (1997) produced an extensive report on conditions in the Grande Ronde subbasin based on the first EDT analysis conducted there. That effort was carried out with the aid of many biologists working in the subbasin. For Wenaha River spring Chinook, the report stated: “The quantity of key habitat in the Grande Ronde River downstream of the Wenaha River is also unchanged compared to historic levels.” Any future EDT modeling in the Grande Ronde subbasin should verify with local biologists what condition should be applied for the mainstem river in this vicinity.

If this discrepancy between the 1997 and 2004 modeling is due to an error in the latter effort, this would mean that the Wenaha spring Chinook smolt capacity for the baseline is probably close to about 80% of its historic level. If this is the case, it would be very difficult to improve performance to levels closer to the historic potential.

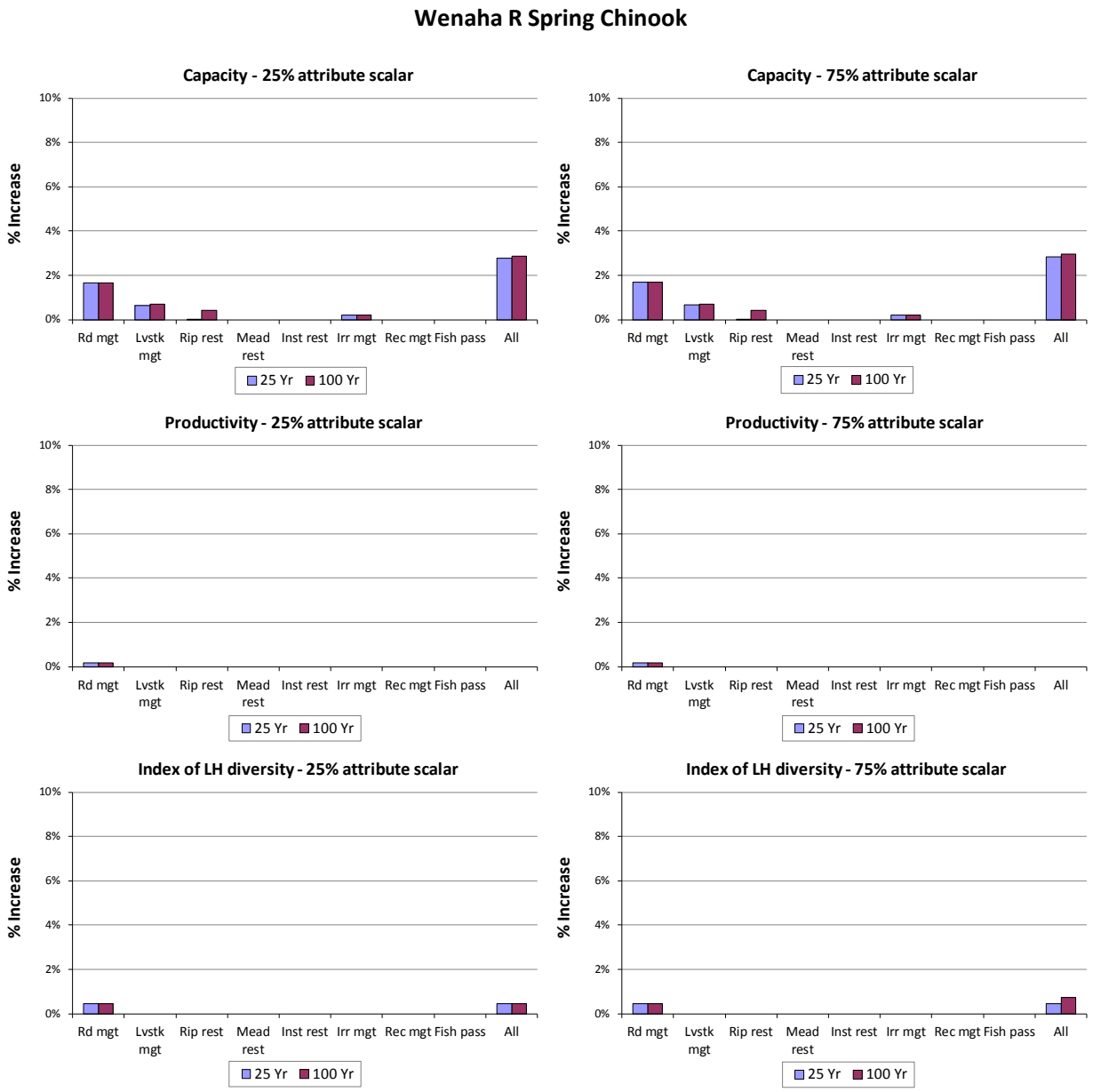


Figure 8-4. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wenaha River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

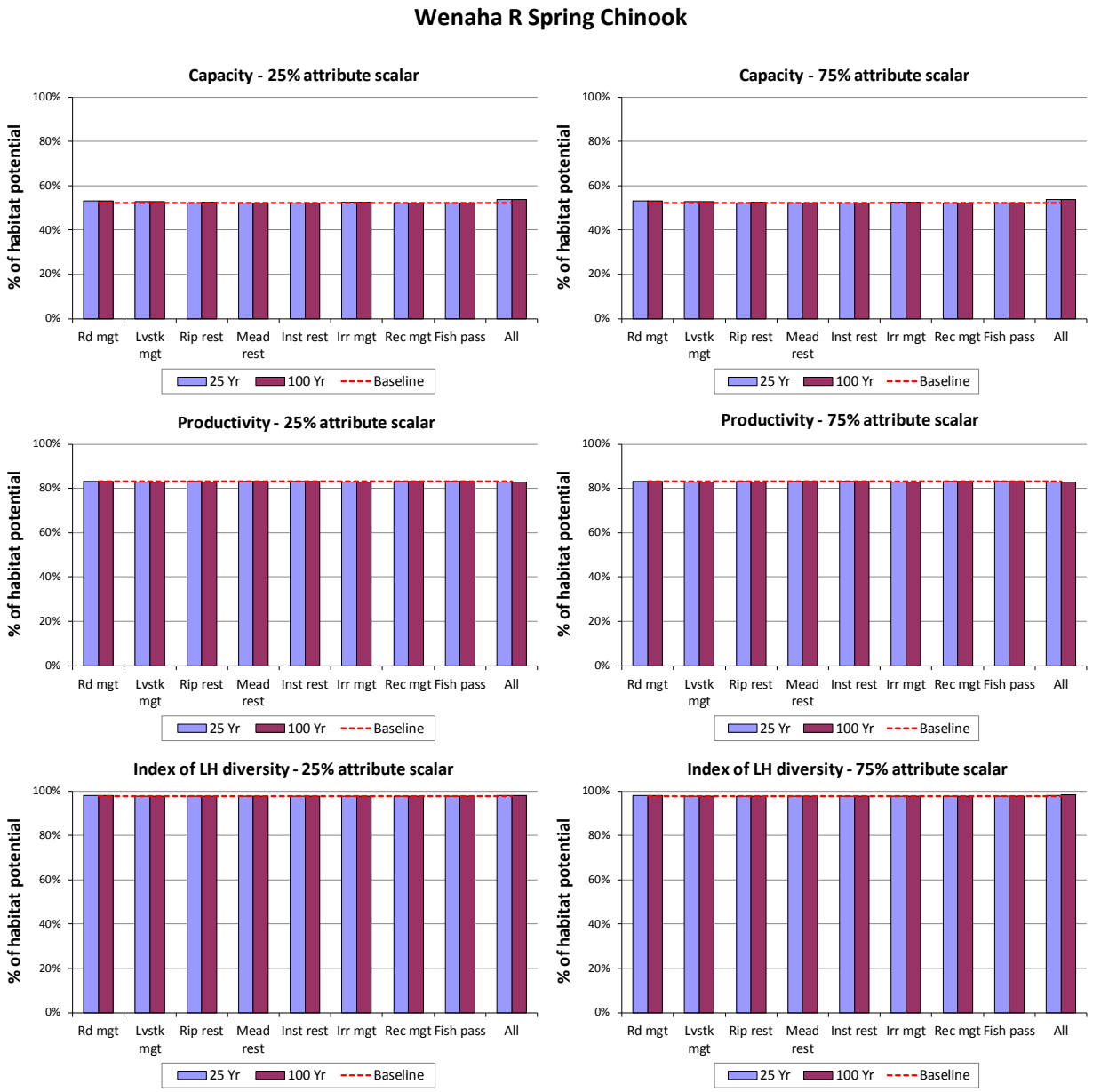


Figure 8-5. Estimated percent of tributary habitat potential at the smolt stage of Wenaha River spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-10. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wenaha River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	1.7%	1.7%	0.2%	0.2%	0.4%	0.4%
	0.75	1.7%	1.7%	0.2%	0.2%	0.4%	0.4%
Livestock management	0.25	0.6%	0.7%	-0.1%	-0.1%	0.0%	0.0%
	0.75	0.7%	0.7%	-0.1%	-0.1%	0.0%	0.0%
Riparian restoration	0.25	0.0%	0.4%	0.0%	-0.2%	0.0%	0.0%
	0.75	0.0%	0.4%	0.0%	-0.2%	0.0%	0.0%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Irrigation management	0.25	0.2%	0.2%	-0.1%	-0.1%	0.0%	0.0%
	0.75	0.2%	0.2%	-0.1%	-0.1%	0.0%	0.0%
Recreation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All strategies	0.25	2.8%	2.9%	-0.2%	-0.2%	0.4%	0.4%
	0.75	2.8%	3.0%	-0.2%	-0.2%	0.4%	0.7%

Table 8-11. Estimated percent of tributary habitat potential at the smolt stage of Wenaha River spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	52.3%	53.2%	53.2%	83.0%	83.2%	83.2%	97.7%	98.1%	98.1%
	0.75	52.3%	53.2%	53.2%	83.0%	83.2%	83.2%	97.7%	98.1%	98.1%
Livestock management	0.25	52.3%	52.7%	52.7%	83.0%	82.9%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.7%	52.7%	83.0%	82.9%	83.0%	97.7%	97.7%	97.7%
Riparian restoration	0.25	52.3%	52.3%	52.5%	83.0%	83.0%	82.9%	97.7%	97.7%	97.7%
	0.75	52.3%	52.3%	52.5%	83.0%	83.0%	82.9%	97.7%	97.7%	97.7%
Wet meadows restoration	0.25	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
Instream restoration	0.25	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
Irrigation management	0.25	52.3%	52.4%	52.4%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.4%	52.4%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
Recreation management	0.25	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
Fish passage	0.25	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
	0.75	52.3%	52.3%	52.3%	83.0%	83.0%	83.0%	97.7%	97.7%	97.7%
All strategies	0.25	52.3%	53.8%	53.8%	83.0%	82.9%	82.9%	97.7%	98.1%	98.1%
	0.75	52.3%	53.8%	53.9%	83.0%	82.9%	82.9%	97.7%	98.1%	98.4%

8.2.2 Wallowa and Lostine Rivers Spring Chinook

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Wallow-Lostine spring Chinook population is generally intermediate within the range of intensities applied to spring Chinook populations (Tables 8-7 and 8-9). However, among the geographic areas associated with all of the populations, the amount of water to be saved by modified irrigation management in the Wallowa-Lostine area would be greatest. A total of approximately 118 cfs would be saved through irrigation management, which would increase flow within this geographic area, as well as to stream reaches downstream. Also, the number of barriers to be corrected that affect fish passage would be the highest for this population compared to all of the other spring Chinook populations.

Projected Changes to Population Performance

Estimated percent changes in population performance of Wallowa-Lostine spring Chinook due to tributary habitat actions are shown in Figures 8-6 and 8-7 and Tables 8-12 and 8-13. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-31 to 8-36. Also, see Appendix 8-D for definitions of diagnostic units.

The two strategies that affect smolt capacity the most are Livestock Management and Irrigation Management (Figure 8-6 and Table 8-12). Each of these strategies increases smolt capacity by about 20%. All actions combined increase capacity by between 45 to 60%, depending on the assumption about the attribute scalar and time lag to realization of benefits.

Benefits of the actions to productivity are estimated to be much less than for capacity, generally in the range of about a 5 to 10% increase. This means that habitat quality is much less affected by the actions than is habitat quantity. It is evident from a review of the diagnostic charts that habitat quality is severely limiting population performance, most notably through three factors: water temperature, habitat diversity, and fine sediment (see Baseline Diagnostic Summary in Appendix 8-C, page 8-32). This is best illustrated by how the strategy Irrigation Management, which increased flow by 118 cfs, produces a 20% increase in smolt capacity, yet causes a small reduction in productivity (Table 8-12). A greater quantity of poor quality habitat produces some increase in capacity, while causing a slight drop in productivity due to a small increase in barely sustainable life history trajectories (due to some associated improvements in habitat quality with increased flow).[16]

While the combination of actions produces some increases in productivity, the benefits to habitat quality are not large, evidenced by the relatively low levels achieved for habitat potential by each strategy (Figure 8-7 and Table 8-13). The combination of actions, affecting both habitat quantity and quality, produces the largest increase in capacity, yet the percent of habitat potential achieved remains modest for both capacity and productivity. To attain a more significant increase in capacity, greater restoration of habitat quality is needed, particularly aimed at water temperature, habitat diversity, and fine sediment (see Scenario Diagnostic Summary in Appendix 8-C, page 8-36). A greater increase in habitat quality would produce a greater benefit to productivity, which in turn would also increase capacity, particularly with the Irrigation Management strategy also in operation.[17]

It is notable that the strategy Fish Passage also produced a drop in productivity, even though the diversity index increased by 19%. Capacity increased very slightly. These results occur because improved passage opened habitats that were generally of relatively poor quality, illustrating that strategies need to be implemented in concert with one another and sequenced logically.

Improvements in habitat quality, particularly in the Grande Ronde subbasin where water temperatures are severely limiting in so many areas, will generally produce the greatest increases in capacity, productivity, and life history diversity. Increasing habitat quantity through either

[16] / As noted in the section above for Wenaha River spring Chinook, it appears that a generally increased capacity of some life histories is acting to depress productivity slightly by increasing the weight of less productive life history trajectories in the computation of population productivity.

[17] / Productivity, which is generally affected by habitat quality and not quantity, is independent of the capacity parameter, but capacity is not independent of productivity. The productivity parameter can be a strong determinant of capacity (Moussalli and Hilborn 1986; Mobrand et al. 1997). Hence any changes in a life history trajectory's productivity will often produce a change in the capacity.

flow management or fish passage should generally always be accompanied by actions that also improve habitat quality.

It should be noted that we found in our review of the habitat characterization of the lower Wallowa River (downstream of Minam River) that the subbasin planning team gave a much reduced pool quantity rating for the current baseline period compared to historic levels. As noted earlier in the section for the Wenaha River, the EDT database shows that the same pattern of change was applied to the Grande Ronde River downstream of the Wallowa River. The original EDT analysis of the Grande Ronde subbasin in the 1990s concluded that the quantities of key habitat in these two areas were approximately the same between the historic and current baseline periods. The general nature of these two river channels led the team who did the original analysis to conclude that there would have been little change in habitat quantity between these two periods (Mobrand and Lestelle 1997). Any future EDT modeling in the Grande Ronde subbasin should verify with local biologists what condition should be applied for these two mainstem river channels in their lower reaches. The importance of this question is that if significant change in key habitat quantity has occurred since the historic period, then restoration potential is much greater. The analysis reported herein suggests that relatively high gains in capacity can be achieved by restoring more habitats in the lower Wallowa and Grande Ronde rivers, but we have doubts about such potential.

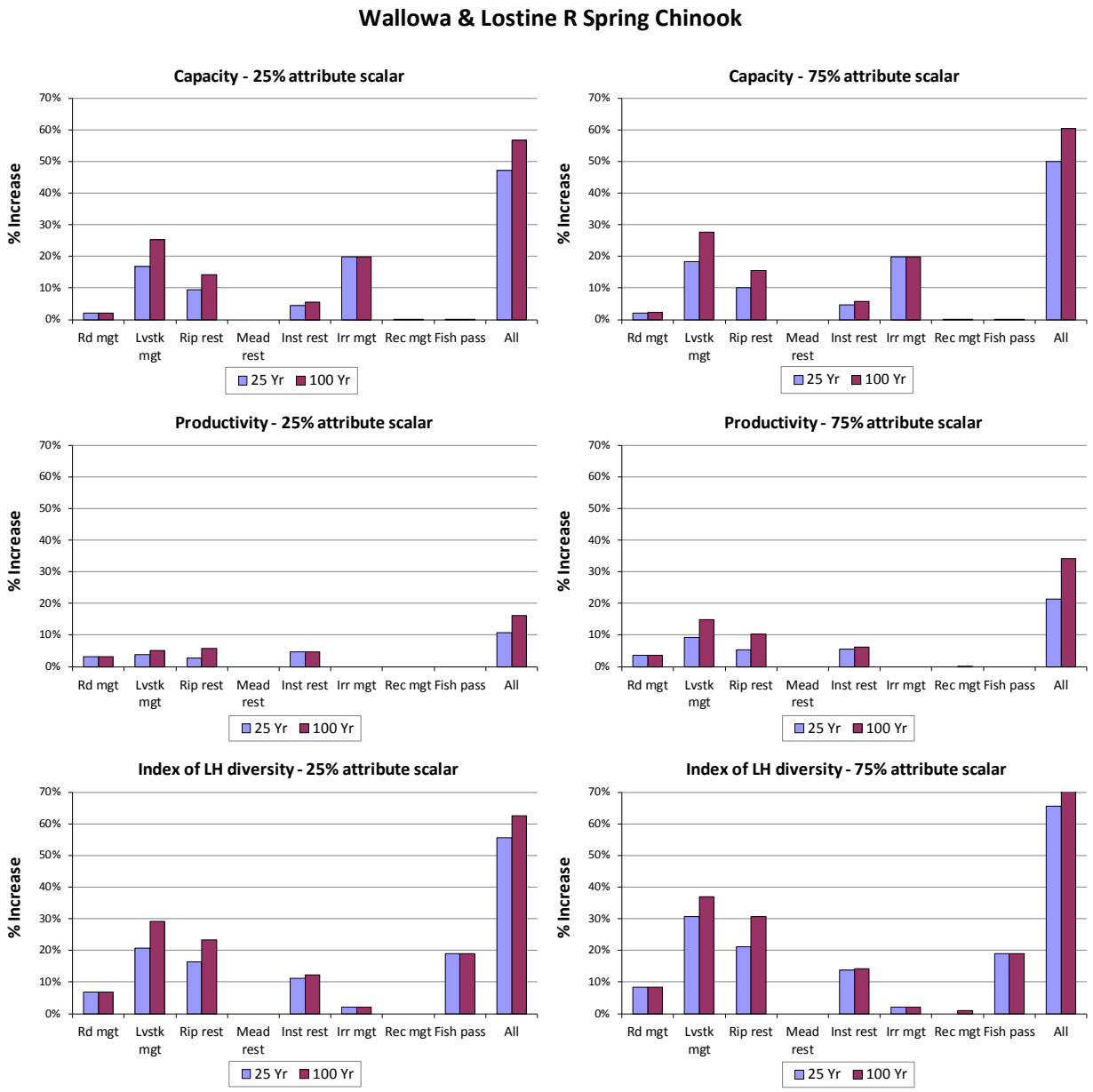


Figure 8-6. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wallowa and Lostine rivers spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

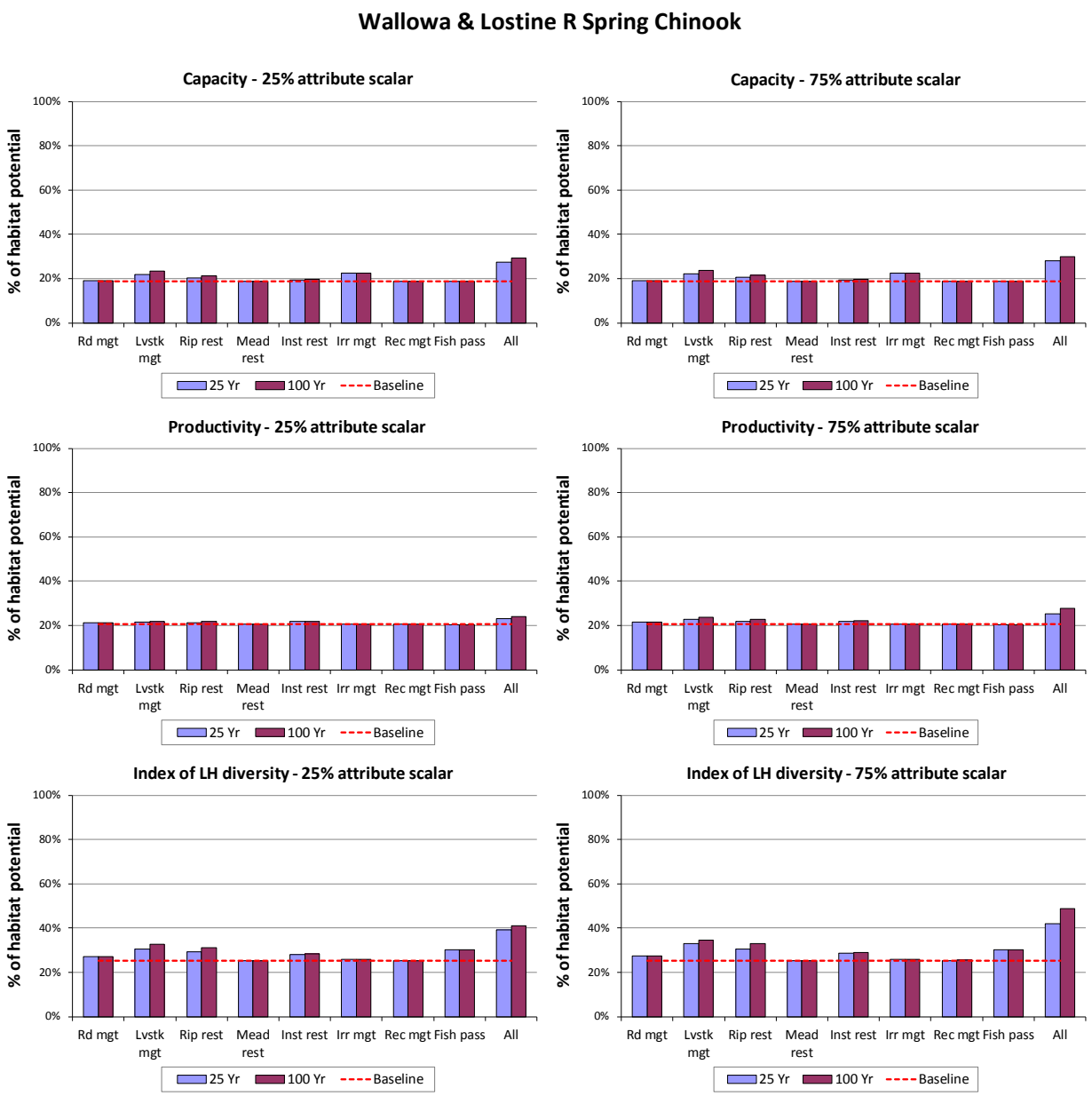


Figure 8-7. Estimated percent of tributary habitat potential at the smolt stage of Wallowa and Lostine rivers spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-12. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wallowa and Lostine rivers spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	2.1%	2.1%	3.1%	3.1%	6.9%	6.9%
	0.75	2.1%	2.2%	3.6%	3.7%	8.5%	8.5%
Livestock management	0.25	16.9%	25.2%	3.9%	5.0%	20.6%	29.1%
	0.75	18.4%	27.6%	9.3%	14.9%	30.7%	37.0%
Riparian restoration	0.25	9.4%	14.1%	2.6%	5.7%	16.4%	23.3%
	0.75	10.2%	15.4%	5.3%	10.4%	21.2%	30.7%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	4.4%	5.6%	4.7%	4.7%	11.1%	12.2%
	0.75	4.7%	5.8%	5.5%	6.2%	13.8%	14.3%
Irrigation management	0.25	19.9%	19.9%	-0.6%	-0.6%	2.1%	2.1%
	0.75	19.9%	19.9%	-0.6%	-0.6%	2.1%	2.1%
Recreation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%
Fish passage	0.25	0.2%	0.2%	-1.9%	-1.9%	19.0%	19.0%
	0.75	0.2%	0.2%	-1.9%	-1.9%	19.0%	19.0%
All strategies	0.25	47.2%	56.7%	10.8%	16.1%	55.6%	62.4%
	0.75	50.1%	60.4%	21.3%	34.2%	65.6%	92.6%

Table 8-13. Estimated percent of tributary habitat potential at the smolt stage of Wallowa and Lostine rivers spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	18.6%	19.0%	19.0%	20.7%	21.4%	21.4%	25.3%	27.0%	27.0%
	0.75	18.6%	19.0%	19.1%	20.7%	21.5%	21.5%	25.3%	27.4%	27.4%
Livestock management	0.25	18.6%	21.8%	23.3%	20.7%	21.5%	21.8%	25.3%	30.5%	32.6%
	0.75	18.6%	22.1%	23.8%	20.7%	22.7%	23.8%	25.3%	33.0%	34.6%
Riparian restoration	0.25	18.6%	20.4%	21.3%	20.7%	21.3%	21.9%	25.3%	29.4%	31.1%
	0.75	18.6%	20.5%	21.5%	20.7%	21.8%	22.9%	25.3%	30.6%	33.0%
Wet meadows restoration	0.25	18.6%	18.6%	18.6%	20.7%	20.7%	20.7%	25.3%	25.3%	25.3%
	0.75	18.6%	18.6%	18.6%	20.7%	20.7%	20.7%	25.3%	25.3%	25.3%
Instream restoration	0.25	18.6%	19.5%	19.7%	20.7%	21.7%	21.7%	25.3%	28.1%	28.3%
	0.75	18.6%	19.5%	19.7%	20.7%	21.9%	22.0%	25.3%	28.7%	28.9%
Irrigation management	0.25	18.6%	22.3%	22.3%	20.7%	20.6%	20.6%	25.3%	25.8%	25.8%
	0.75	18.6%	22.3%	22.3%	20.7%	20.6%	20.6%	25.3%	25.8%	25.8%
Recreation management	0.25	18.6%	18.7%	18.7%	20.7%	20.7%	20.7%	25.3%	25.3%	25.3%
	0.75	18.6%	18.7%	18.7%	20.7%	20.7%	20.7%	25.3%	25.3%	25.5%
Fish passage	0.25	18.6%	18.7%	18.7%	20.7%	20.3%	20.3%	25.3%	30.1%	30.1%
	0.75	18.6%	18.7%	18.7%	20.7%	20.3%	20.3%	25.3%	30.1%	30.1%
All strategies	0.25	18.6%	27.4%	29.2%	20.7%	23.0%	24.1%	25.3%	39.3%	41.0%
	0.75	18.6%	28.0%	29.9%	20.7%	25.1%	27.8%	25.3%	41.8%	48.7%

8.2.3 Minam River Spring Chinook

Level of Action Coverage

Eight different actions were prescribed for the geographic area encompassing the Minam River spring Chinook population (Tables 8-7 and 8-9). Intensity levels for all these actions were defined to be low. Except for legacy effects of historic splash dam logging, the habitat in the Minam watershed is mostly undisturbed. The Snake River Oregon recovery planning team recommended that restoration actions focus on the river reach downstream of RM 9, where some effects of land use are evident (see also the Baseline Diagnostic Summary in Appendix 8-C, page 8-38).

Actions occurring outside the Minam River drainage, particularly those in the Wallowa watershed, also have some effect on the Minam spring Chinook population.

Projected Changes to Population Performance

Estimated percent changes in population performance of Minam River spring Chinook due to tributary habitat actions are shown in Figures 8-8 and 8-9 and Tables 8-14 and 8-15. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to

refer to the diagnostic charts in Appendix 8-C pages 8-38 to 8-43. Also, see Appendix 8-D for definitions of diagnostic units.

Increases in smolt capacity resulting from restoration actions are predicted to be small (<2%) for each time period lag and each strategy. All actions combined are predicted to produce approximately a 5% increase in capacity. No particular strategy was a primary driver to the response; all of the strategies implemented had small effects. It is noteworthy that Irrigation Management, which increases streamflow into the mainstem Wallowa River by 118 cfs (Table 8-7), results in a very slight increase in smolt capacity of the Minam River population. This means that the amount of juvenile rearing of Minam River fish in the mainstem Wallowa River downstream of Minam River is small or that flow increases in this reach of river do little to add to key habitats used by these fish (or both). We note that the main channel low flow width of the Wallowa River downstream of the Minam River was characterized by the subbasin planning team to be essentially the same between the historic period and the current baseline period, despite irrigation withdrawals. This characterization by the subbasin planning team is consistent with the conclusions reached in the original EDT analysis of the Grande Ronde subbasin: Mobrand and Lestelle (1997) stated that "the quantities of key habitat in the Wallowa and Grande Ronde rivers downstream of the Minam River are nearly unchanged compared to historic levels." However, as explained near the end of this section on the Minam River, the subbasin planning team downgraded the quantity of pool habitat from the historic period in the Wallowa River downstream of the Minam River.

Productivity is predicted to decrease very slightly under most strategies (Table 8-14). These slight decreases mean that habitat quality is much less affected by the actions than is key habitat quantity (see Scenario Profile Report in Appendix 8-C, page 8-41). As a result, capacity is increased for certain life history trajectories that utilize the lower Minam River relative to changes in productivity for those same trajectories. This can cause a slight reduction in overall population productivity.[18]

It is noteworthy that the modeling shows that the baseline performance, as well as performance for the various scenarios, would be approximately 50 and 80% of the habitat potential (i.e., historic potential) for capacity and productivity respectively (Figure 8-9 and Table 8-15). Most of the loss in performance (both capacity and productivity) is seen due to changes to stream reaches in the lower mainstem Minam River, though a substantial amount of the loss is attributed to changes in streams in the lower Wallowa River and lower Grande Ronde River (Baseline Diagnostic Summary in Appendix 8-C, page 8-38). Our observations about possible errors in the habitat database for the quantity of pool habitat in the baseline for reaches in the Grande Ronde River made above for Wenaha River spring Chinook are applicable here. We have a similar concern about how pool habitat was characterized for the baseline in the lower Wallowa River.

[18] / Each life history trajectory used in modeling has a productivity and capacity value. The population's productivity and capacity is a weighted average of all trajectory values, weighted by trajectory capacities; see Blair et al. (2009).

Mobrand and Lestelle (1997), in the EDT analysis produced prior to subbasin planning, stated: "The quantities of key habitat in the Wallowa and Grande Ronde rivers downstream of the Minam River are nearly unchanged compared to historic levels." Any future EDT modeling in the Grande Ronde subbasin should verify with local biologists what condition should be applied for the mainstem rivers downstream of the Minam River.

If this discrepancy between the 1997 and 2004 modeling is due to an error in the latter effort, this would mean that the Minam River spring Chinook smolt capacity for the baseline is probably closer to 80% than to 50% of its historic level. The Scenario Diagnostic Summary in Appendix 8-C page 8-43 indicates that the largest potential for restoring greater capacity to the Minam population would be through means of increasing key habitat quantity. The most effective way of doing this may be through a more aggressive effort to increase large wood jams in the river (the Instream Restoration strategy) than was applied herein.

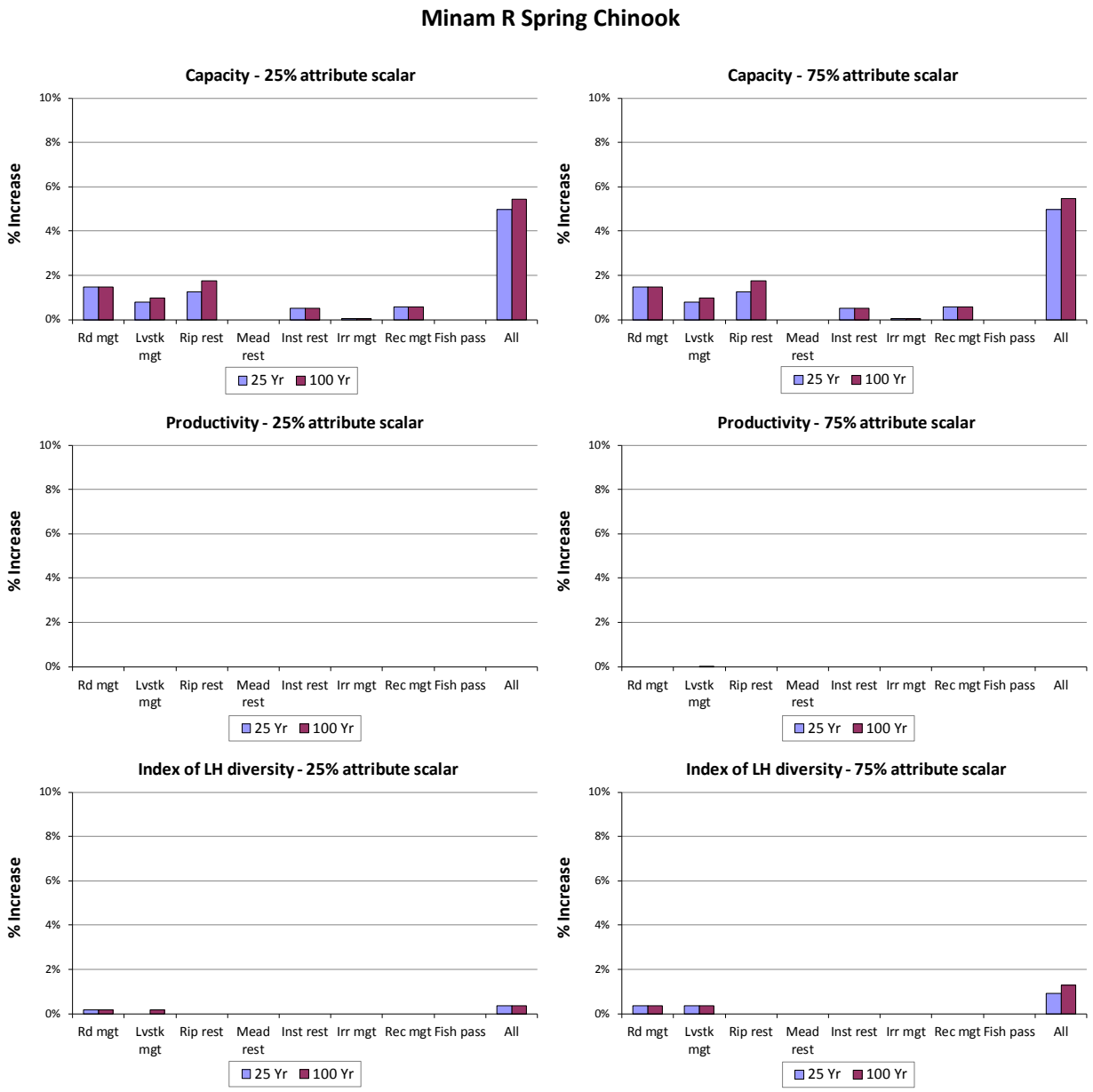


Figure 8-8. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Minam River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

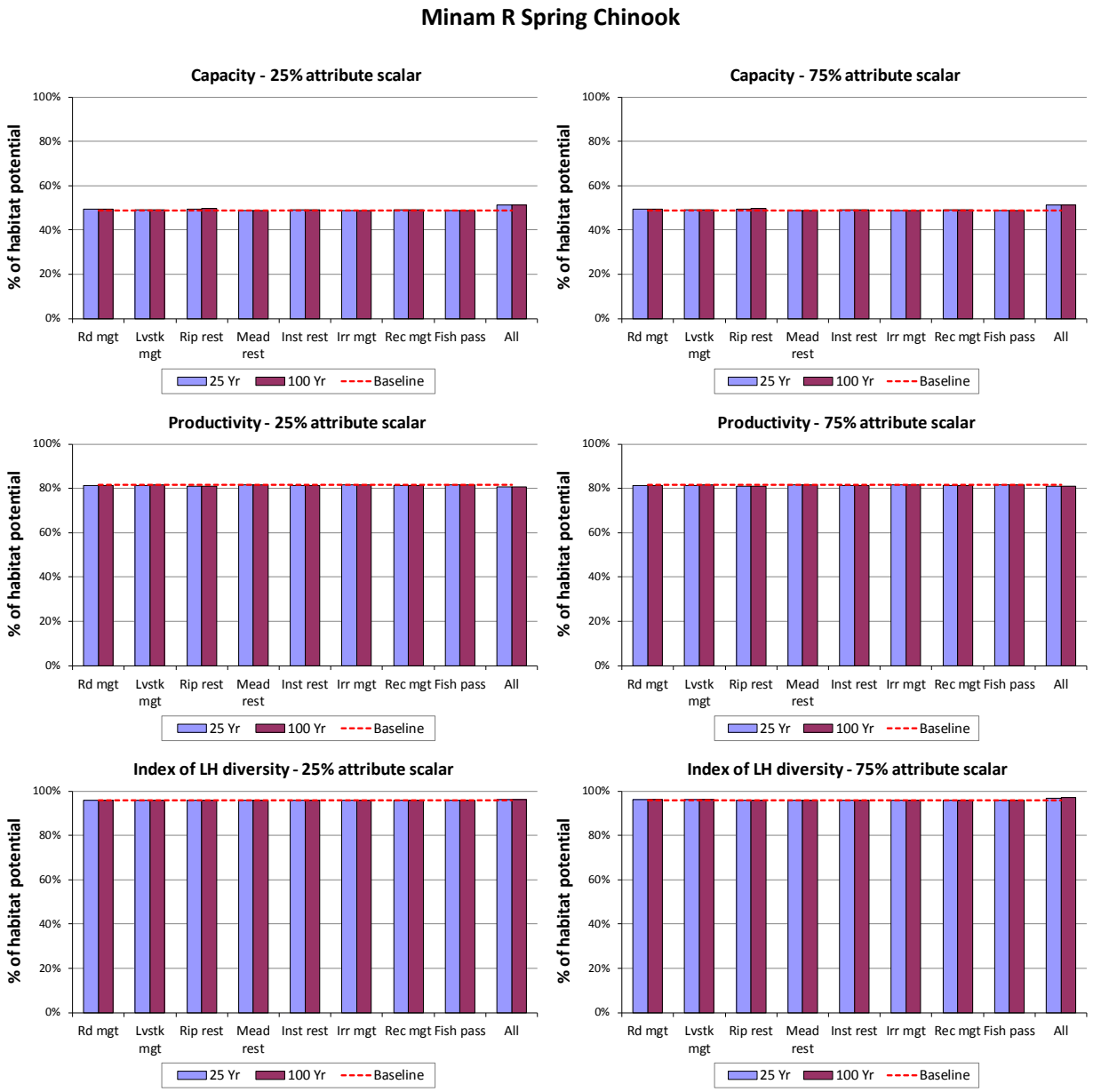


Figure 8-9. Estimated percent of tributary habitat potential at the smolt stage of Minam River spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-14. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Minam River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	1.5%	1.5%	-0.4%	-0.4%	0.2%	0.2%
	0.75	1.5%	1.5%	-0.4%	-0.4%	0.4%	0.4%
Livestock management	0.25	0.8%	1.0%	-0.1%	0.0%	0.0%	0.2%
	0.75	0.8%	1.0%	-0.1%	0.0%	0.4%	0.4%
Riparian restoration	0.25	1.3%	1.8%	-0.5%	-0.6%	0.0%	0.0%
	0.75	1.3%	1.8%	-0.5%	-0.6%	0.0%	0.0%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	0.5%	0.5%	-0.2%	-0.2%	0.0%	0.0%
	0.75	0.5%	0.5%	-0.2%	-0.2%	0.0%	0.0%
Irrigation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Recreation management	0.25	0.6%	0.6%	-0.3%	-0.3%	0.0%	0.0%
	0.75	0.6%	0.6%	-0.3%	-0.3%	0.0%	0.0%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All strategies	0.25	5.0%	5.4%	-0.8%	-0.8%	0.4%	0.4%
	0.75	5.0%	5.5%	-0.7%	-0.6%	0.9%	1.3%

Table 8-15. Estimated percent of tributary habitat potential at the smolt stage of Minam River spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	48.7%	49.4%	49.4%	81.5%	81.2%	81.2%	95.7%	95.9%	95.9%
	0.75	48.7%	49.4%	49.4%	81.5%	81.2%	81.2%	95.7%	96.1%	96.1%
Livestock management	0.25	48.7%	49.1%	49.2%	81.5%	81.4%	81.5%	95.7%	95.7%	95.9%
	0.75	48.7%	49.1%	49.2%	81.5%	81.4%	81.5%	95.7%	96.1%	96.1%
Riparian restoration	0.25	48.7%	49.3%	49.6%	81.5%	81.1%	81.0%	95.7%	95.7%	95.7%
	0.75	48.7%	49.3%	49.6%	81.5%	81.1%	81.0%	95.7%	95.7%	95.7%
Wet meadows restoration	0.25	48.7%	48.7%	48.7%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
	0.75	48.7%	48.7%	48.7%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
Instream restoration	0.25	48.7%	49.0%	49.0%	81.5%	81.4%	81.4%	95.7%	95.7%	95.7%
	0.75	48.7%	49.0%	49.0%	81.5%	81.4%	81.4%	95.7%	95.7%	95.7%
Irrigation management	0.25	48.7%	48.8%	48.8%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
	0.75	48.7%	48.8%	48.8%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
Recreation management	0.25	48.7%	49.0%	49.0%	81.5%	81.2%	81.2%	95.7%	95.7%	95.7%
	0.75	48.7%	49.0%	49.0%	81.5%	81.2%	81.3%	95.7%	95.7%	95.7%
Fish passage	0.25	48.7%	48.7%	48.7%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
	0.75	48.7%	48.7%	48.7%	81.5%	81.5%	81.5%	95.7%	95.7%	95.7%
All strategies	0.25	48.7%	51.1%	51.4%	81.5%	80.8%	80.8%	95.7%	96.1%	96.1%
	0.75	48.7%	51.2%	51.4%	81.5%	80.9%	81.0%	95.7%	96.6%	97.0%

8.2.4 Lookingglass Creek Spring Chinook

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Lookingglass spring Chinook population is generally in the upper half of the range of relative intensities applied to spring Chinook populations (Table 8-9). On an absolute scale, intensity levels are in the lower part of the range among populations (Table 8-7).

Actions occurring outside of the Lookingglass Creek drainage, which can affect the Grande Ronde River downstream of Lookingglass Creek, also have some effect on this population.

Projected Changes to Population Performance

Estimated percent changes in population performance of Lookingglass Creek spring Chinook due to tributary habitat actions are shown in Figures 8-10 and 8-11 and Tables 8-16 and 8-17. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-45 to 8-50. Also, see Appendix 8-D for definitions of diagnostic units.

It should be noted that Lookingglass Creek spring Chinook are extirpated. Therefore, all results presented here are meant to be representative of habitat characteristics that could support an adapted population if present.

The three strategies that affect smolt performance measures the most are Livestock Management, Road Management, and Riparian Restoration (Figure 8-10 and Table 8-16). Each of these strategies increases smolt capacity, productivity, and the index of life history diversity by about 5 to 10%. All actions combined increase the metrics by between 10 to 25%, with capacity being affected the least.

The strategies are seen to affect habitat quality and quantity attributes primarily within the Lookingglass Creek drainage, resulting in improvements in the three performance measures (see Scenario Profile Report in Appendix 8-C, page 8-47).

It is noteworthy that the modeling shows that the baseline performance, as well as performance for the various scenarios, would be approximately 30 and 40% of the habitat potential (i.e., historic potential) for capacity and productivity respectively (Figure 8-11 and Table 8-17). It is evident from a review of the diagnostic summaries in Appendix 8-C that a substantial portion of the loss in performance is attributable to conditions in the mainstem Grande Ronde River downstream of Lookingglass Creek. As noted in sections above for the Wenaha River, Wallowa River, and Minam River, part of this presumed loss in the lower Grande Ronde River attributed to a decline in the quantity of key habitat may be an error made in the habitat characterization during the subbasin planning effort. That planning effort significantly downgraded the quantity of pool habitat in the mainstem Grande Ronde River downstream of Lookingglass Creek to be a small fraction of the historic level. This would have the effect of suggesting that there is a much higher restoration potential for Lookingglass Creek spring Chinook by restoring more pool habitat in the Grande Ronde River downstream of Lookingglass Creek (see Scenario Diagnostic Report in Appendix 8-C, page 8-49).

In the original EDT analysis for the Grande Ronde River, Mobrand and Lestelle (1997) concluded that “the quantity of key habitat in the Grande Ronde River downstream of Lookingglass Creek is virtually unchanged compared to historic levels.” Those authors also reported that “compared to the Grande Ronde River, Lookingglass Creek contains relatively little key habitat.”

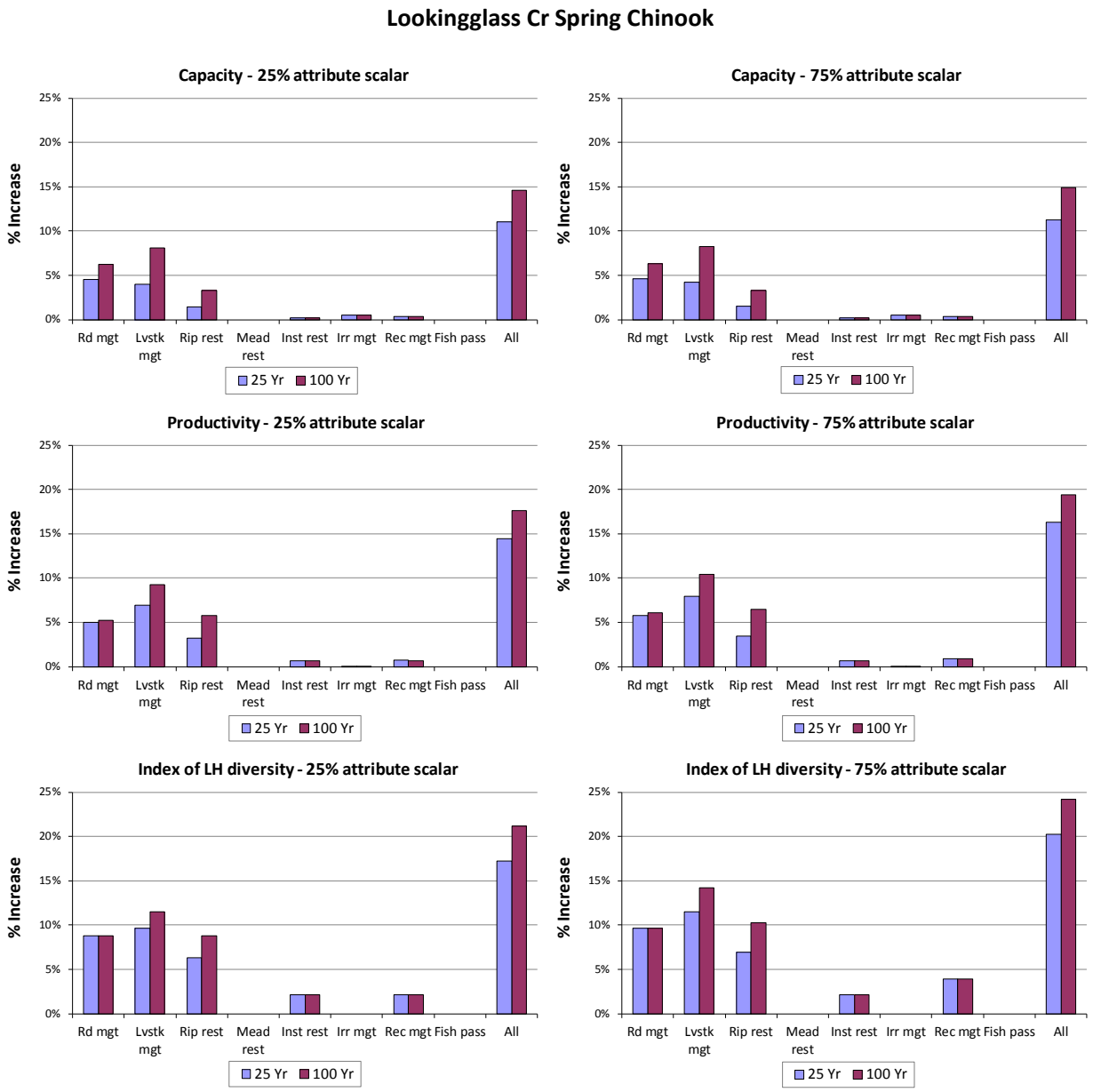


Figure 8-10. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Lookingglass Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75. Note: the Lookingglass Creek spring Chinook population has been extirpated—results shown are based on assumed existence.

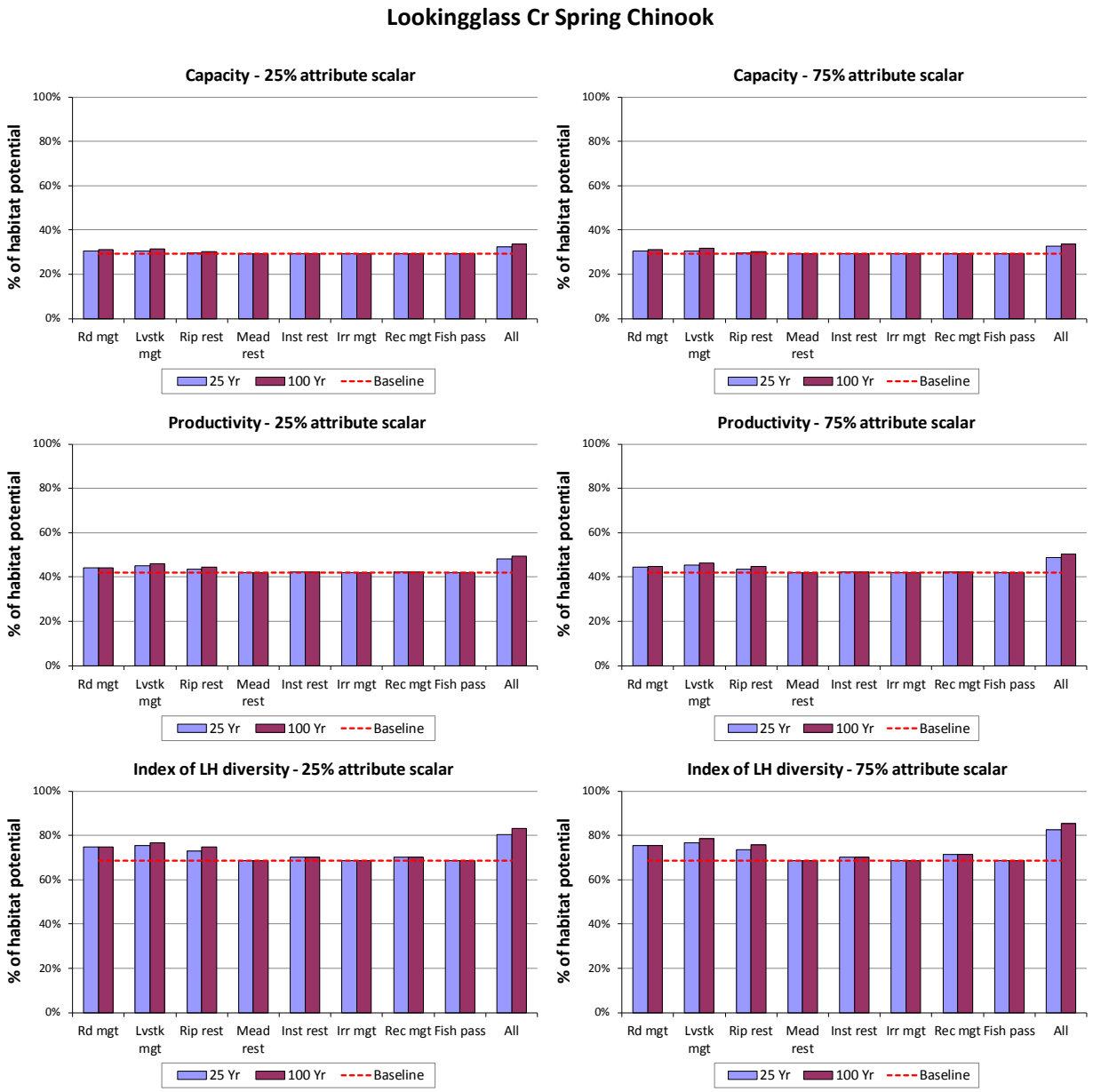


Figure 8-11. Estimated percent of tributary habitat potential at the smolt stage of Lookingglass Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line. Note: the Lookingglass Creek spring Chinook population has been extirpated—results shown are based on assumed existence.

Table 8-16. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Lookingglass Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75. Note: the Lookingglass Creek spring Chinook population has been extirpated—results shown are based on assumed existence.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	4.5%	6.3%	5.0%	5.3%	8.8%	8.8%
	0.75	4.6%	6.3%	5.8%	6.1%	9.7%	9.7%
Livestock management	0.25	4.0%	8.1%	7.0%	9.3%	9.7%	11.5%
	0.75	4.2%	8.2%	7.9%	10.4%	11.5%	14.2%
Riparian restoration	0.25	1.5%	3.3%	3.2%	5.8%	6.3%	8.8%
	0.75	1.5%	3.3%	3.4%	6.5%	6.9%	10.3%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	0.2%	0.2%	0.7%	0.7%	2.1%	2.1%
	0.75	0.2%	0.2%	0.7%	0.7%	2.1%	2.1%
Irrigation management	0.25	0.5%	0.5%	0.0%	0.0%	0.0%	0.0%
	0.75	0.5%	0.5%	0.0%	0.0%	0.0%	0.0%
Recreation management	0.25	0.3%	0.3%	0.7%	0.7%	2.1%	2.1%
	0.75	0.3%	0.3%	0.9%	0.9%	3.9%	3.9%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All strategies	0.25	11.0%	14.6%	14.4%	17.6%	17.2%	21.1%
	0.75	11.3%	14.9%	16.3%	19.4%	20.2%	24.2%

Table 8-17. Estimated percent of tributary habitat potential at the smolt stage of Lookingglass Creek spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Note: the Lookingglass Creek spring Chinook population has been extirpated—results shown are based on assumed existence.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	29.2%	30.6%	31.1%	42.1%	44.2%	44.3%	68.7%	74.7%	74.7%
	0.75	29.2%	30.6%	31.1%	42.1%	44.5%	44.6%	68.7%	75.3%	75.3%
Livestock management	0.25	29.2%	30.4%	31.6%	42.1%	45.0%	46.0%	68.7%	75.3%	76.6%
	0.75	29.2%	30.5%	31.6%	42.1%	45.4%	46.4%	68.7%	76.6%	78.4%
Riparian restoration	0.25	29.2%	29.7%	30.2%	42.1%	43.4%	44.5%	68.7%	73.0%	74.7%
	0.75	29.2%	29.7%	30.2%	42.1%	43.5%	44.8%	68.7%	73.4%	75.7%
Wet meadows restoration	0.25	29.2%	29.2%	29.2%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
	0.75	29.2%	29.2%	29.2%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
Instream restoration	0.25	29.2%	29.3%	29.3%	42.1%	42.3%	42.3%	68.7%	70.1%	70.1%
	0.75	29.2%	29.3%	29.3%	42.1%	42.3%	42.3%	68.7%	70.1%	70.1%
Irrigation management	0.25	29.2%	29.4%	29.4%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
	0.75	29.2%	29.4%	29.4%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
Recreation management	0.25	29.2%	29.3%	29.3%	42.1%	42.4%	42.3%	68.7%	70.1%	70.1%
	0.75	29.2%	29.3%	29.3%	42.1%	42.4%	42.4%	68.7%	71.4%	71.4%
Fish passage	0.25	29.2%	29.2%	29.2%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
	0.75	29.2%	29.2%	29.2%	42.1%	42.1%	42.1%	68.7%	68.7%	68.7%
All strategies	0.25	29.2%	32.5%	33.5%	42.1%	48.1%	49.4%	68.7%	80.5%	83.2%
	0.75	29.2%	32.5%	33.6%	42.1%	48.9%	50.2%	68.7%	82.6%	85.3%

8.2.5 Catherine Creek Spring Chinook

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Catherine Creek spring Chinook population is in the upper end of the range of intensities applied to spring Chinook populations (Tables 8-7 and 8-9). For most actions, the level of intensity of treatment is the highest or second highest among the populations. Relative intensities as expressed by the indices in Table 8-9 are generally the highest among the populations. Among the geographic areas associated with the populations, the amount of water to be saved by modified irrigation management in the Catherine Creek area would be second only to that saved in the Wallowa watershed. A total of approximately 26 cfs would be saved through irrigation management and would serve to increase flow within this geographic area, as well as to stream reaches downstream. Also, the number of barriers that affect fish passage to be corrected would be among the highest for the geographic areas associated with spring Chinook populations.

Projected Changes to Population Performance

Estimated percent changes in population performance of Catherine Creek spring Chinook due to tributary habitat actions are shown in Figures 8-12 and 8-13 and Tables 8-18 and 8-19. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why

capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-52 to 8-57. Also, see Appendix 8-D for definitions of diagnostic units.

The two strategies that affect each of the smolt performance measures the most are Livestock Management and Riparian Restoration (Figure 8-12 and Table 8-18). Each of these strategies increases smolt capacity and productivity between approximately 50 to 200% depending on time lag and the attribute scalar applied. The Livestock Management strategy has the greater effect of the two strategies. The other strategies are projected to have much smaller benefits. All actions combined produced increases in smolt capacity and productivity of approximately 200 to 300% depending on time lag and attribute scalar used. Increases in the life history index were even greater.

It is evident from a review of the diagnostic reports in Appendix 8-C that the strategies most effective in benefitting Catherine Creek spring Chinook are those that produce major improvements in the quality and quantity of habitats in the middle and lower reaches of Catherine Creek (see Scenario Profile Report in Appendix 8-C, Appendix pages 8-54 and 8-55).

It should be noted that the Irrigation Management strategy, which increases flow in Catherine Creek during late summer by 26 cfs (Table 8-7), has a relatively small effect on smolt capacity (about 15% increase) and almost no effect on productivity (about 1%) (Table 8-18). Such small increases are due to this strategy only affecting habitat quantity without affecting major habitat quality issues such as water temperature. In effect, the strategy produces a greater quantity of poor quality habitat, hence productivity is hardly affected. As noted in the Wallowa-Lostine River section, improvements in habitat quality, particularly in the Grande Ronde subbasin where water temperatures are severely limiting in so many areas, will generally produce the greatest increases in capacity, productivity, and life history diversity. Increasing habitat quantity through either flow management or fish passage should generally always be accompanied by actions that also improve habitat quality.

The benefit of the Irrigation Management strategy is greatest when it is combined with the other strategies that have substantial effects on habitat quality, as in the all-actions combined strategy.

With all actions combined, we projected that approximately 40 to 60% of the habitat potential (historic level) for capacity and productivity would be achieved. Significant restoration potential would remain, primarily in the middle and lower reaches of Catherine Creek, Indian Creek, and in the Grande Ronde River below these tributaries (see Scenario Diagnostic Report in Appendix 8-C, Appendix page 8-56).

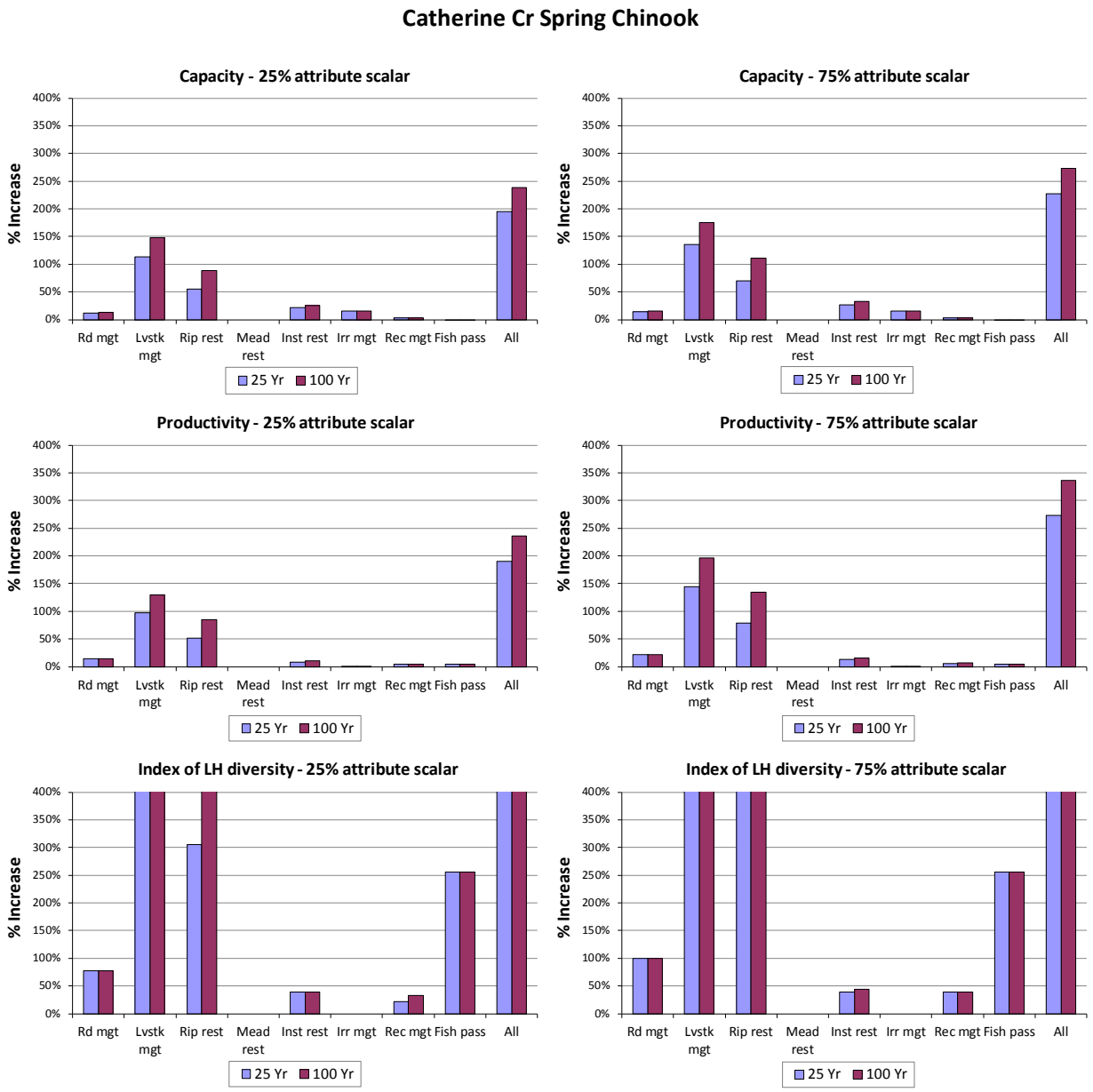


Figure 8-12. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Catherine Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

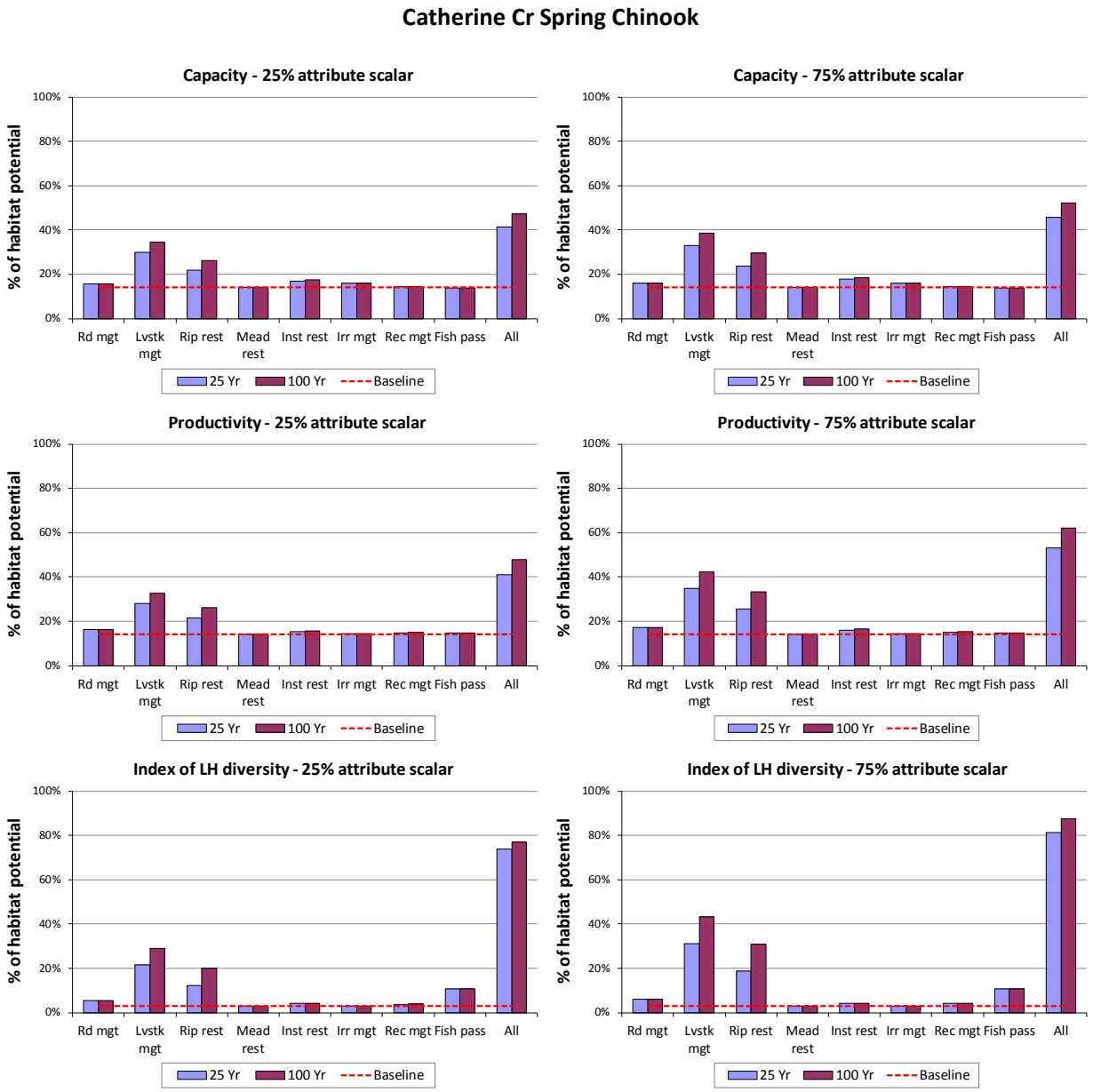


Figure 8-13. Estimated percent of tributary habitat potential at the smolt stage of Catherine Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-18. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Catherine Creek spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	11.9%	12.5%	14.0%	14.1%	77.8%	77.8%
	0.75	14.5%	15.3%	21.4%	21.8%	100.0%	100.0%
Livestock management	0.25	113.7%	147.5%	97.0%	129.4%	616.7%	866.7%
	0.75	135.1%	175.4%	144.9%	196.8%	944.4%	1338.9%
Riparian restoration	0.25	55.4%	88.1%	51.3%	84.9%	305.6%	566.7%
	0.75	69.5%	111.2%	79.2%	134.3%	522.2%	933.3%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	21.3%	26.1%	8.6%	10.7%	38.9%	38.9%
	0.75	27.3%	33.0%	13.1%	15.8%	38.9%	44.4%
Irrigation management	0.25	15.1%	15.1%	1.0%	1.0%	0.0%	0.0%
	0.75	15.1%	15.1%	1.0%	1.0%	0.0%	0.0%
Recreation management	0.25	2.7%	3.2%	4.3%	5.0%	22.2%	33.3%
	0.75	3.1%	3.6%	6.2%	7.1%	38.9%	38.9%
Fish passage	0.25	-0.7%	-0.7%	4.4%	4.4%	255.6%	255.6%
	0.75	-0.7%	-0.7%	4.4%	4.4%	255.6%	255.6%
All strategies	0.25	195.3%	238.8%	189.6%	235.6%	2361.1%	2472.2%
	0.75	226.8%	273.6%	272.7%	336.8%	2611.1%	2816.7%

Table 8-19. Estimated percent of tributary habitat potential at the smolt stage of Catherine Creek spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	14.0%	15.6%	15.7%	14.2%	16.2%	16.2%	3.0%	5.3%	5.3%
	0.75	14.0%	16.0%	16.1%	14.2%	17.3%	17.3%	3.0%	6.0%	6.0%
Livestock management	0.25	14.0%	29.9%	34.6%	14.2%	28.0%	32.6%	3.0%	21.5%	29.0%
	0.75	14.0%	32.9%	38.5%	14.2%	34.8%	42.2%	3.0%	31.3%	43.1%
Riparian restoration	0.25	14.0%	21.7%	26.3%	14.2%	21.5%	26.3%	3.0%	12.1%	20.0%
	0.75	14.0%	23.7%	29.5%	14.2%	25.5%	33.3%	3.0%	18.6%	30.9%
Wet meadows restoration	0.25	14.0%	14.0%	14.0%	14.2%	14.2%	14.2%	3.0%	3.0%	3.0%
	0.75	14.0%	14.0%	14.0%	14.2%	14.2%	14.2%	3.0%	3.0%	3.0%
Instream restoration	0.25	14.0%	17.0%	17.6%	14.2%	15.4%	15.7%	3.0%	4.2%	4.2%
	0.75	14.0%	17.8%	18.6%	14.2%	16.1%	16.5%	3.0%	4.2%	4.3%
Irrigation management	0.25	14.0%	16.1%	16.1%	14.2%	14.4%	14.4%	3.0%	3.0%	3.0%
	0.75	14.0%	16.1%	16.1%	14.2%	14.4%	14.4%	3.0%	3.0%	3.0%
Recreation management	0.25	14.0%	14.4%	14.4%	14.2%	14.8%	14.9%	3.0%	3.7%	4.0%
	0.75	14.0%	14.4%	14.5%	14.2%	15.1%	15.2%	3.0%	4.2%	4.2%
Fish passage	0.25	14.0%	13.9%	13.9%	14.2%	14.9%	14.9%	3.0%	10.6%	10.6%
	0.75	14.0%	13.9%	13.9%	14.2%	14.9%	14.9%	3.0%	10.6%	10.6%
All strategies	0.25	14.0%	41.3%	47.3%	14.2%	41.2%	47.7%	3.0%	73.7%	77.0%
	0.75	14.0%	45.7%	52.2%	14.2%	53.0%	62.1%	3.0%	81.2%	87.4%

8.2.6 Upper Grande Ronde River Spring Chinook

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Upper Grande Ronde spring Chinook population is in the upper end of the range of intensities applied to spring Chinook populations (Tables 10-7 and 10-9). For most actions, the level of treatment is the highest or second highest among the populations. Relative intensities as expressed by the indices in Table 10-9 are in the upper half of the range for these measures. The number of barriers that affect fish passage to be corrected would be among the highest for the geographic areas associated with spring Chinook populations.

Projected Changes to Population Performance

Estimated percent changes in population performance of Upper Grande Ronde River spring Chinook due to tributary habitat actions are shown in Figures 8-14 and 8-15 and Tables 8-20 and 8-21. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-59 to 8-64. Also, see Appendix 8-D for definitions of diagnostic units.

A review of the diagnostic report for the baseline habitat conditions associated with this population shows that the greatest amount of restoration benefit to smolt capacity would be produced from actions that affect habitat in three diagnostic units (see Baseline Diagnostic Report in Appendix 8-C, page 8-59): Mid Grnd Rnd R 3, Mid Grnd Rnd R 4, and Upper Grnd Rnd R 1. These geographic units extend upstream of Catherine Creek to Limberjim Creek. The greatest amount of restoration benefit to smolt productivity generally includes these areas as well as several geographic areas that encompass certain upper river tributaries, such as Sheep Creek.

The strategies that target this population focused on some of these areas. The top three strategies that benefitted each of the three performance measures the most were Livestock Management, Riparian Restoration, and Instream Restoration (Figure 8-14 and Table 8-20). The other strategies had smaller effects. The Livestock Management strategy was predicted to produce the greatest benefit. Under this strategy, smolt capacity was increased between approximately 100 to 150% depending on time lag and assumptions about the attribute scalar. Productivity under this strategy was increased between 50 to 150%.

All actions combined produced increases in smolt capacity and productivity of approximately 100 to 250% depending on time lag and attribute scalar used. Increases in the life history index were even greater.

It is evident from a review of the diagnostic reports in Appendix 8-C that the strategies most effective in benefitting Upper Grande River spring Chinook are those that produce major improvements in the quality and quantity of habitats in the mainstem river from the heart of the Grande Ronde valley extending upstream to the vicinity of Limberjim Creek (see Scenario Profile Report in Appendix 8-C, Appendix pages 8-61 and 8-62). All strategies in combination were shown to have substantial positive effects on water temperature, fine sediment load, passage barriers, habitat diversity, flow amounts, and the quantity of key habitat.

Despite the substantial improvements in performance as percentage increases over baseline performance, the actions were predicted to produce relatively modest increases in performance compared to historic levels (Figure 8-15, Table 8-22). With all actions combined, we projected that approximately 20 to 50% of the habitat potential (historic level) for capacity, productivity, and life history diversity would be achieved, depending on the assumption about the attribute scalar. Significant restoration potential would remain both in the Grande Ronde valley and in areas upstream (see Scenario Diagnostic Report in Appendix 8-C, Appendix page 8-63 and 8-64). The aspects of habitat quality that would continue to have significant adverse effects on performance would be water temperature and fine sediment load, followed by habitat diversity. The quantity of key habitat would continue to be an important limiting factor.

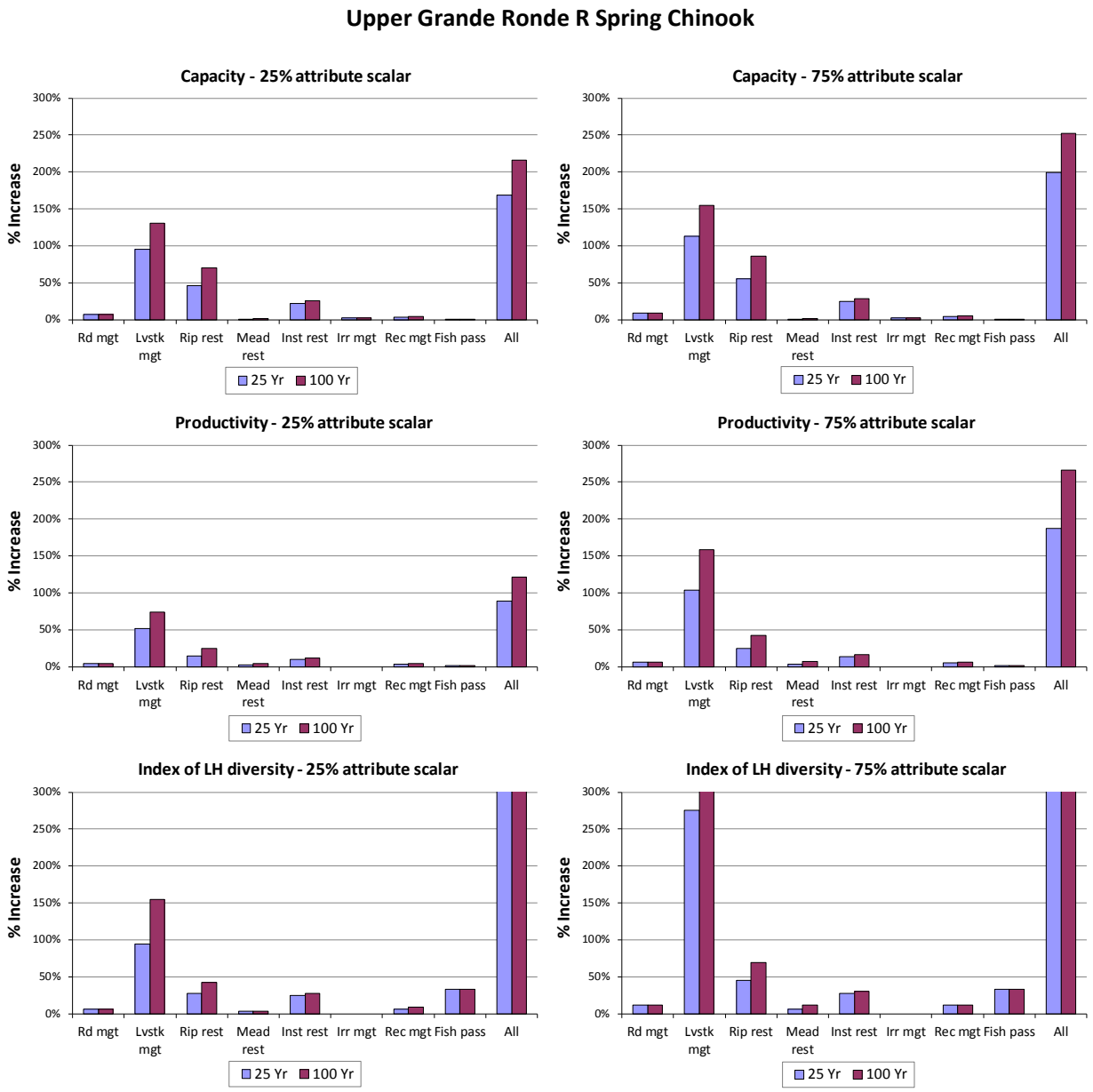


Figure 8-14. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Upper Grande Ronde River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

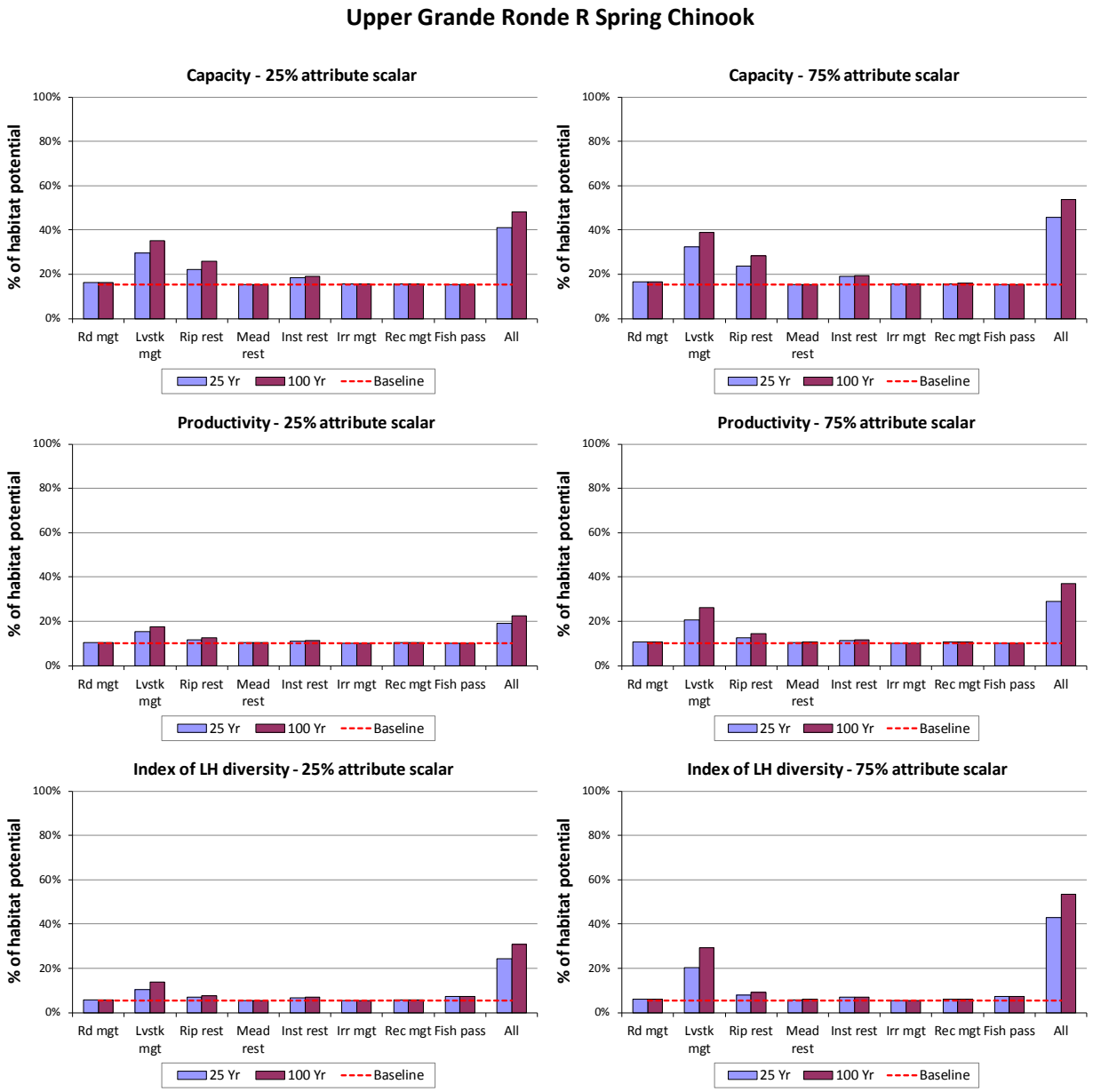


Figure 8-15. Estimated percent of tributary habitat potential at the smolt stage of Upper Grande Ronde River spring Chinook as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-20. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Upper Grande Ronde River spring Chinook as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	7.2%	7.3%	3.9%	4.1%	6.1%	6.1%
	0.75	8.5%	8.7%	6.4%	6.6%	12.1%	12.1%
Livestock management	0.25	95.1%	130.5%	51.7%	73.7%	93.9%	154.5%
	0.75	113.1%	154.6%	104.0%	158.0%	275.8%	439.4%
Riparian restoration	0.25	46.0%	70.7%	14.8%	25.0%	27.3%	42.4%
	0.75	55.6%	86.0%	24.9%	42.3%	45.5%	69.7%
Wet meadows restoration	0.25	0.8%	1.1%	2.5%	4.4%	3.0%	3.0%
	0.75	0.9%	1.2%	3.6%	6.9%	6.1%	12.1%
Instream restoration	0.25	22.1%	25.6%	10.2%	11.7%	24.2%	27.3%
	0.75	24.4%	28.1%	13.5%	16.2%	27.3%	30.3%
Irrigation management	0.25	2.2%	2.2%	-0.6%	-0.6%	0.0%	0.0%
	0.75	2.2%	2.2%	-0.6%	-0.6%	0.0%	0.0%
Recreation management	0.25	3.0%	3.9%	3.6%	4.3%	6.1%	9.1%
	0.75	3.9%	5.0%	5.2%	6.4%	12.1%	12.1%
Fish passage	0.25	0.0%	0.0%	1.1%	1.1%	33.3%	33.3%
	0.75	0.0%	0.0%	1.1%	1.1%	33.3%	33.3%
All strategies	0.25	168.8%	216.4%	89.1%	121.2%	348.5%	472.7%
	0.75	199.5%	252.7%	187.5%	266.5%	693.9%	884.8%

Table 8-21. Estimated percent of tributary habitat potential at the smolt stage of Upper Grande Ronde River spring Chinook achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	15.2%	16.3%	16.3%	10.1%	10.5%	10.5%	5.4%	5.7%	5.7%
	0.75	15.2%	16.5%	16.5%	10.1%	10.7%	10.8%	5.4%	6.1%	6.1%
Livestock management	0.25	15.2%	29.7%	35.1%	10.1%	15.3%	17.5%	5.4%	10.5%	13.8%
	0.75	15.2%	32.4%	38.7%	10.1%	20.6%	26.0%	5.4%	20.3%	29.2%
Riparian restoration	0.25	15.2%	22.2%	26.0%	10.1%	11.6%	12.6%	5.4%	6.9%	7.7%
	0.75	15.2%	23.7%	28.3%	10.1%	12.6%	14.4%	5.4%	7.9%	9.2%
Wet meadows restoration	0.25	15.2%	15.3%	15.4%	10.1%	10.3%	10.5%	5.4%	5.6%	5.6%
	0.75	15.2%	15.4%	15.4%	10.1%	10.5%	10.8%	5.4%	5.7%	6.1%
Instream restoration	0.25	15.2%	18.6%	19.1%	10.1%	11.1%	11.3%	5.4%	6.7%	6.9%
	0.75	15.2%	18.9%	19.5%	10.1%	11.5%	11.7%	5.4%	6.9%	7.0%
Irrigation management	0.25	15.2%	15.5%	15.5%	10.1%	10.0%	10.0%	5.4%	5.4%	5.4%
	0.75	15.2%	15.5%	15.5%	10.1%	10.0%	10.0%	5.4%	5.4%	5.4%
Recreation management	0.25	15.2%	15.7%	15.8%	10.1%	10.5%	10.5%	5.4%	5.7%	5.9%
	0.75	15.2%	15.8%	16.0%	10.1%	10.6%	10.7%	5.4%	6.1%	6.1%
Fish passage	0.25	15.2%	15.2%	15.2%	10.1%	10.2%	10.2%	5.4%	7.2%	7.2%
	0.75	15.2%	15.2%	15.2%	10.1%	10.2%	10.2%	5.4%	7.2%	7.2%
All strategies	0.25	15.2%	40.9%	48.2%	10.1%	19.1%	22.3%	5.4%	24.3%	31.0%
	0.75	15.2%	45.6%	53.7%	10.1%	29.0%	37.0%	5.4%	43.0%	53.3%

8.2.7 Joseph Creek Summer Steelhead

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Joseph Creek summer steelhead population is generally intermediate within the range of intensities applied to steelhead populations (Tables 8-8 and 8-9). The actions were almost entirely directed at reducing road and grazing impacts. The number of barriers to be corrected was the lowest for the geographic areas associated with steelhead populations.

Projected Changes to Population Performance

Estimated percent changes in population performance of Joseph Creek summer steelhead due to tributary habitat actions are shown in Figures 8-16 and 8-17 and Tables 8-22 and 8-23. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-66 to 8-71. Also, see Appendix 8-D for definitions of diagnostic units.

To understand the results of the action modeling on Joseph Creek steelhead, the reader should note that the water temperature update made to Joseph Creek data resulted in a substantial downgrade to this attribute than was used during the subbasin planning analysis done in 2004. The data summary of water temperature ratings in the Joseph Creek drainage presented in Table 8-1 indicates that large segments of Joseph Creek are among the warmest stream reaches in the entire Grande Ronde subbasin. It should be noted that the characterization of historic water temperature conditions in Joseph Creek also assumed that the stream was very warm, though not quite as warm as it has been characterized for the current baseline (reflected in the Baseline Diagnostic Report, Appendix 8-C page 8-67). This representation of the historic condition is consistent with how the original EDT analysis characterized the stream system (Mobrand and Lestelle 1997). These conditions, combined with a worsening of other habitat quality aspects in Joseph Creek due to land use practices, suggests that the current overall quality of habitat for survival in this drainage is relatively poor. This observation is important in interpreting the results of the action modeling.

Increases in smolt capacity associated with each of the strategies were predicted to be less than approximately 3% for all strategies (Figure 8-16 and Table 8-22). Predicted increases in smolt productivity were somewhat larger, upwards to 10% when the higher attribute scalar was applied. Increases in the index of life history diversity were predicted to be greater still. All actions combined produced an increase in smolt capacity of about 5% and between 10 to 25% for smolt productivity depending on time lag and the attribute scalar applied.

It is noteworthy that the modeling shows that the baseline productivity level compared to the historic potential, as well as productivity for the various scenarios, is much less than it is for smolt capacity (Figure 8-17 and Table 8-23). It appears, therefore, that productivity is much more depressed than capacity in the Joseph Creek drainage. We interpret this to mean that there is a large quantity of habitat—many miles of streams with a large abundance of key habitat—but the quality of that habitat for density-independent survival is generally poor. We hypothesize that historically the population was relatively unproductive (i.e., relatively low productivity) but that the capacity of the stream was quite high. Relatively high water temperatures historically probably kept productivity relatively low compared to other more productive steelhead populations. For restoration actions to be more effective at producing a greater abundance of steelhead in Joseph Creek, much greater improvements in habitat quality are needed.

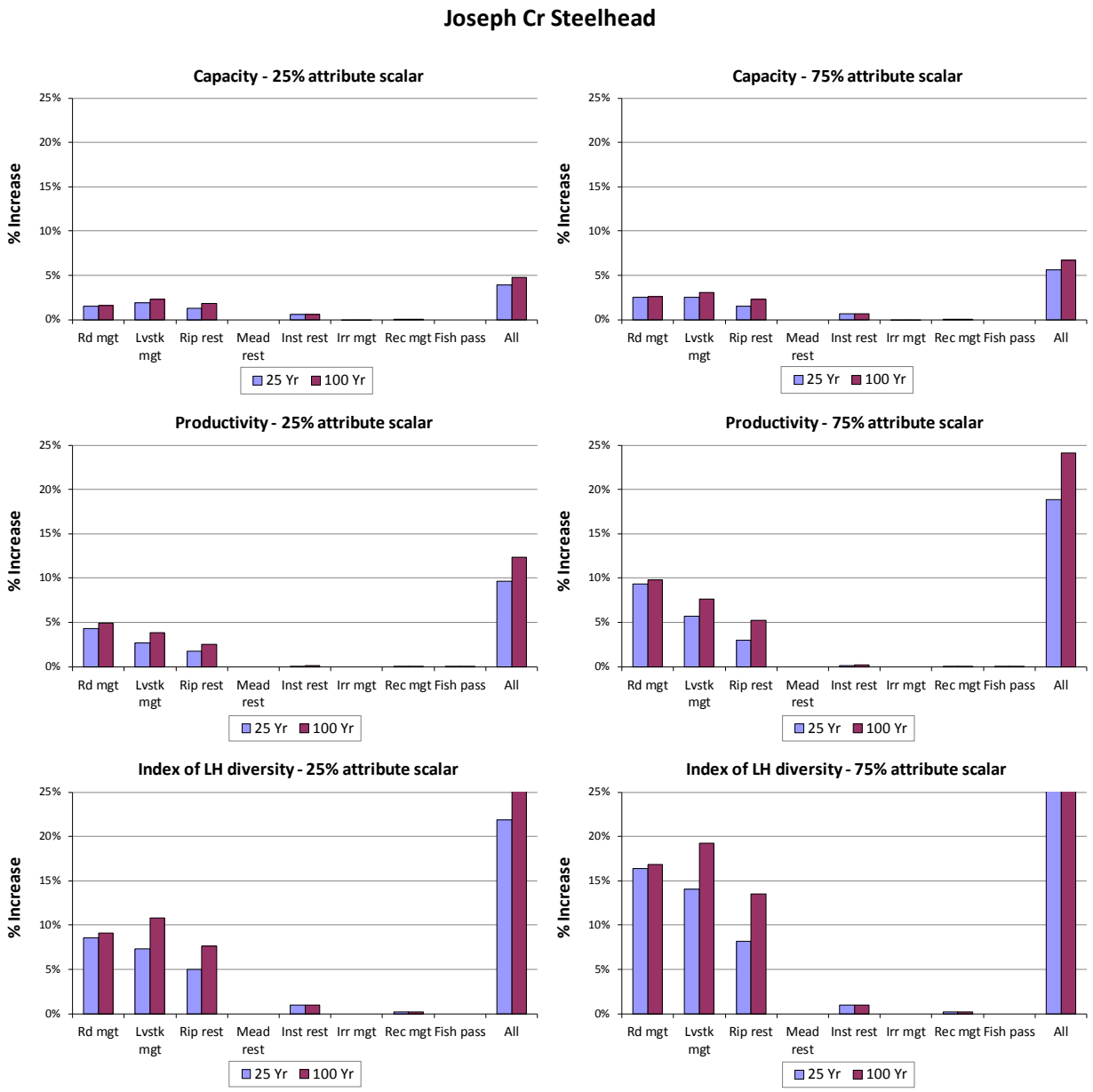


Figure 8-16. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Joseph Creek summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

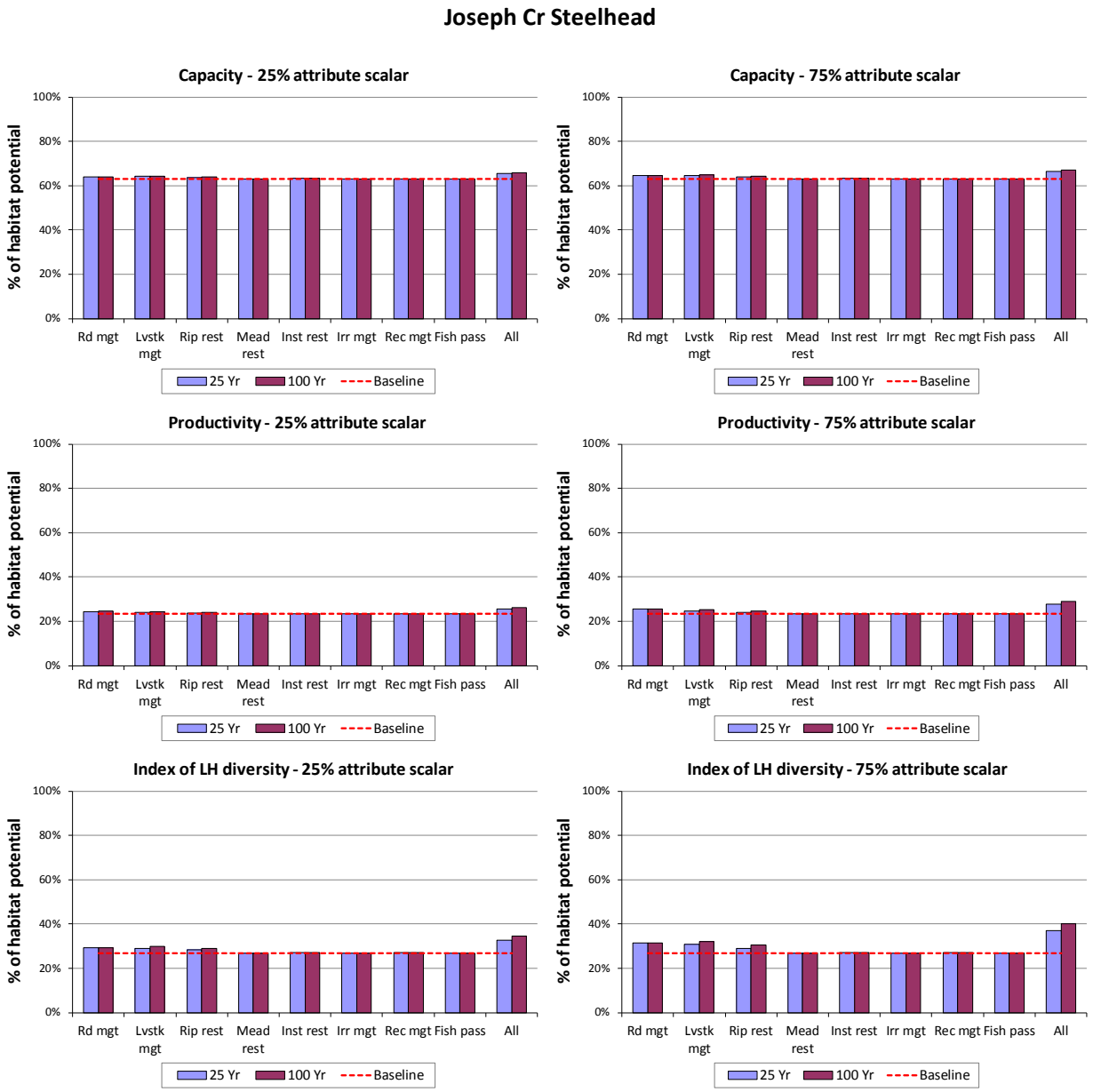


Figure 8-17. Estimated percent of tributary habitat potential at the smolt stage of Joseph Creek summer steelhead as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-22. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Joseph Creek summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	1.6%	1.6%	4.3%	4.9%	8.6%	9.1%
	0.75	2.5%	2.6%	9.4%	9.8%	16.4%	16.9%
Livestock management	0.25	1.9%	2.3%	2.7%	3.9%	7.3%	10.8%
	0.75	2.5%	3.0%	5.7%	7.6%	14.0%	19.2%
Riparian restoration	0.25	1.3%	1.8%	1.7%	2.5%	5.0%	7.6%
	0.75	1.6%	2.3%	3.0%	5.2%	8.2%	13.5%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	0.6%	0.6%	0.1%	0.1%	1.0%	1.0%
	0.75	0.6%	0.6%	0.2%	0.2%	1.0%	1.0%
Irrigation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Recreation management	0.25	0.0%	0.0%	0.1%	0.1%	0.2%	0.2%
	0.75	0.0%	0.0%	0.1%	0.1%	0.2%	0.2%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All strategies	0.25	3.9%	4.8%	9.6%	12.3%	21.8%	28.4%
	0.75	5.6%	6.7%	18.9%	24.1%	37.4%	49.2%

Table 8-23. Estimated percent of tributary habitat potential at the smolt stage of Joseph Creek summer steelhead achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	62.9%	63.9%	63.9%	23.4%	24.4%	24.5%	26.9%	29.2%	29.4%
	0.75	62.9%	64.5%	64.6%	23.4%	25.6%	25.7%	26.9%	31.3%	31.5%
Livestock management	0.25	62.9%	64.1%	64.4%	23.4%	24.0%	24.3%	26.9%	28.9%	29.8%
	0.75	62.9%	64.5%	64.9%	23.4%	24.7%	25.2%	26.9%	30.7%	32.1%
Riparian restoration	0.25	62.9%	63.8%	64.1%	23.4%	23.8%	24.0%	26.9%	28.3%	29.0%
	0.75	62.9%	63.9%	64.4%	23.4%	24.1%	24.6%	26.9%	29.1%	30.6%
Wet meadows restoration	0.25	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
	0.75	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
Instream restoration	0.25	62.9%	63.3%	63.3%	23.4%	23.4%	23.4%	26.9%	27.2%	27.2%
	0.75	62.9%	63.3%	63.4%	23.4%	23.4%	23.4%	26.9%	27.2%	27.2%
Irrigation management	0.25	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
	0.75	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
Recreation management	0.25	62.9%	63.0%	63.0%	23.4%	23.4%	23.4%	26.9%	27.0%	27.0%
	0.75	62.9%	63.0%	63.0%	23.4%	23.4%	23.4%	26.9%	27.0%	27.0%
Fish passage	0.25	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
	0.75	62.9%	62.9%	62.9%	23.4%	23.4%	23.4%	26.9%	26.9%	26.9%
All strategies	0.25	62.9%	65.4%	66.0%	23.4%	25.7%	26.3%	26.9%	32.8%	34.6%
	0.75	62.9%	66.5%	67.2%	23.4%	27.8%	29.0%	26.9%	37.0%	40.2%

8.2.8 Lower Grande Ronde River Summer Steelhead

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Lower Grande Ronde summer steelhead population is the lowest among the four Grande Ronde steelhead populations (Tables 8-8 and 8-9). The actions were almost entirely directed at reducing road and grazing impacts.

Projected Changes to Population Performance

Estimated percent changes in population performance of Lower Grande Ronde River summer steelhead due to tributary habitat actions are shown in Figures 8-18 and 8-19 and Tables 8-24 and 8-25. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-73 to 8-78. Also, see Appendix 8-D for definitions of diagnostic units.

The projected percent increases in smolt capacity, smolt productivity, and the index of life history diversity are negligible for all strategies and scenarios due to the low intensities of action treatment (Figure 8-18 and Table 8-24).

Between approximately 60-80% of habitat potential (i.e., historic potential) for smolt capacity and productivity were estimated to exist for the current baseline conditions (Figure 8-19 and Table 10-25). These relatively high levels demonstrate that population performance in general has been less affected by land use than the other populations, though it is clear that large differences in the magnitude of land use impacts exist within the geographic area encompassing the natal streams that support this population (see Baseline Diagnostic Report, Appendix 8-C page 8-73).

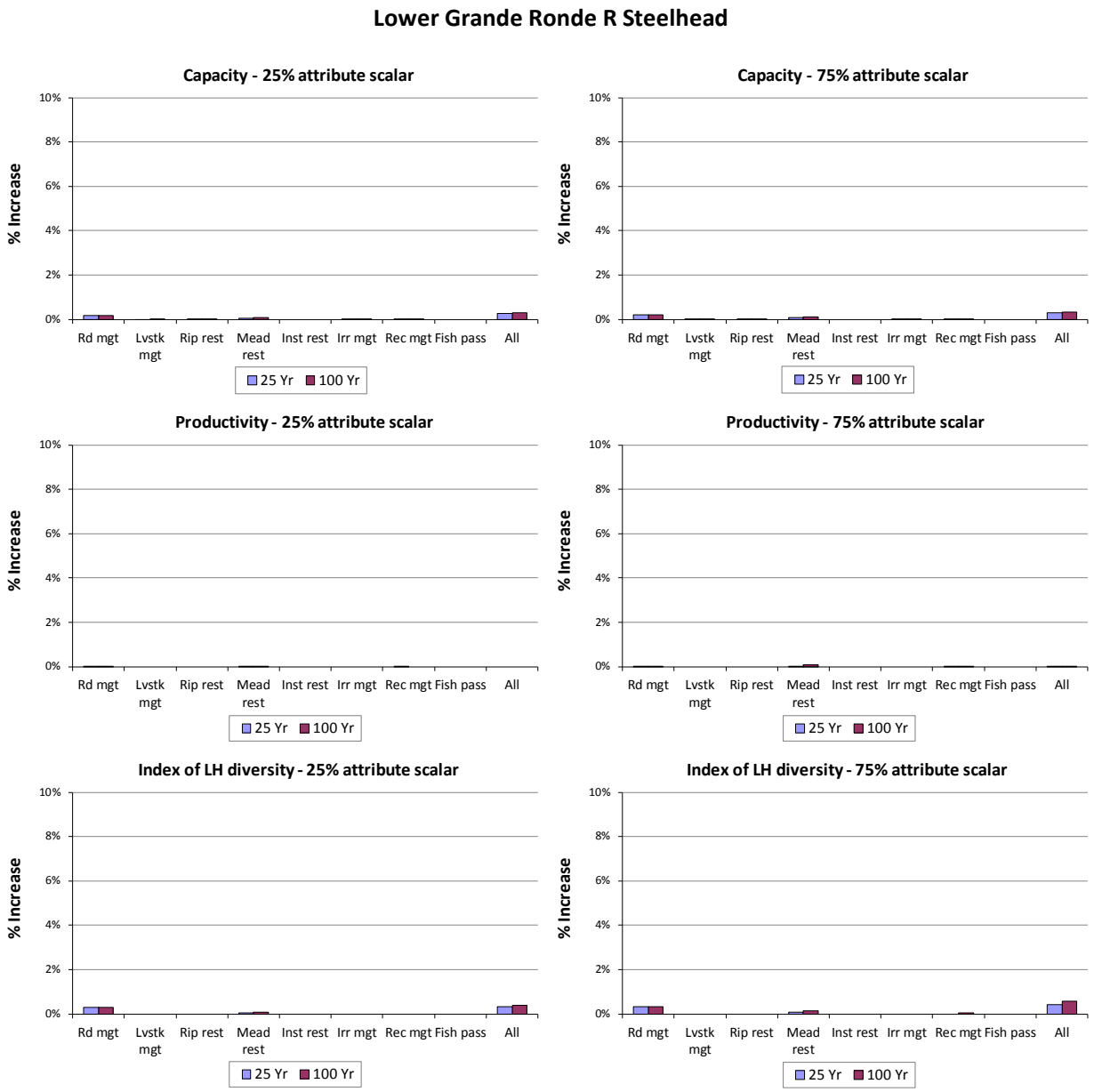


Figure 8-18. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Lower Grande Ronde River summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

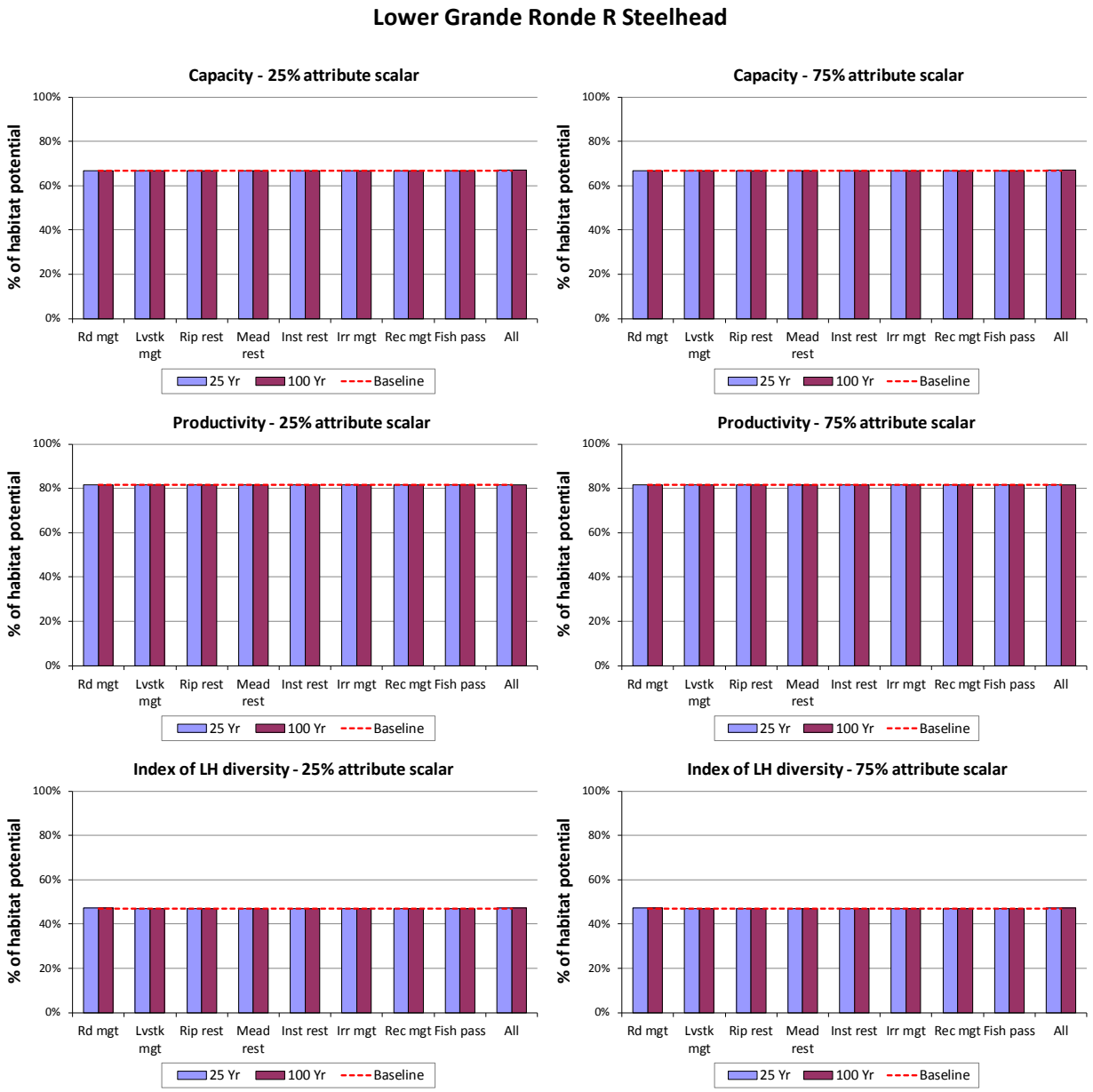


Figure 8-19. Estimated percent of tributary habitat potential at the smolt stage of Lower Grande Ronde River summer steelhead as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-24. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Lower Grande Ronde River summer steelhead as a result of

tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	0.2%	0.2%	0.0%	0.0%	0.3%	0.3%
	0.75	0.2%	0.2%	0.0%	0.0%	0.3%	0.3%
Livestock management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Riparian restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wet meadows restoration	0.25	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%
	0.75	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%
Instream restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Irrigation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Recreation management	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All strategies	0.25	0.3%	0.3%	0.0%	0.0%	0.3%	0.4%
	0.75	0.3%	0.3%	0.0%	0.0%	0.4%	0.6%

Table 8-25. Estimated percent of tributary habitat potential at the smolt stage of Lower Grande Ronde River summer steelhead achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	66.8%	66.9%	66.9%	81.5%	81.5%	81.5%	47.0%	47.1%	47.1%
	0.75	66.8%	66.9%	66.9%	81.5%	81.5%	81.5%	47.0%	47.2%	47.2%
Livestock management	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
Riparian restoration	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
Wet meadows restoration	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.6%	47.0%	47.0%	47.1%
Instream restoration	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
Irrigation management	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
Recreation management	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
Fish passage	0.25	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
	0.75	66.8%	66.8%	66.8%	81.5%	81.5%	81.5%	47.0%	47.0%	47.0%
All strategies	0.25	66.8%	66.9%	67.0%	81.5%	81.5%	81.5%	47.0%	47.2%	47.2%
	0.75	66.8%	67.0%	67.0%	81.5%	81.5%	81.5%	47.0%	47.2%	47.3%

8.2.9 Wallowa River Summer Steelhead

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Wallow summer steelhead population is generally intermediate within the range of intensities applied to summer steelhead populations (Tables 8-8 and 8-9). Among the geographic areas associated with the populations, the amount of water to be saved by modified irrigation management in the Wallowa watershed area would be greatest among the four population areas. A total of approximately 118 cfs would be saved through irrigation management and would serve to increase flow within this geographic area, as well as to stream reaches downstream. The number of barriers that affect fish passage to be corrected would be the second highest among the geographic areas associated with the four summer steelhead populations.

Projected Changes to Population Performance

Estimated percent changes in population performance of Wallowa River summer steelhead due to tributary habitat actions are shown in Figures 8-20 and 8-21 and Tables 8-26 and 8-27. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-80 to 8-85. Also, see Appendix 8-D for definitions of diagnostic units.

The most effective strategies for Wallowa River steelhead were predicted to produce modest gains in smolt capacity (Figure 8-20 and Table 8-26). The top three strategies were Irrigation Management, Livestock Management, and Fish Passage—each increased smolt capacity by approximately 5%. The next most effective strategy was Riparian Restoration, which produced a somewhat smaller gain to smolt capacity. All actions combined increased smolt capacity by upwards to 20% depending on time lag and the attribute scalar applied.

For nearly all strategies and scenarios, smolt productivities were predicted to decline slightly, with the largest declines occurring with Irrigation Management and Fish Passage (Table 8-26). These results, except for Fish Passage, indicate that habitat quality is much less affected by the actions than is habitat quantity. It is evident from a review of the diagnostic charts that habitat quality is severely limiting population performance with a number of factors showing substantial declines from conditions assumed to characterize the historic condition (see Baseline Diagnostic Report, Appendix 8-C page 8-81). However, loss in the quantity of key habitat is also clearly evident. It appears in general that the strategies increased the quantity of key habitats to a greater extent than improvements were made in habitat quality, which had the effect of causing more life history trajectories not sustainable under the baseline condition (productivity <1) to become just barely sustainable (due to some benefit to habitat quality). This is seen in the increase in the index of life history diversity (Figure 8-20). The result of these changes produced a slight drop in productivity for most strategies.[19] This is most evident for Irrigation Management—greater flow in the river during late summer produces a larger quantity of key habitat though of generally poor quality.

The Fish Passage strategy, in opening more underutilized habitats upstream of barriers, acted to increase smolt capacity but produced a small drop in productivity. These results occur because improved passage opened habitats that were generally of relatively poor quality, illustrating that strategies need to be implemented in concert with one another and sequenced logically.

With all actions combined, we projected that approximately 50 to 70% of the habitat potential (historic level) for productivity and capacity respectively would be achieved. Significant restoration potential would remain, primarily in the upper half of the Wallowa River steelhead distribution (see Scenario Diagnostic Report in Appendix 8-C, Appendix pages 8-84 and 8-85).

[19] / As noted in the section above for Wenaha River spring Chinook, it appears that a generally increased capacity of some life histories is acting to depress productivity slightly by increasing the weight of less productive life history trajectories in the computation of population productivity; see Blair et al. (2009).

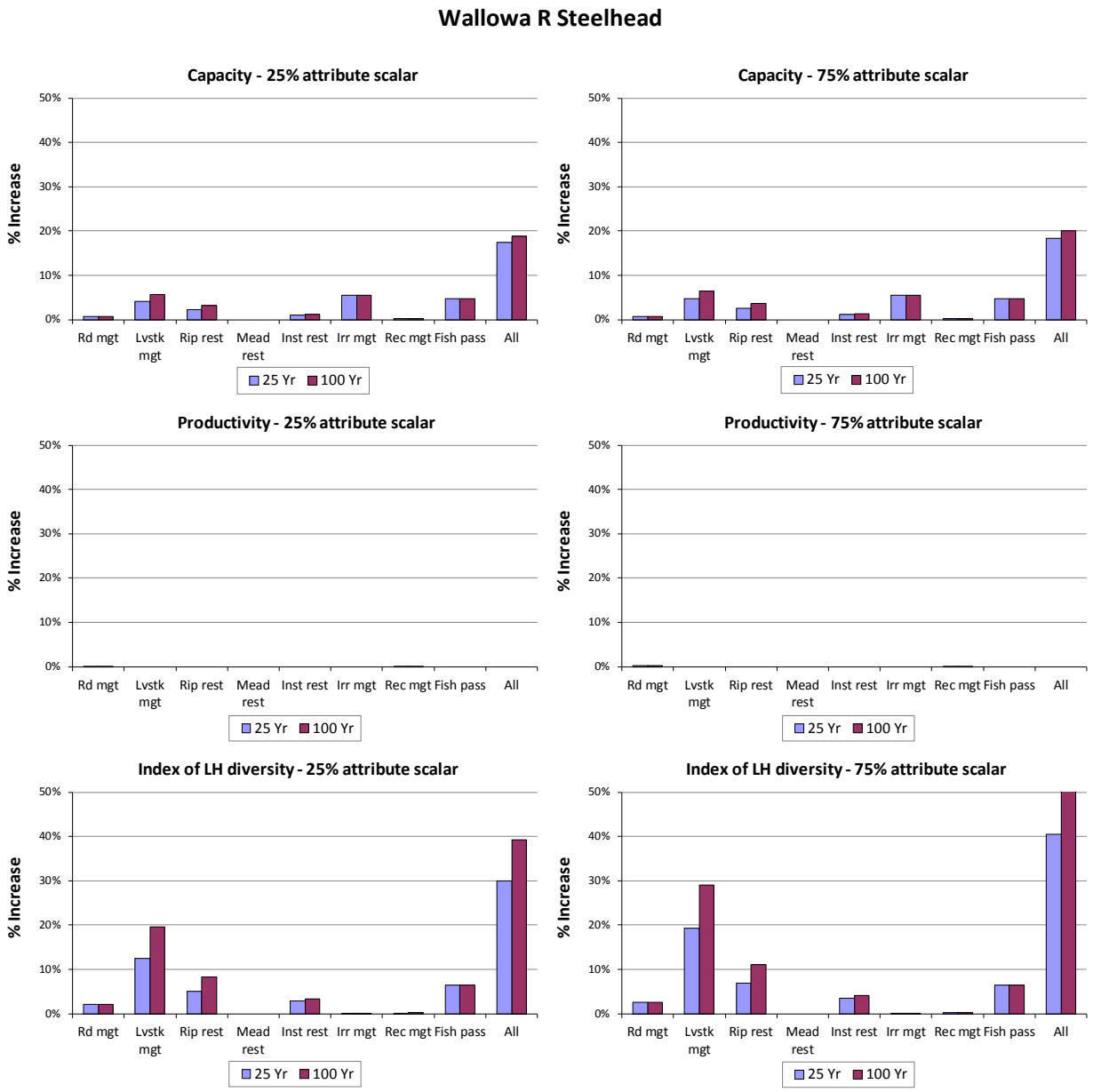


Figure 8-20. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wallowa River summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

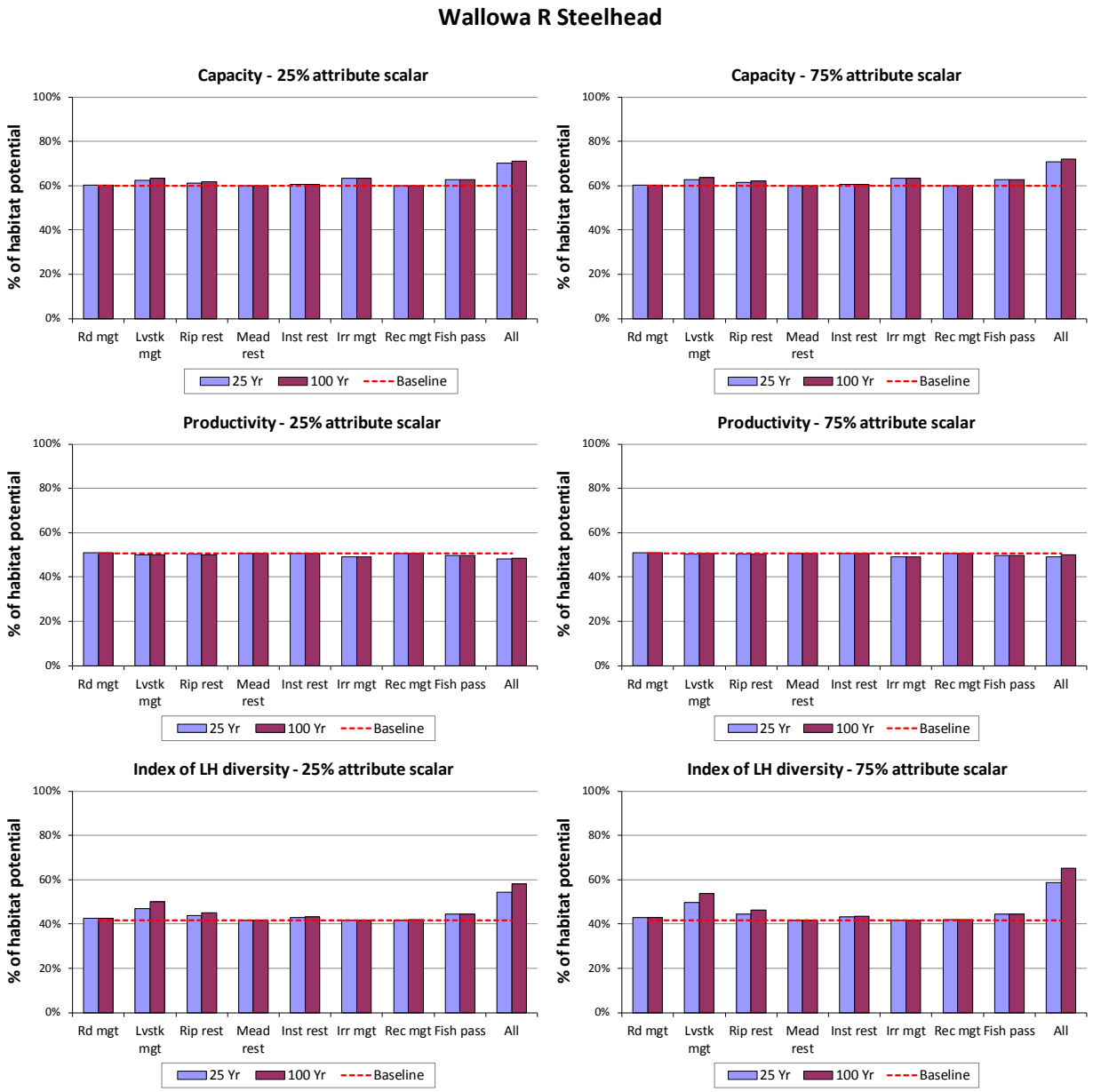


Figure 8-21. Estimated percent of tributary habitat potential at the smolt stage of Wallowa River summer steelhead as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-26. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Wallowa River summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	0.7%	0.7%	0.1%	0.1%	2.0%	2.0%
	0.75	0.7%	0.7%	0.3%	0.3%	2.6%	2.6%
Livestock management	0.25	4.1%	5.6%	-1.4%	-1.6%	12.5%	19.6%
	0.75	4.7%	6.4%	-0.6%	-0.1%	19.2%	29.1%
Riparian restoration	0.25	2.3%	3.2%	-1.0%	-1.1%	5.0%	8.3%
	0.75	2.6%	3.6%	-0.7%	-0.6%	6.9%	11.0%
Wet meadows restoration	0.25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Instream restoration	0.25	1.0%	1.2%	-0.3%	-0.3%	2.9%	3.3%
	0.75	1.1%	1.3%	-0.2%	-0.2%	3.5%	4.1%
Irrigation management	0.25	5.6%	5.6%	-3.1%	-3.1%	0.1%	0.1%
	0.75	5.6%	5.6%	-3.1%	-3.1%	0.1%	0.1%
Recreation management	0.25	0.2%	0.2%	0.0%	0.0%	0.2%	0.3%
	0.75	0.2%	0.2%	0.0%	0.1%	0.3%	0.3%
Fish passage	0.25	4.7%	4.7%	-2.2%	-2.2%	6.4%	6.4%
	0.75	4.7%	4.7%	-2.2%	-2.2%	6.4%	6.4%
All strategies	0.25	17.4%	18.9%	-5.2%	-4.5%	30.0%	39.3%
	0.75	18.3%	20.1%	-3.3%	-1.3%	40.6%	56.0%

Table 8-27. Estimated percent of tributary habitat potential at the smolt stage of Wallowa River summer steelhead achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	59.9%	60.3%	60.3%	50.7%	50.8%	50.8%	41.7%	42.6%	42.6%
	0.75	59.9%	60.3%	60.3%	50.7%	50.9%	50.9%	41.7%	42.8%	42.8%
Livestock management	0.25	59.9%	62.3%	63.3%	50.7%	50.0%	49.9%	41.7%	47.0%	49.9%
	0.75	59.9%	62.7%	63.7%	50.7%	50.4%	50.7%	41.7%	49.8%	53.9%
Riparian restoration	0.25	59.9%	61.3%	61.8%	50.7%	50.2%	50.2%	41.7%	43.8%	45.2%
	0.75	59.9%	61.4%	62.1%	50.7%	50.4%	50.4%	41.7%	44.6%	46.3%
Wet meadows restoration	0.25	59.9%	59.9%	59.9%	50.7%	50.7%	50.7%	41.7%	41.7%	41.7%
	0.75	59.9%	59.9%	59.9%	50.7%	50.7%	50.7%	41.7%	41.7%	41.7%
Instream restoration	0.25	59.9%	60.5%	60.6%	50.7%	50.6%	50.6%	41.7%	43.0%	43.1%
	0.75	59.9%	60.6%	60.7%	50.7%	50.6%	50.6%	41.7%	43.2%	43.4%
Irrigation management	0.25	59.9%	63.2%	63.2%	50.7%	49.1%	49.1%	41.7%	41.8%	41.8%
	0.75	59.9%	63.2%	63.2%	50.7%	49.1%	49.1%	41.7%	41.8%	41.8%
Recreation management	0.25	59.9%	60.0%	60.0%	50.7%	50.7%	50.8%	41.7%	41.8%	41.8%
	0.75	59.9%	60.0%	60.0%	50.7%	50.8%	50.8%	41.7%	41.8%	41.9%
Fish passage	0.25	59.9%	62.7%	62.7%	50.7%	49.6%	49.6%	41.7%	44.4%	44.4%
	0.75	59.9%	62.7%	62.7%	50.7%	49.6%	49.6%	41.7%	44.4%	44.4%
All strategies	0.25	59.9%	70.3%	71.2%	50.7%	48.1%	48.5%	41.7%	54.2%	58.1%
	0.75	59.9%	70.9%	71.9%	50.7%	49.0%	50.1%	41.7%	58.7%	65.1%

8.2.10 Upper Grande Ronde River Summer Steelhead

Level of Action Coverage

The level of action coverage proposed to be carried out within the geographic area encompassing the Upper Grande Ronde River summer steelhead population is the highest within the range of intensities applied to summer steelhead populations (Tables 8-8 and 8-9). The indices of relative intensity (Table 8-9) show that a much greater level of action coverage is applied to this population compared to the others. Intensities of actions aimed at reducing road, grazing, riparian, and stream channelization effects are the highest in this area.

Projected Changes to Population Performance

Estimated percent changes in population performance of Upper Grande Ronde River summer steelhead due to tributary habitat actions are shown in Figures 8-22 and 8-23 and Tables 8-28 and 8-29. Results are given with the attribute scalar value set to both 0.25 and 0.75. To better understand why capacity and productivity responded the way they did to the actions, it will be helpful for the reader to refer to the diagnostic charts in Appendix 8-C pages 8-87 to 8-92. Also, see Appendix 8-D for definitions of diagnostic units.

The top two strategies that benefitted each of the three performance measures the most were Livestock Management and Riparian Restoration (Figure 8-22 and Table 8-28). The other strategies had smaller effects. The Livestock Management strategy was predicted to produce the greatest benefit. Under this strategy, smolt capacity was increased by upwards to 20% depending on time lag and assumptions about the attribute scalar. Productivity under this strategy was increased between 20 to 33% depending on the attribute scalar at the 100 year time lag.

All actions combined produced increases in smolt capacity between 27 to 31% depending on attribute scalar applied at the 100 year time lag. The range in productivity increases for these same conditions was between 37 to 60%. Significant restoration potential would remain, though mostly as it would affect productivity, even if all strategies were to be implemented as proposed, primarily in the upper areas of (see Scenario Diagnostic Report in Appendix 8-C, Appendix pages 8-91 and 8-92). It is evident from a review of the diagnostic charts that the greatest limiting factors on steelhead would continue to be habitat quality, particularly with respect to fine sediment load and water temperature.

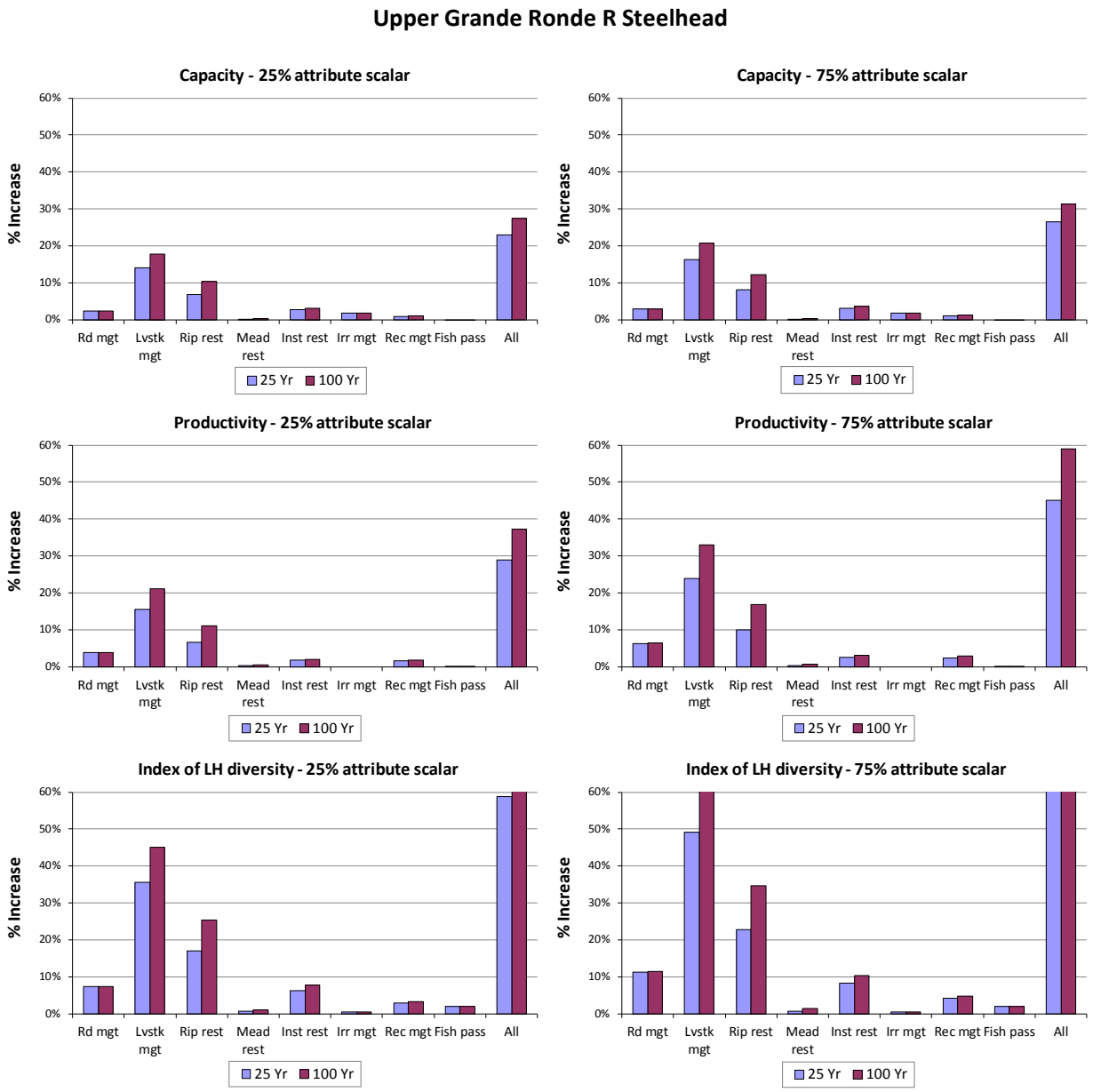


Figure 8-22. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Upper Grande River summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

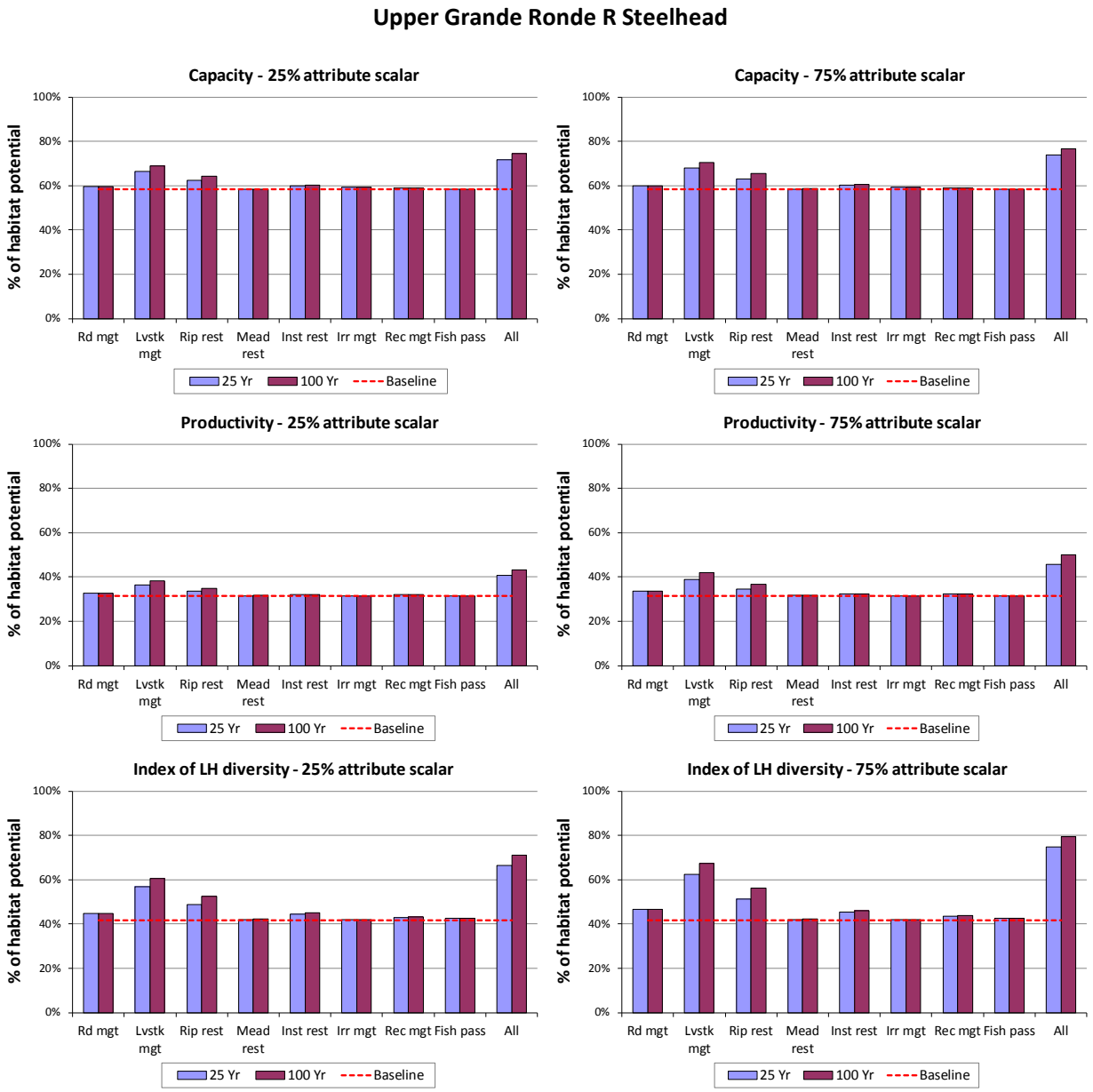


Figure 8-23. Estimated percent of tributary habitat potential at the smolt stage of Upper Grande Ronde River summer steelhead as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin. Results are shown both with the attribute scalar set to 0.25 and 0.75. Baseline performance is shown by the red dashed line.

Table 8-28. Estimated percent changes in capacity and productivity at the smolt stage and in the index of life history diversity of Upper Grande Ronde River summer steelhead as a result of tributary habitat actions grouped by strategy type. Results are shown both with the attribute scalar set to 0.25 and 0.75.

Strategy	Attribute scalar	Capacity		Productivity		Diversity index	
		25 yr	100 yr	25 yr	100 yr	25 yr	100 yr
Road management	0.25	2.4%	2.4%	3.8%	3.9%	7.3%	7.4%
	0.75	2.9%	2.9%	6.2%	6.4%	11.3%	11.4%
Livestock management	0.25	14.0%	17.8%	15.6%	21.1%	35.7%	45.1%
	0.75	16.3%	20.7%	23.9%	32.9%	49.2%	61.1%
Riparian restoration	0.25	6.9%	10.3%	6.6%	11.1%	17.1%	25.4%
	0.75	8.1%	12.1%	10.0%	16.8%	22.8%	34.6%
Wet meadows restoration	0.25	0.2%	0.3%	0.2%	0.4%	0.6%	1.0%
	0.75	0.2%	0.3%	0.4%	0.7%	0.7%	1.3%
Instream restoration	0.25	2.6%	3.1%	1.7%	2.1%	6.3%	7.6%
	0.75	3.0%	3.6%	2.5%	3.1%	8.3%	10.3%
Irrigation management	0.25	1.8%	1.8%	-0.4%	-0.4%	0.5%	0.5%
	0.75	1.8%	1.8%	-0.4%	-0.4%	0.5%	0.5%
Recreation management	0.25	0.9%	1.0%	1.5%	1.8%	3.0%	3.3%
	0.75	1.0%	1.2%	2.4%	2.8%	4.3%	4.8%
Fish passage	0.25	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
	0.75	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
All strategies	0.25	23.0%	27.4%	29.0%	37.3%	58.8%	70.1%
	0.75	26.5%	31.3%	45.1%	59.0%	78.8%	89.8%

Table 8-29. Estimated percent of tributary habitat potential at the smolt stage of Upper Grande River summer steelhead achieved as a result of tributary habitat actions grouped by strategy type. Habitat potential is assumed equal to performance associated with the pre-development (historic) condition in the subbasin.

Strategy	Attribute scalar	Capacity			Productivity			Diversity index		
		Baseline	25 yr	100 yr	Baseline	25 yr	100 yr	Baseline	25 yr	100 yr
Road management	0.25	58.4%	59.7%	59.8%	31.5%	32.7%	32.7%	41.8%	44.8%	44.9%
	0.75	58.4%	60.0%	60.1%	31.5%	33.5%	33.5%	41.8%	46.5%	46.6%
Livestock management	0.25	58.4%	66.6%	68.8%	31.5%	36.4%	38.2%	41.8%	56.7%	60.6%
	0.75	58.4%	67.9%	70.5%	31.5%	39.0%	41.9%	41.8%	62.4%	67.3%
Riparian restoration	0.25	58.4%	62.4%	64.4%	31.5%	33.6%	35.0%	41.8%	48.9%	52.4%
	0.75	58.4%	63.1%	65.4%	31.5%	34.7%	36.8%	41.8%	51.3%	56.2%
Wet meadows restoration	0.25	58.4%	58.5%	58.5%	31.5%	31.6%	31.6%	41.8%	42.1%	42.2%
	0.75	58.4%	58.5%	58.6%	31.5%	31.6%	31.7%	41.8%	42.1%	42.3%
Instream restoration	0.25	58.4%	59.9%	60.2%	31.5%	32.0%	32.2%	41.8%	44.4%	45.0%
	0.75	58.4%	60.1%	60.5%	31.5%	32.3%	32.5%	41.8%	45.3%	46.1%
Irrigation management	0.25	58.4%	59.4%	59.4%	31.5%	31.4%	31.4%	41.8%	42.0%	42.0%
	0.75	58.4%	59.4%	59.4%	31.5%	31.4%	31.4%	41.8%	42.0%	42.0%
Recreation management	0.25	58.4%	58.9%	59.0%	31.5%	32.0%	32.1%	41.8%	43.0%	43.2%
	0.75	58.4%	59.0%	59.1%	31.5%	32.3%	32.4%	41.8%	43.6%	43.8%
Fish passage	0.25	58.4%	58.4%	58.4%	31.5%	31.5%	31.5%	41.8%	42.7%	42.7%
	0.75	58.4%	58.4%	58.4%	31.5%	31.5%	31.5%	41.8%	42.7%	42.7%
All strategies	0.25	58.4%	71.8%	74.4%	31.5%	40.6%	43.3%	41.8%	66.3%	71.1%
	0.75	58.4%	73.8%	76.6%	31.5%	45.7%	50.1%	41.8%	74.7%	79.3%

8.3 Discussion

This chapter provides an analysis of a range of restoration habitat strategies intended to reduce the effects of habitat-related factors within the Grande Ronde subbasin that adversely affect the performance and viability of Grande Ronde River salmon and steelhead populations. The analysis employs the EDT model to evaluate potential benefits of the strategies, as they would affect smolt capacity, smolt productivity, and an index of life history diversity.

The EDT modeling was based on use of habitat characterization in all relevant stream reaches as it was done in 2004 by a team who prepared the Grande Ronde subbasin plan (NPPC 2004). All attribute characterization done at that time, for both historic conditions and a recent period baseline, was applied in this current analysis with two exceptions. A more complete and comprehensive set of water temperature data was used to update the water temperature attributes in the subbasin. This resulted in a general worsening of temperature conditions, in some reaches by a substantial margin, compared to the characterization used in the 2004 plan. The second change incorporated more than 100 additional barriers affecting either juvenile or adult fish passage in the subbasin.

The analysis was then performed by first projecting the effectiveness of 23 separate habitat actions in the subbasin, which group into eight separate strategies. Action effectiveness was

projected by use of a detailed set of intensity metrics that define the scope of each action and generally where each action would be implemented. Effectiveness values were projected separately for each action using a prescribed set of rules.

The EDT model was then applied to project the effects of each strategy (groups of related actions) on salmon and steelhead performance, i.e., on smolt capacity, smolt productivity, and an index of life history diversity. The results were presented as percent changes in the performance parameters compared to the recent baseline period for each strategy and for all actions combined. In addition, results were given for the relative amount of the habitat potential (i.e., the historic performance measure) achieved by each strategy (as a percent). This second set of results is helpful as it shows how much more performance might be gained with greater habitat restoration efforts.

The results for each population were presented in a separate section together with a discussion of the findings pertaining to that population. Insights about which strategies were most effective were presented, along with issues that should be given further consideration in applying the results.

An important conclusion of this analysis, which is consistent with past EDT analyses done in the subbasin, is that elements of habitat quality are most severely limiting the performance of both salmon and steelhead populations. This is clearly illustrated in the diagnostic baseline charts in Appendix 8-C. While the quantity of key habitats is very important in general, it is vitally important to make significant strides in improving various aspects of habitat quality in many areas of the subbasin. These aspects of habitat quality in particular are water temperature and fine sediment load. The significance of this conclusion was illustrated clearly in the results for one strategy, Irrigation Management, which as proposed would increase stream flow collectively by approximately 150 cfs. Without appropriate steps to improve habitat quality, adding more water to the streams acts to create more key habitat but of generally poor quality (high temperature, high sediment load, and so on). The result of this strategy alone generally produced a small increase in smolt capacity and a slight drop in smolt productivity.

A similar type of effect was seen for the strategy Fish Passage, which as defined consisted solely of improving fish passage effectiveness at many barrier locations in the subbasin. The result of this action tended to produce some increase in smolt capacity but with an associated drop in smolt productivity. These results occurred because improved passage opened habitats that were generally of relatively poor quality, illustrating that certain types of strategies need to be implemented in concert with one another and sequenced logically. Restoration planning should give particular attention to developing suites of actions that complement one another and that are prioritized with proper sequencing. Modeling tools, such as the EDT model, can help to develop strategic planning alternatives that consider different combinations of actions and their sequencing.

Future modeling in the Grande Ronde subbasin that might employ the EDT model should consider the following:

- Resolution of an uncertainty raised in this chapter about the extent that the quantity of key habitats (such as pool habitat) has been altered in the Grande Ronde River

downstream of Lookingglass Creek and in the Wallowa River downstream of Minam River.

- Updating and refining the modeling generation of life history trajectories in the Grande Ronde subbasin so that they take into account the most recent information on life history patterns and tactics based on results of PIT tagging research.
- Updating of the habitat characterization for a new baseline period, taking into account expected benefits of habitat actions that have already been implemented or that are known to soon be implemented—this would help to identify the gaps between current baselines and the amounts of restoration work needed to achieve recovery goals.
- Incorporation of data on cold water refuges in the subbasin into the habitat characterization database (the current database incorporates a surrogate measure but has not been evaluated in light of recent work by Torgersen et al. 2012)—the role of cold water refuge sites is likely vitally important and it has not been given adequate attention in EDT analyses done to date in this subbasin).
- Updating of the biological rules used in EDT to assess the effects of water temperature—this has been recognized by the architects of EDT as a pressing need, especially for the redband subspecies.
- Use of a new version of EDT (EDT 3.0) that provides for greater flexibility and latitude in how the model is used to analyze different kinds of conditions and rule formulations (note: this version is being released in 2014).

D-1

D R A F T
APPENDIX for Chapter 8

Management Actions Effectiveness

APPENDIX for Chapter 8
Management Actions Effectiveness

Appendix 8 consist of four sections:

- 8-A – Application of the Beverton-Holt Relationship in EDT
- 8-B – Tributary Habitat Action Effectiveness Assumptions
- 8-C – Summaries of Diagnostic Reports
- 8-D – Stream Reach and Diagnostic Unit List

Appendix 8-A provides a brief overview of some of the properties of the Beverton-Holt stock-production relationship that make it particularly useful as an analytical framework for use in the EDT.

Appendix 8-B provides action effectiveness assumptions and related factor scalars used in analyzing the tributary habitat actions in EDT.

Appendix 8-C provides a series of graphic reports that give additional information about the predicted outcomes of the subbasin habitat scenarios analyzed in Chapter 8. These graphic reports are extracted from output produced by EDT.

Appendix 8-D lists stream reaches used in the Grande Ronde EDT analysis with the following information provided: sequence number, reach name, associated stream name, reach description, diagnostic unit name, and reach length in miles (current condition).

APPENDIX 8-A
Application of the Beverton-Holt Relationship in EDT and AHA

This description of some of the properties of the Beverton-Holt relationship is largely adapted from more detailed presentations given in Lestelle et al. (1996) and Mobrand Biometrics Inc (1999).

A traditional type of analysis of fish population dynamics is called stock-recruitment, or spawner-production (S-P), analysis (Ricker 1954; Beverton and Holt 1957). The approach is based on an assumption that there exists some underlying relationship between spawners (parent stock) and resultant production (progeny). This type of analysis has been most commonly applied in harvest management, though it has been widely extended to analyzing environmental issues that can affect the production relationship (e.g., Christensen et al. 1977; Emlen 1995; Mobrand et al. 1997; Scheuerell et al. 2006).

A S-P relationship is a simple conceptual model meant to depict how population abundance varies in relation to the size of the reproducing parent population. Different forms of simple S-P relationships are applied to different species, populations, and situations. Three commonly used relationships are the Ricker (dome-shaped), Beverton-Holt (asymptotic), and hockey stick (rectilinear incorporating a threshold).

All of these relationships incorporate the two components of the total mortality rate: the density-independent rate and the density-dependent rate. The result of these two mortality components is variable total mortality as a function of population density. Total mortality increases with increasing population density due to increased competition for resources.

At extremely low population densities, the rate of mortality on a population is theoretically unaffected by the abundance of that population; hence mortality rate is largely density-independent at these densities. As population density grows, competition for food and space typically increases, thereby increasing mortality beyond the rate imposed solely by density-independent processes. This additional amount of mortality is the density-dependent component of mortality. The population is ultimately constrained to some carrying capacity by limited food or space.

The difference in the three common forms of S-P relationships is primarily in how density-dependent mortality operates. The Beverton-Holt form assumes an asymptotic carrying capacity as population size increases. The Ricker form assumes that total recruitment declines past a point where carrying capacity is evident, thus the density-dependent mortality rate increases at a faster rate beyond the carrying capacity than in the Beverton-Holt. The hockey stick form assumes that density-dependent mortality is not operative until the carrying capacity is reached, hence it is threshold driven.

The EDT and AHA models employ the Beverton-Holt form (Figure 1) of the S-P relationship as their core analytical framework. The point where the replacement line (i.e., the line that defines how many returning adults are needed to exactly replace the parent stock) in the figure crosses

the production relationship identifies the equilibrium abundance of the population (under steady state conditions). In theory, there is no difference between how density-independence and density-dependence combine in the Beverton-Holt and Ricker forms to produce total mortality at relatively small population sizes. Recovery and restoration planning is primarily focused on populations performing below their carrying capacity. In contrast to the Ricker form, however, the Beverton-Holt form has some very convenient mathematical properties that make it especially helpful to this type of modeling. This is the main reason it is used in these models, although its familiarity and broad use in population dynamics modeling is another reason. Moreover, the Beverton-Holt form is generally considered to be most appropriate for freshwater juvenile life stages of stream-rearing salmonids (Ward and Slaney 1993).

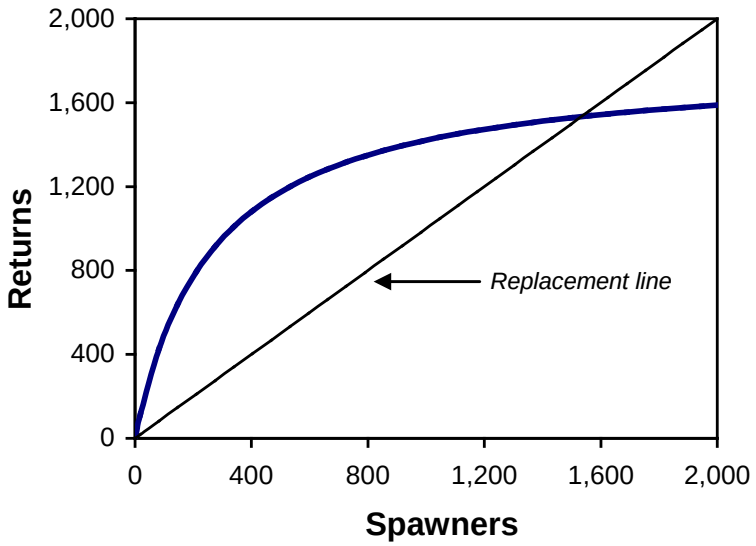


Figure 1. The Beverton-Holt stock-production relationship.

In evaluating the effects of environmental issues on salmon populations, it is important to consider how effects can differ markedly between the different life stages of a species. For example, fine sediment that is entrained within the stream substrate can have one level of effect on incubating eggs and embryos, but a completely different effect on juveniles rearing in the stream during summer. The Beverton-Holt relationship's mathematical properties allow it to be easily disaggregated into life stage relationships—or for that matter, into ever smaller sub-stages or segments within a single life stage—where each relationship can be defined by its own Beverton-Holt relationship (Beverton and Holt 1957; Moussalli and Hilborn 1986). These disaggregated relationships can then be easily re-aggregated to formulate the overall spawner to adult return relationship. These properties allowing for disaggregation and re-aggregation are especially useful in analyzing issues that affect population performance through models like EDT and AHA.

Figure 2 displays a Beverton-Holt relationship for one life stage in the life cycle of a salmon population. Here the relationship describes the number of individuals surviving to the end of the life stage as a function of how many begin the life stage. The figure is used to illustrate the parameters that define the relationship. The density-independent survival rate—called productivity—is defined by the slope of the curve at zero density for the number starting the life

stage (illustrated by the slope of the line labeled productivity). It is survival without density-dependence effects. Productivity is equivalent to the concept of intrinsic productivity discussed in McElheny et al. (2000) to describe population viability. If environmental conditions result in an increase in density-independent mortality, the slope of the productivity line would be decreased. Improved survival would steepen the slope of the curve at zero spawners.

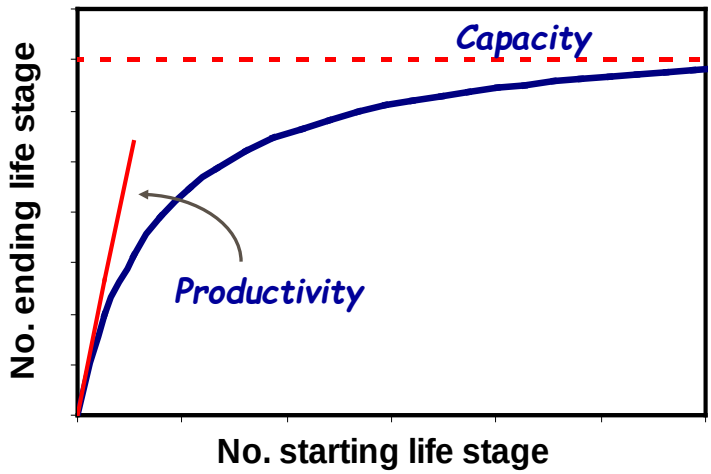


Figure 2. Productivity and capacity elements of the Beverton-Holt relationship. Productivity is defined by the slope of the curve at the origin, reflected in the red solid line. Capacity is the asymptote of the curve at higher initial densities.

The capacity of the habitat for the life stage is defined by the asymptote for the curve at high levels of beginning population size. Capacity limits how large the population can grow given finite space and food resources. It controls the extent that density-dependence is operative at different population levels.

Different characteristics of the environment affect productivity and capacity differently. Productivity is affected by the quality of the environment, since quality in itself is not being competed for by individuals in the population. Water temperature, for example, will generally affect all animals within the population at about the same rate, regardless of the population density. In contrast, capacity is a function of the quantity of key habitats and food resources, characteristics of the environment that animals compete for.

A fundamental assumption of the model is that the life history of a salmon species can be partitioned into segments within which (a) habitat conditions are relatively uniform, and (b) the survival response is constant and predictable.

The curve in Figure 2 is described by two parameters:

(equation 1)

$$S = \frac{P}{1 + \frac{PN}{C}}$$

where *P* is productivity and *C* is carrying capacity for the life segment. *N* is the number of individuals alive at the beginning of the segment and *S* is the number alive at the end of the segment.

Moussali and Hilborn (1986) showed that if survival in a sequence of life stage segments along the life history is either density-independent or follows a Beverton-Holt survival function, then so does the full sequence. They showed further that "cumulative" productivity and capacity for a sequence of n segments with productivities p_i and c_i can be computed as:

(equation 2)

$$P_n = \prod_{i=1}^{n} p_i$$

and

(equation 3)

$$C_n = \frac{P_n}{\sum_{i=1}^{n} \frac{P_i}{c_i}}$$

which leads to the useful recursion:

(equation 4)

$$C_n = \frac{p_n}{\frac{1}{C_{n-1}} + \frac{p_n}{c_n}}$$

If the *n* segments comprise the entire life cycle, we can now, for example, predict the equilibrium abundance, *Neq*, from:

(equation 5)

$$Neq = C_n \left(1 - 1/P_n\right)$$

The productivity parameter can be used to describe the effect of any issue that operates through density-independent survival. Hence, genetic fitness can be included within the productivity parameter by treating it as a scalar between values 0 to 1 and multiplying it by the density-independent survival rate for the life segment to compute productivity. It is noteworthy also that due to the multiplicative nature of productivity that a change in the density-independent survival in any life stage will have the same effect on life cycle productivity.

Equations 4 and 5 illustrate that carrying capacity over some number of segments is affected by both the capacities of the individual segments and segment productivities. Thus, it is important to recognize that when environmental quality is changed, such as by a restoration action, then both life cycle productivity and capacity are affected. In contrast, a change in habitat quantity that does not change environmental quality will only affect capacity but not productivity.

In EDT, the sequence of life history segments are modeled using trajectories (or pathways) that precisely define the temporal-spatial sequence of life through the environment. Use of these trajectories allows the model to compute a myriad of possible pathways that a population uses within the environmental time-space mosaic of conditions available to it. Each trajectory is modeled using the disaggregation properties of the Beverton-Holt relationship. All of the trajectories are then “rolled-up”, i.e., aggregated, to formulate a productivity and a capacity parameter for the entire population.

EDT uses a set of rules that define how various environmental attributes affect productivity and capacity habitat components for specific salmonid species (see Lestelle et al. 2004).

The reader should refer to Blair et al. (2009) for the most recent presentation of algorithms used in EDT.

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APPENDIX 8-B
Tributary Habitat Action Effectiveness Assumptions

This appendix consists of five tables that describe action effectiveness assumptions and related factor scalars used in analyzing the subbasin habitat actions. See Chapter 8 of the report for a full description of how the assumptions and scalars are applied. The five tables are:

8-B.1 List of habitat actions analyzed within the subbasins.
8-B.2 Action effectiveness assumptions and levels applied in analysis.
8-B.3 Action effectiveness lag scalars applied to habitat actions.
8-B.4 Attribute scalars applied to habitat actions.
8-B.5 Definitions of freshwater habitat attributes shown in Table 8-B.4.

Table 8-B.1. Tributary habitat actions analyzed for their effects on population performance of Grande Ronde salmon and steelhead populations. See Chapter 8 for further descriptive details of actions.

Strategy	Action	Description
1. Road management		
	Close/relocate roads	Close, obliterate or relocate sediment producing roads not needed for the transportation system. Upgrade or remove problem forest roads. Close, remove, and restore riparian road prisms.
	Improve road maintenance	Adjust maintenance activities, or resurface sediment producing roads that cannot be closed, obliterated, or relocated.
	Replace culverts	Improve drainage and replace/install new culverts to reduce sedimentation.
2. Livestock management		
	Improve grazing management	Manage livestock grazing to avoid adverse impacts to riparian areas,ensuring that grazing plans are designed to improve riparian condition. Methods include exclusion, partial season use, and other BMPs.
	Move feedlots	Remove animal feedlots from active floodplain. Apply BMPs to animal feeding operations.
	Riparian fencing	Install fencing to exclude livestock from riparian areas.
	Off-site watering	Install off-stream livestock watering.
3. Riparian restoration		
	Riparian plantings	Reestablish riparian vegetation by planting and protecting trees, shrubs, and sedges (native species preferred).
	Stabilize streambank erosion	Stabilize active streambank erosion sites through integrated use of wood structures (limit use of rock) and vegetation reestablishment.
	CREP (or related) programs	Work with landowners to protect riparian corridors through incentive programs (e.g. CREP, WRP, EQIP).
	Riparian thinning	Thin forested riparian zones to promote tree growth and facilitate obtaining large tree characteristics.
	Riparian species alteration	Improve the density, condition, species, and age composition of riparian vegetation through active management and restoration measures.
	LWD maintenance program	Maintain existing LWD by promoting forestry practices that maintain existing instream and riparian area large wood, and promote adequate future large wood recruitment.
4. Meadow restoration		
	Restore wet meadows	Re-establish historic wet meadow complexes.
5. Instream restoration		
	Relocate channelized stream	Reconstruct channelized stream reaches to historic or near-historic form and location.
	Remove channel confinement	Promote interaction of stream channels and floodplains by removing, where feasible and appropriate, channel confinement structures (roads, dikes, tailings, berms, etc.).
	Reconnect floodplain	Reconnect floodplains to channels, including restoring side channels and off-channel habitats.
	Add channel structure	Add in-channel structure (LWD, boulders) to improve habitat complexity with particular focus on re-establishing the function and abundance of wood and large organic debris in streambeds.
6. Irrigation management		
	Restore instream flows	Reduce irrigation withdrawals through an integrated program of irrigation efficiency improvements, diversion point consolidations, water right leasing and water right purchase.

Strategy	Action	Description
7. Recreation management		
	Relocate riparian recreational sites	Relocate developed recreational facilities, where appropriate, from riparian areas to upland sites.
	Limit motorized use within riparian zone	Restrict use of motorized vehicles within riparian zones.
	Limit non-motorized recreational activites	Update management plans for use of certain riparian areas for recreational activities to foster re-establishment of healthy riparian characteristics.
8. Fish passage restoration		
	Remove or modify barriers	Replace barriers blocking passage including dams, road culverts and irrigation structures.

Table 8-B.2. Action effectiveness (potential) assumptions and levels applied in analysis (a) and corresponding effectiveness values assigned to each action with rationale/comments (b). See Chapter 8 for how effectiveness values were applied.

Table 8-B.2a. Action effectiveness levels.

Effectiveness level	Definition	Effectiveness
1	Very high	0.80
2	Moderately high	0.56
3	Moderate	0.32
4	Low	0.08
5	Negligible	0.01
6	No effect	0.00

Table 8-B.2b. Rationale applied in assigning effectiveness levels.

Strategy	Action	Effect.	Rationale/comment
1. Road management			
	Close/relocate roads	0.560	Roads are a major source of sediment in managed watersheds. Road closures and obliteration are known to be effective at reducing sediment loading to streams. A moderately high level of effectiveness is assumed; realized effectiveness will be strongly driven by the amount of roads closed or improved (defined by the intensity factor). Higher effectiveness would essentially assume that there is little other source of man-caused sediment. The action would also remove riparian roads, which are highly intrusive to riparian corridors, adding sediment, intercepting and diverting groundwater seeps, and impeding other floodplain functions. Effectiveness at restoring certain conditions within the floodplain corridor of this action is also assumed to be moderately high due to their intrusive nature and the ability to effectively remove them.
	Improve road maintenance	0.320	Roads are a major source of sediment in managed watersheds. Road improvements and routine maintenance is effective at reducing sediment loading to streams. A moderate level of effectiveness is assumed; realized effectiveness will be strongly driven by the amount of roads improved and routinely maintained (defined by the intensity factor).
	Replace culverts	0.080	Road culverts are a cause of sedimentation because they can be prone to plugging and blowing out causing major disruptions and sedimentation to drainage channels downstream. Roads and associated culverts also change natural drainage patterns along the landscape due to how water (including groundwater) is intercepted and routed. Such changes in patterns can affect runoff rates and water temperature. Overall, the effectiveness of aging culverts and poorly designed installations are assumed to be low because they affect a relatively small amount of the overall contributions from the road system. Realized effectiveness will be strongly driven by the number of culverts being replaced.
2. Livestock management			
	Improve grazing management	0.320	Grazing practices can be managed to reduce impacts on sediment loading, temperature, stream bank and channel stability, and other aspects of stream habitat (Elmore 1992; Armour et al. 1994). A moderate level of effectiveness is assumed for a comprehensive program of improving grazing practices.

Table 8-B.2b. Rationale applied in assigning effectiveness levels.

Strategy	Action	Effect.	Rationale/comment
	Move feedlots	0.320	Animal feedlots can be a major source of sediments to nearby streams due to the intensive disturbance of soils in localized areas and concentrations of organics. A moderate effectiveness level is assigned to the action because feedlots do not typically extend over large areas.
	Riparian fencing	0.560	Enclosures, such as by fencing, can have significant success in restoring riparian areas within eastside streams (Opperman and Merenlender 2004). A moderately high level of effectiveness is assumed. Fencing is not equivalent to restoring a fully functioning riparian community, however. The width of the buffered zone is often thin and does not function the same as a pristine riparian zone.
	Off-site watering	0.320	Off-stream livestock watering can significantly aid in reducing grazing pressure immediately adjacent to streams. A moderate level of effectiveness is assumed with a concerted effort to achieve the objective.
3. Riparian restoration			
	Riparian plantings	0.560	Riparian plantings can accelerate and promote restoration of riparian areas. However, they would have limited success without on-going efforts to control grazing. A moderately high level of effectiveness is assumed since it is assumed that the action would only occur where some form of limitations on grazing would be occurring. Full restoration of riparian communities would have a high effectiveness. In that case, it is assumed that restoring riparian communities over a substantially long reach could nearly achieve pristine condition over a long period of time.
	Stabilize streambank erosion	0.320	Stream bank stabilization is affected by various factors besides just what can be affected at specific sites at the time of implementation. Success is often determined by factors occurring at the landscape level. Well designed stabilization projects can be quite effective, however. Overall, a moderate level of effectiveness is assumed.
	CREP (or related) programs	0.320	This action would implement a Continuous Conservation Reserve Program or similar programs intended to provide for streamside buffers, affording voluntary, non-competitive, programs for agricultural landowners built on financial incentives. Voluntary participation by local landowners is sought through a cost share program designed to restore and enhance habitat and increase bank stability along waterways on private lands with a cropping history. These programs are often implemented in areas with highly erodible soils. When implemented fully, it should be quite effective, here it was assumed to have a moderate effectiveness (vs. a higher effectiveness) due to uncertainties in reported results that have been reviewed.
	Riparian thinning	0.080	Riparian thinning can facilitate restoration of more normative riparian zones that existed historically. It is assumed, however, to add only a relatively small incremental addition to the effects of riparian zones where thinning might be warranted.

Table 8-B.2b. Rationale applied in assigning effectiveness levels.

Strategy	Action	Effect.	Rationale/comment
	Riparian species alteration	0.320	Restoring riparian communities over a substantially long reach can be very effective when various conditions can be controlled (such as controlling grazing----Platts 1991) and where natural watershed processes are largely intact (such as having a normative or natural hydrograph--Naiman et al. 2005). Intensive efforts to restore riparian conditions can produce significant progress towards predevelopment conditions in relatively few years in some ecoregions (Opperman and Merenlender 2004). This level of effectiveness is assumed to be applicable to an eastside ecoregion. With an intensive application to fully restore riparian communities, and in conjunction with activities that simultaneously restore the natural hydrograph and control land uses, effectiveness is assumed to be very high. This action, however, is more limited in scope and aims to restore species composition and regain some amount of natural function. Therefore, a moderate level of effectiveness is assumed.
	LWD maintenance program	0.320	Restoration of large wood in streams can have a significant effect on channel form and function, in both small and large streams. The ability of large wood to so function depends in part on its abundance, size, and type of wood, and on the size and geomorphology of the stream system (Maser and Sedell 1994; Collins et al. 2003; Fox 2001; Fox 2003). When wood can be completely restored to its pre-development level, it can very effectively restore channel conditions, though not necessarily to pre-development conditions due to other operating factors (such as change in hydrograph, sediment loading, floodplain development, etc.). However, wood restoration through natural processes is limited by on-going land uses. Therefore, a moderate level of effectiveness is assumed.
4. Meadow restoration			
	Restore wet meadows	0.560	Wet meadows are a key element in some streams for helping to maintain flows and in providing some aspects of off-channel habitats in some seasons. A moderately high level of effectiveness is assumed where such sites can be targeted for restoration and where the action would be scaled sufficiently large to function similarly to historic condition, and where land use practices can be effectively controlled. The realized effectiveness, however, will be limited by the small scale that such projects typically occur at.
5. Instream restoration			
	Relocate channelized stream	0.320	Measures to reconstruct properly functioning channels can be limited by how channels and floodplains have been altered by past land use practices and legacy effects of features that now exist. Channel incision, for example, can be very difficult to reverse. A moderate level of effectiveness is assumed.
	Remove channel confinement	0.320	Measures to remove channel confinement and restore fully functioning channels can be limited by how channels and floodplains have been altered by past land use practices and effects of features that now exist (roads, railroads, etc). Where opportunities exist to completely remove such structures, effectiveness can be very high. However, due to various constraints that often exist, a moderate level of effectiveness is assumed.
	Reconnect floodplain	0.320	Measures to reconnect floodplain channels can be limited by how channels and floodplains have been altered by past land use practices. Channel incision, for example, can be difficult to reverse. A moderate level of effectiveness is assumed.

Table 8-B.2b. Rationale applied in assigning effectiveness levels.

Strategy	Action	Effect.	Rationale/comment
	Add channel structure	0.320	Enhancement of large wood can have a significant effect on channel form and function, in both small and large streams. The ability of large wood to so function depends in part on its abundance, size, and type of wood, and on the size and geomorphology of the stream system (Maser and Sedell 1994; Collins et al. 2003; Fox 2001; Fox 2003). When wood can be completely restored to its pre-development level, it can very effectively restore channel conditions, though not necessarily to pre-development conditions due to other operating factors (such as change in hydrograph, sediment loading, floodplain development, etc.). However, wood enhancement is often limited by availability, size classes available, ability to locate properly, and other logistical difficulties. Additionally, wood enhancement is usually not maintained, hence it can be naturally depleted without future recruitment. A moderate level of effectiveness is assumed.
6. Irrigation management			
	Restore instream flows	specified	The amount of flow in cfs is prescribed by the actions described in Section 9 of this plan.
7. Recreation management			
	Relocate riparian recreational sites	0.080	This action focuses on a relatively narrow aspect of land use that affects conditions within and near riparian areas. Therefore, its effectiveness is assumed to be low.
	Limit motorized use within riparian zone	0.080	This action focuses on a relatively narrow aspect of land use that affects conditions within and near riparian areas. Therefore, its effectiveness is assumed to be low.
	Limit non-motorized recreational activites	0.080	This action focuses on a relatively narrow aspect of land use that affects conditions within and near riparian areas. Therefore, its effectiveness is assumed to be low.
8. Fish passage restoration			
	Remove or modify barriers	1.000	Where barriers are identified in the actions to be fixed or removed, it is assumed that passage will be provided in full.

Table 8-B.3. Action effectiveness lag scalars applied to habitat actions. Lag scalars are assumed values, representing the expected amount of the potential effectiveness that would be realized 25 years after implementation. A lag scalar value reflects the expected rate that an action's effectiveness will mature with time (e.g., due to tree growth, change in sediment load, reshaping of hydrograph) . All lag scalars were assumed to attain values of 1.0 after 100 years. See Chapter 8 for how lag scalars were applied.

Strategy	Action	Scalar
1. Road management		
	Close/relocate roads	0.9
	Improve road maintenance	1.0
	Replace culverts	1.0
2. Livestock management		
	Improve grazing management	0.8
	Move feedlots	1.0
	Riparian fencing	0.8
	Off-site watering	1.0
3. Riparian restoration		
	Riparian plantings	0.7
	Stabilize streambank erosion	0.9
	CREP (or related) programs	0.7
	Riparian thinning	0.8
	Riparian species alteration	0.7
	LWD maintenance program	0.7
4. Meadow restoration		
	Restore wet meadows	0.5
5. Instream restoration		
	Relocate channelized stream	0.8
	Remove channel confinement	0.8
	Reconnect floodplain	0.8
	Add channel structure	0.9
6. Irrigation management		
	Restore instream flows	1.0
7. Recreation management		
	Relocate riparian recreational sites	0.8
	Limit motorized use within riparian zone	0.8
	Limit non-motorized recreational activites	0.8
8. Fish passage restoration		
	Remove or modify barriers	1.0

Table 8-B.4. Attribute scalars applied to habitat actions. Attribute scalars define whether the potential effectiveness of an action will be the full amount (scalar = 1) or reduced due to an attribute effect. Some actions have no effect on some attributes (scalar = 0). For each action, attributes were identified as being affected or not affected. A scalar of 1 was assigned to any attribute that would be affected, except for those that characterize some aspect of sediment, flow, and temperature. Scalars for these were set to 0.25 or 0.75 (both values were modeled for all scenarios), recognizing that these attributes are broadly affected by watershed conditions and can be more difficult to influence than attributes driven mainly by site-specific conditions. See Chapter 8 for how scalars were applied. See Table 8-B.5 for definitions of attributes.

Strategy	Action	BdScour	BenComRch	ConfineHydro	DisOxy	Emb	FlwDielVar	FlwHigh	FlwIntraAnn	FlwLow	FnSedi	HbOfChFctr	HbPls	Icing	MscToxWat	NutEnrch	RipFunc	TmpMonMn	TmpMonMx	TmpSptVar	Turb	WdDeb	Wdrwl	WidthMn	WidthMx
1. Road management																									
	Close/relocate roads	1.00	0.00	1.00	0.00	0.25	1.00	0.25	0.25	0.25	0.25	0.00	1.00	0.00	0.00	0.00	1.00	0.25	0.25	0.25	1.00	0.00	0.00	1.00	1.00
	Improve road maintenance	1.00	0.00	1.00	0.00	0.25	1.00	0.25	0.25	0.25	0.25	0.00	1.00	0.00	0.00	0.00	1.00	0.25	0.25	0.25	1.00	0.00	0.00	1.00	1.00
	Replace culverts	1.00	0.00	1.00	0.00	0.25	1.00	0.25	0.25	0.25	0.25	0.00	1.00	0.00	0.00	0.00	1.00	0.25	0.25	0.25	1.00	0.00	0.00	0.00	0.00
2. Livestock management																									
	Improve grazing management	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Move feedlots	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
	Riparian fencing	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Off-site watering	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
3. Riparian restoration																									
	Riparian plantings	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Stabilize streambank erosion	1.00	1.00	1.00	1.00	0.25	0.00	0.00	0.00	0.25	0.25	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0.25	1.00	1.00	0.00	1.00	1.00
	CREP (or related) programs	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Riparian thinning	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Riparian species alteration	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	0.00	0.00
	LWD maintenance program	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	1.00	0.00	1.00	1.00
4. Meadow restoration																									
	Restore wet meadows	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	0.00	1.00	1.00	0.25	0.25	0.25	1.00	0.00	0.00	1.00	1.00
5. Instream restoration																									
	Relocate channelized stream	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Remove channel confinement	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Reconnect floodplain	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	1.00	1.00
	Add channel structure	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	1.00	0.00	1.00	1.00
6. Irrigation management																									
	Restore instream flows	0.00	1.00	0.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	0.00	1.00	0.00	0.00	1.00	0.00	0.25	0.25	0.25	1.00	0.00	0.00	*	*
7. Recreation management																									
	Relocate riparian recreational sites	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	0.00	0.00
	Limit motorized use within riparian zone	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	0.00	0.00
	Limit non-motorized recreational activites	1.00	1.00	1.00	1.00	0.25	1.00	0.25	0.25	0.25	0.25	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	1.00	1.00	0.00	0.00	0.00
8. Fish passage restoration																									
	Remove or modify barriers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8-B.5. Definitions of freshwater habitat attributes shown in Table 8-B.4 (shown as attribute codes there). The attributes are applied in EDT analysis.

Attribute code	Attribute name	Definition
BdScour	Bed scour	Average depth and frequency of bed scour of small-cobble/gravel substrates of pool-tail outs, glides, and riffles during high flow events.
BenComRch	Benthos diversity and production	Measure of the diversity and production of the benthos community.
ConfineHydro	Confinement - Hydromodifications	The extent that man-made structures within or adjacent to the stream channel constrict flow (as at bridges) or restrict flow access to the stream's floodplain (due to streamside roads, revetments, diking or levees) or the extent that the channel has been ditched or channelized.
DisOxy	Dissolved oxygen	Average dissolved oxygen within the water column for the specified time interval.
Emb	Embeddedness	The extent that larger cobbles or gravel are surrounded by or covered by fine sediment.
FlwDielVar	Flow - Intra daily (diel) variation	Varibility in flow level during a daily period. This attribute is informative mainly for regulated rivers or when flow patterns are influenced by storm water runoff.
FlwHigh	Flow - change in interannual variability in high flows	A measure of between year variation in magnitude of high flow levels and/or the extent of change in overall high flow level during a month relative to an undisturbed watershed of comparable size, geology, and geography.
FlwIntraAnn	Flow - intra-annual flow pattern	The average extent of intra-annual flow variation during a month -- a measure of a stream's "flashiness" during a season.
FlwLow	Flow - changes in interannual variability in low flows	A measure of between year variation in the severity of low flow discharge during a month. Variation in low flows as applied here is relative to an undisturbed watershed of comparable size, geology, and geography.
FnSedi	Fine sediment	Percentage of fine sediment within pool-tailouts and riffles.
HbOfChFctr	Habitat type - off-channel habitat factor	A multiplier used to estimate the amount of off-channel habitat based on the wetted surface area of the all combined in-channel habitat.
HbPls	Habitat type - primary pools	Percentage of the wetted channel surface area comprising pools.
Icing	Icing	Extent (magnitude and frequency) of icing events.
MscToxWat	Miscellaneous toxic pollutants - water column	The extent of miscellaneous toxic pollantants within the water column.
NutEnrch	Nutrient enrichment	The amount of nutrient enrichment consisting of such items as ammonia, nitrogen, phosphorous.
Obstr	Obstructions to fish migration	Obstructions to fish passage by physical barriers (not dewatered channels or hinderances to migration caused by pollutants or lack of oxygen).
RipFunc	Riparian function	A measure of riparian function that has been altered within the reach.

Attribute code	Attribute name	Definition
TmpMonMn	Temperature - daily minimum (by month)	Minimum water temperatures within the stream reach reach during a month.
TmpMonMx	Temperature - daily maximum (by month)	Maximum water temperatures within the stream reach reach during a month.
TmpSptVar	Temperature - spatial variation	The extent of water temperature variation within the reach as influenced by inputs of groundwater.
Turb	Turbidity	The relative extent of turbidity episodes within the stream reach.
WdDeb	Wood	The amount of wood within the reach. Note definition of "large wood" under terms/clarification.
Wdrwl	Water withdrawals	The number and relative size of water withdrawals in the stream reach.
WidthMn	Channel month Minimum width (ft)	Average width of the wetted channel. If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels.
WidthMx	Channel month Maximum width (ft)	Average width of the wetted channel during peak flow month (average monthly conditions). If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels.

Appendix 8-B

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APPENDIX 8-C
Summaries of Diagnostic Reports

This appendix consists of a series of graphic reports that give additional information about the predicted outcomes of the subbasin habitat scenarios analyzed in Chapter 8. These reports are extracted from output produced by EDT.

Summaries from three different EDT reports are provided for each salmon and steelhead population modeled. The first report—the Baseline Diagnostic Report—summarizes basic diagnostic information for each population under baseline habitat conditions within the relevant subbasin. It is based on a comparison of habitat conditions within the baseline period to the pre-development state (see Lichatowich et al. 1995). Some of this information served as the basis of parts of the diagnostic summaries described in Section 8 of this report. The baseline diagnostic report serves here to help illustrate—in conjunction the other reports described below—the extent that subbasin habitat factors responsible for changes in population performance are expected to be affected by the proposed habitat scenarios. It shows the relative extent that population performance has been affected by habitat changes (due to land and water uses) within each individual stream reach or geographic area within the subbasin.[20] One aspect of the report displays the potential benefits of full restoration or full protection (i.e., avoiding future habitat degradation) for each stream reach or geographic area. This report (together with a more detailed presentation in the full EDT output) summarizes the limiting factors analysis produced by the EDT model.

The second report—the Scenario Profile Report—summarizes the extent of changes to the habitat factors expected to result from a habitat action scenario once implemented within a subbasin. It identifies the relative gain (or loss in some cases) in population performance that would occur as a result of the scenario's effect within the subbasin. The extent of changes to population performance are shown for the scenario's effects within each stream reach or geographic area.

The third report—the Scenario Diagnostic Report—is like the baseline diagnostic report, only instead of comparing the baseline to the pre-development state, it compares the habitat scenario to the pre-development condition. It identifies the geographic areas and habitat factors that would be expected to still be inhibiting population performance after action implementation relative to the pre-development habitat condition. The report is essentially a limiting factors analysis of the habitat as it is predicted to exist following implementation and maturation of effects of the habitat scenario. As such, it helps identify areas/factors where additional habitat actions might be considered. Hence, it can serve to further refine proposed actions as a part of future planning efforts.

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[20] / The spatial scale used in this report was defined by the individuals who did the original EDT analysis for subbasin planning. EDT stream reaches were grouped into geographic areas for the sake of simplifying the diagnosis. For definitions of stream reaches or geographic areas, see the Grande Ronde subbasin report. The information can also be obtained by retrieving the Stream Reach Editor for the Grande Ronde subbasin at http://edt.jonesandstokes.com/index.jsp

Each report consists of two figures. The first one is a "tornado chart" displaying the potential benefits from restoration or protection actions—or in the case of the Scenario Profile Report the relative gain/loss of the habitat scenario. The charts show an assigned level of benefit, listed as A through E, where A areas are those the greatest amount of benefit and D and E provide essentially no benefit. The charts also show the expectation of amount of benefit/loss in population performance as the percentage of increase or decrease in a particular performance measure. (See Chapter 8 for definitions of performance measures.)

Each tornado chart is followed by a second figure giving a summary of the diagnostics for the various habitat factors affecting survival within each stream reach or geographic area. This chart summarizes where and what factors are most responsible for the loss in population performance. For the Scenario Profile Report, it shows the relative extent that each factor is expected to be affected by the scenario as pertaining to population performance. The chart is meant only to be a summary snapshot of the effects of each factor (or the effects on each factor for the Scenario Profile Report).

Results for the habitat scenario consisting of all subbasin habitat actions at 100 years are presented. The results are given with an Attribute Scalar of 25% assigned. See Chapter 8 for an explanation of the Attribute Scalar.

The order in which the reports are presented is as follows:

Species	Population
Spring Chinook	Wenaha River
	Wallowa and Lostine Rivers
	Minam River
	Lookingglass Creek
	Catherine Creek
	Upper Grande Ronde River
Summer steelhead	Joseph Creek
	Lower Grande Ronde River
	Wallowa River
	Upper Grande Ronde River

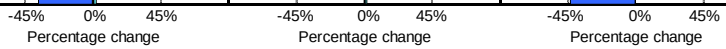
Wenaha River Spring Chinook
Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Wenaha River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	A	2	A	1						
Lower Wenaha R	A	4	C	3						
Upper Wenaha R	A	1	C	2						
Wenaha misc tribs	B	5	D	4						
Wenaha Forks	A	2	D	4						



Baseline Diagnostic Report – Diagnostic Summary

Wenaha River Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	◯	◯					•		●					•				●
Lower Wenaha R	◯	∘																•
Upper Wenaha R	◯																	
Wenaha misc tribs	○																	
Wenaha Forks	◯																	

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wenaha River Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	D	1	C	1						
Lower Wenaha R	E	2	E	2						
Upper Wenaha R	E	2	E	2						
Wenaha misc tribs	E	2	E	2						
Wenaha Forks	E	2	E	2						

-5% 0% 5%
Percentage change

-5% 0% 5%
Percentage change

-5% 0% 5%
Percentage change

Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Wenaha River Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1		o																o
Lower Wenaha R																		
Upper Wenaha R																		
Wenaha misc tribs																		
Wenaha Forks																		

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
○ High	○ Medium	o Low	Indirect or General
●	●	•	

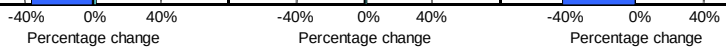
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wenaha River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	A	2	A	1						
Lower Wenaha R	A	4	D	4						
Upper Wenaha R	A	1	C	2						
Wenaha misc tribs	B	5	D	4						
Wenaha Forks	A	2	D	4						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Wenaha River Spring Chinook
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	◯	◯					•		●					•				●
Lower Wenaha R	◯																	•
Upper Wenaha R	◯																	
Wenaha misc tribs	○																	
Wenaha Forks	◯																	

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

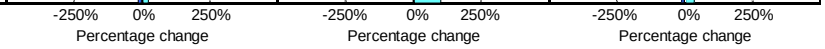
Wallowa and Lostine Rivers Spring Chinook Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Wallowa-Lostine Rivers Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	7	D	12						
Lower Grnd Rnd R 2	B	5	C	8						
Lower Wallowa R	B	4	C	7						
Mid Wallowa R	A	2	B	4						
Lower Bear Cr (Wallowa)	C	8	C	6						
Upper Bear Cr (Wallowa)	C	6	D	9						
Lower Lostine R	A	1	A	2						
Upper Lostine R	A	3	D	11						
Upper Wallowa R	B	5	A	1						
Spring Cr (Wallowa)	D	10	D	9						
Hurricane Cr	D	11	B	3						
Prairie Cr (Wallowa)	C	8	B	5						



Baseline Diagnostic Report – Diagnostic Summary

Wallowa-Lostine Rivers Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○								•					•				•
Lower Grnd Rnd R 2	◯	○							•					•	•			●
Lower Wallowa R	◯	○					•		•					•				●
Mid Wallowa R	◯	◯					•		●				•	•	•	•		●
Lower Bear Cr (Wallowa)	○	○					•	•	●		●		•	•	•	●		●
Upper Bear Cr (Wallowa)	○				•				●					•	●	●		•
Lower Lostine R	◯	◯					•	•	●		●			•	•	●		●
Upper Lostine R	◯				•				●					•		•		•
Upper Wallowa R	◯	◯			•		•	•	●		●	•	•	•	●	●	•	●
Spring Cr (Wallowa)					•			•	●			•	•	•	•	●		●
Hurricane Cr		◯	•		•		•	•	●		●	•	•	•	●	●		●
Prairie Cr (Wallowa)	○	◯			•		•	•	●		•	•	•	•	●	●		●

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

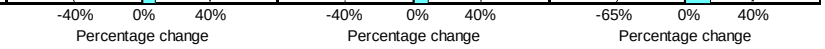
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wallowa-Lostine Rivers Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	3	D	10						
Lower Grnd Rnd R 2	E	2	D	12						
Lower Wallowa R	E	3	C	7						
Mid Wallowa R	E	3	A	1						
Lower Bear Cr (Wallowa)	E	3	C	5						
Upper Bear Cr (Wallowa)	E	3	C	7						
Lower Lostine R	E	3	A	2						
Upper Lostine R	E	3	D	10						
Upper Wallowa R	E	3	A	2						
Spring Cr (Wallowa)	E	3	C	5						
Hurricane Cr	B	1	C	9						
Prairie Cr (Wallowa)	E	3	B	4						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Wallowa-Lostine Rivers Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		
Lower Grnd Rnd R 2																		
Lower Wallowa R		○																○
Mid Wallowa R		◯					○		○						○	○		◯
Lower Bear Cr (Wallowa)		○							○		◯					○		◯
Upper Bear Cr (Wallowa)		○							○									
Lower Lostine R		◯							○		◯					○		◯
Upper Lostine R									○									
Upper Wallowa R		◯					○		◯		◯	○			◯	◯		◯
Spring Cr (Wallowa)		○							○			○	○		○	◯		◯
Hurricane Cr	●	○					○		◯		◯				◯	◯		◯
Prairie Cr (Wallowa)		◯							◯		○				◯	◯		◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

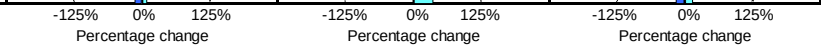
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wallowa-Lostine Rivers Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	E	10	E	12						
Lower Grnd Rnd R 2	A	4	C	6						
Lower Wallowa R	A	4	C	6						
Mid Wallowa R	A	1	B	3						
Lower Bear Cr (Wallowa)	C	9	D	8						
Upper Bear Cr (Wallowa)	C	9	D	9						
Lower Lostine R	A	2	A	2						
Upper Lostine R	A	3	D	9						
Upper Wallowa R	A	6	A	1						
Spring Cr (Wallowa)	E	10	D	11						
Hurricane Cr	C	9	A	2						
Prairie Cr (Wallowa)	B	8	B	4						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Wallowa-Lostine Rivers Spring Chinook
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1									•					•				•
Lower Grnd Rnd R 2	◯	∘							•					•	•			●
Lower Wallowa R	◯	∘					•		•					•				●
Mid Wallowa R	◯	○					•		•					•		•		●
Lower Bear Cr (Wallowa)	∘						•	•	●				•	•	•	●		●
Upper Bear Cr (Wallowa)	∘				•				●					•	•	●		•
Lower Lostine R	◯	◯					•	•	●					•	•	●		⬤
Upper Lostine R	◯				•				•					•		•		•
Upper Wallowa R	◯	◯			•				•				•	•	⬤	●		●
Spring Cr (Wallowa)					•			•	•				•	•	•	●		●
Hurricane Cr	∘	◯			•		•	•	●				•	•	⬤	●		●
Prairie Cr (Wallowa)	○	○			•				•				•	•	●	●		●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

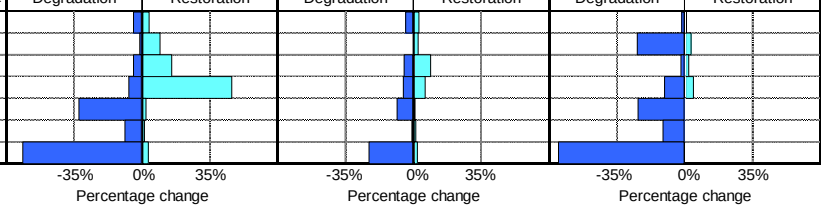
Minam River Spring Chinook
Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Minam River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	7	C	4						
Lower Grnd Rnd R 2	C	6	C	3						
Lower Wallowa R	C	5	B	2						
Lower Minam R	C	3	A	1						
Mid Minam R	B	2	D	6						
Little Minam	C	4	D	6						
Upper Minam	A	1	C	5						



Baseline Diagnostic Report – Diagnostic Summary

Minam River Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○							•					•				•
Lower Grnd Rnd R 2	○	○							•					•	•			●
Lower Wallowa R	○	◯					•		●					•	•			●
Lower Minam R	○	◯							•						●			⬤
Mid Minam R	◯																	●
Little Minam	○																	●
Upper Minam	◯	○																●

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

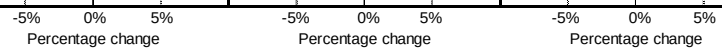
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Minam River Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	D	3	E	3						
Lower Grnd Rnd R 2	D	2	E	4						
Lower Wallowa R	D	3	C	1						
Lower Minam R	C	1	C	1						
Mid Minam R	D	3	E	5						
Little Minam	D	3	E	5						
Upper Minam	D	3	E	5						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Minam River Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		
Lower Grnd Rnd R 2																		
Lower Wallowa R		○																○
Lower Minam R	●	○													○			◯
Mid Minam R																		
Little Minam																		
Upper Minam																		

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

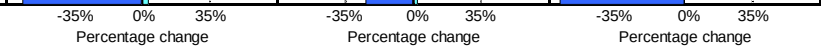
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Minam River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	7	C	4						
Lower Grnd Rnd R 2	C	6	C	3						
Lower Wallowa R	C	4	B	2						
Lower Minam R	C	3	A	1						
Mid Minam R	B	2	D	6						
Little Minam	C	4	D	6						
Upper Minam	A	1	C	5						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Minam River Spring Chinook

Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○							•					•				•
Lower Grnd Rnd R 2	○	○							•					•	•			●
Lower Wallowa R	○	◯					•		●					•				●
Lower Minam R	○	◯							•						●			⬤
Mid Minam R	◯																	●
Little Minam	○																	●
Upper Minam	◯	○																●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

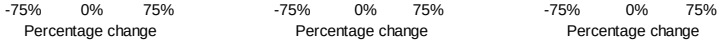
Lookingglass Creek Spring Chinook Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Lookingglass Creek Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	5	C	5						
Lower Grnd Rnd R 2	A	1	A	1						
Mid Grnd Rnd R 1	C	4	D	6						
Lower Lookglass Cr	B	2	B	2						
Little Lookglass Cr	C	5	C	4						
Upper Lookglass Cr	B	2	B	3						



Baseline Diagnostic Report – Diagnostic Summary

Lookingglass Creek Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○							●					●				⬤
Lower Grnd Rnd R 2	◯	◯							●					●	●			⬤
Mid Grnd Rnd R 1	○						●		●						●			⬤
Lower Lookglass Cr	◯	◯					●		⬤					●		●		⬤
Little Lookglass Cr	○	○					●		⬤						●			⬤
Upper Lookglass Cr	◯	◯							⬤						●			⬤

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
⬤	●	●	

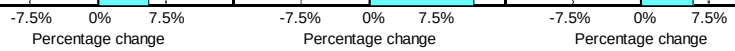
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Lookingglass Creek Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	2	D	5						
Lower Grnd Rnd R 2	E	1	E	6						
Mid Grnd Rnd R 1	E	2	C	4						
Lower Lookglass Cr	E	2	B	1						
Little Lookglass Cr	E	2	B	3						
Upper Lookglass Cr	E	2	B	1						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Lookingglass Creek Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		
Lower Grnd Rnd R 2																		
Mid Grnd Rnd R 1		○							○						○			◯
Lower Lookglass Cr		◯					○		◯							○		◯
Little Lookglass Cr		◯							◯						○			◯
Upper Lookglass Cr		◯							○						○			◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

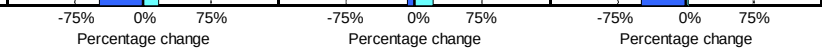
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Lookingglass Creek Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	6	B	5						
Lower Grnd Rnd R 2	A	1	A	1						
Mid Grnd Rnd R 1	C	5	D	6						
Lower Lookglass Cr	A	2	B	2						
Little Lookglass Cr	B	4	B	4						
Upper Lookglass Cr	A	3	B	3						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Lookingglass Creek Spring Chinook
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Lower Grnd Rnd R 1	○	○							•					•				●
Lower Grnd Rnd R 2	◯	◯							•					•	•			●
Mid Grnd Rnd R 1	○								•									●
Lower Lookglass Cr	◯	○					•		●					•		•		●
Little Lookglass Cr	○	○							●									●
Upper Lookglass Cr	◯	○							•									●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

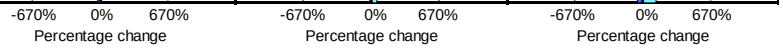
Catherine Creek Spring Chinook
Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Catherine Creek Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	7	D	9						
Lower Grnd Rnd R 2	B	3	C	6						
Mid Grnd Rnd R 1	D	9	D	12						
Mid Grnd Rnd R 2	C	6	C	7						
Lower Indian Cr	C	8	A	2						
Upper Indian Cr	B	2	D	9						
Mid Grnd Rnd R 3	E	10	D	11						
Lower Catherine Cr	E	11	B	3						
Mid Catherine Cr	B	4	A	1						
Mid Catherine tribs	E	11	C	7						
SF Catherine Cr	B	4	C	5						
NF Caterine Cr.	B	1	B	4						



Baseline Diagnostic Report – Diagnostic Summary

Catherine Creek Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○								•					•				•
Lower Grnd Rnd R 2	◯	○							•					•	•			●
Mid Grnd Rnd R 1									•						•			●
Mid Grnd Rnd R 2	○	○					•		•					•	•	•		●
Lower Indian Cr	○	◯					•		●			•			•	●		●
Upper Indian Cr	◯								•			•						●
Mid Grnd Rnd R 3							•		●					•	•	•		●
Lower Catherine Cr		◯					•		●		●		•	•	●	•		
Mid Catherine Cr	○	◯					•	•	●		●			•	•	●		●
Mid Catherine tribs		○					•		●						●	●		●
SF Catherine Cr	○	○							•						●			•
NF Caterine Cr.	◯	◯					•		●						●	•		●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

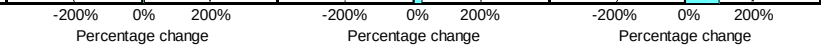
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Catherine Creek Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	2	E	11						
Lower Grnd Rnd R 2	E	1	E	12						
Mid Grnd Rnd R 1	E	2	E	10						
Mid Grnd Rnd R 2	E	2	D	6						
Lower Indian Cr	E	2	B	2						
Upper Indian Cr	E	2	E	8						
Mid Grnd Rnd R 3	E	2	E	9						
Lower Catherine Cr	E	2	B	3						
Mid Catherine Cr	E	2	A	1						
Mid Catherine tribs	E	2	D	7						
SF Catherine Cr	E	2	C	5						
NF Caterine Cr.	E	2	C	4						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Catherine Creek Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		
Lower Grnd Rnd R 2																		
Mid Grnd Rnd R 1									○						○			◯
Mid Grnd Rnd R 2									○						○	○		◯
Lower Indian Cr		◯					○		◯			○			○	◯		◯
Upper Indian Cr												○						○
Mid Grnd Rnd R 3							○		◯						○			◯
Lower Catherine Cr		◯					○		◯		◯				◯	○		◯
Mid Catherine Cr		◯					○		◯		◯				○	◯		◯
Mid Catherine tribs							○		◯						◯	◯		
SF Catherine Cr		○							○						◯			○
NF Caterine Cr.		○					○		◯						◯	○		◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

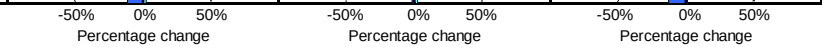
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Catherine Creek Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	D	8	D	6						
Lower Grnd Rnd R 2	C	6	C	5						
Mid Grnd Rnd R 1	D	10	E	11						
Mid Grnd Rnd R 2	C	5	D	6						
Lower Indian Cr	C	6	B	2						
Upper Indian Cr	E	12	E	12						
Mid Grnd Rnd R 3	D	8	C	4						
Lower Catherine Cr	B	2	B	3						
Mid Catherine Cr	A	1	A	1						
Mid Catherine tribs	D	10	E	10						
SF Catherine Cr	C	3	D	8						
NF Caterine Cr.	C	4	D	8						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Catherine Creek Spring Chinook

Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1									•					•				•
Lower Grnd Rnd R 2	○	○							•					•	•			●
Mid Grnd Rnd R 1									•									●
Mid Grnd Rnd R 2	○								•					•		•		●
Lower Indian Cr	○	◯							•						•	●		●
Upper Indian Cr																		●
Mid Grnd Rnd R 3		○							•					•				●
Lower Catherine Cr	◯	◯							•					•				
Mid Catherine Cr	◯	◯												•		•		●
Mid Catherine tribs									•						•	●		●
SF Catherine Cr	○														•			•
NF Caterine Cr.	○								•							•		●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ ● High	○ ● Medium	○ • Low	Indirect or General

1/ "Channel stability" applies to freshwater areas only.

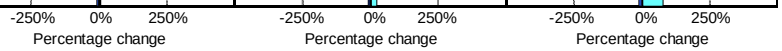
Upper Grande Ronde River Spring Chinook Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Upper Grande Ronde River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	7	E	14						
Lower Grnd Rnd R 2	C	6	E	15						
Mid Grnd Rnd R 1	D	12	E	17						
Mid Grnd Rnd R 2	D	11	E	16						
Mid Grnd Rnd R 3	D	13	C	10						
Mid Grnd Rnd R 4	B	3	A	1						
Mid Grnd Rnd tribs 4	D	13	B	6						
Lower Meadow Cr	D	13	B	5						
McCoy Cr	D	13	C	10						
Upper Meadow Cr	D	13	C	8						
Upper Grnd Rnd R 1	A	2	A	2						
Fly Cr	C	9	B	4						
Sheep Cr (GR)	B	4	B	3						
Limber Jim Cr	C	9	D	13						
Upper Grnd Rnd R 2	A	1	B	7						
Clear Cr (GR)	C	8	C	8						
Upper Grnd Rnd R 3	C	5	C	12						



Baseline Diagnostic Report – Diagnostic Summary

Upper Grande Ronde River Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○								•					•				
Lower Grnd Rnd R 2	○													•				
Mid Grnd Rnd R 1									•									•
Mid Grnd Rnd R 2									•					•	•			●
Mid Grnd Rnd R 3		○					•		●		●			•	•	•		◯
Mid Grnd Rnd R 4	○	◯					•		●		●			•	•	●		◯
Mid Grnd Rnd tribs 4		○							•			•			●	•		●
Lower Meadow Cr		○					•		•			•			●	●		•
McCoy Cr		○					•		●			•			●	●		●
Upper Meadow Cr		○					•		•			•			●	●		•
Upper Grnd Rnd R 1	◯	◯					•		●						●	●		●
Fly Cr	○	○					•		•						●	●		•
Sheep Cr (GR)	○	○							•		•				●	●		•
Limber Jim Cr	○								•		•				●	•		●
Upper Grnd Rnd R 2	◯	○					•		•						●	•		●
Clear Cr (GR)	○	○							•						●			●
Upper Grnd Rnd R 3	○	○					•		●						●			●

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

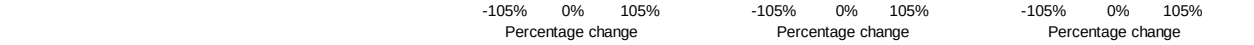
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Spring Chinook

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	17	D	12						
Lower Grnd Rnd R 2	E	17	E	17						
Mid Grnd Rnd R 1	E	17	D	13						
Mid Grnd Rnd R 2	E	17	D	14						
Mid Grnd Rnd R 3	E	17	B	3						
Mid Grnd Rnd R 4	E	17	A	1						
Mid Grnd Rnd tribs 4	E	17	D	11						
Lower Meadow Cr	E	17	D	10						
McCoy Cr	E	17	D	8						
Upper Meadow Cr	E	17	C	6						
Upper Grnd Rnd R 1	E	17	A	1						
Fly Cr	E	17	E	15						
Sheep Cr (GR)	E	17	D	8						
Limber Jim Cr	E	17	E	16						
Upper Grnd Rnd R 2	E	17	B	3						
Clear Cr (GR)	E	17	C	5						
Upper Grnd Rnd R 3	E	17	C	6						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Spring Chinook
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		
Lower Grnd Rnd R 2																		
Mid Grnd Rnd R 1																		○
Mid Grnd Rnd R 2															○			◯
Mid Grnd Rnd R 3		○					○		○		○				○	○		◯
Mid Grnd Rnd R 4		◯					○		○		○				○	◯		◯
Mid Grnd Rnd tribs 4									○						○			○
Lower Meadow Cr									○						○	◯		○
McCoy Cr									○						○	◯		○
Upper Meadow Cr		○							○						○	◯		
Upper Grnd Rnd R 1		◯					○		○						○	◯		◯
Fly Cr																○		
Sheep Cr (GR)											○							
Limber Jim Cr											○							
Upper Grnd Rnd R 2		○							○						○	○		◯
Clear Cr (GR)		○													○			○
Upper Grnd Rnd R 3		○							○						○			◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

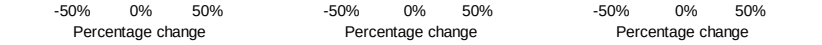
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	14	D	14						
Lower Grnd Rnd R 2	C	14	D	15						
Mid Grnd Rnd R 1	C	14	E	17						
Mid Grnd Rnd R 2	C	14	D	16						
Mid Grnd Rnd R 3	A	3	B	8						
Mid Grnd Rnd R 4	A	1	A	1						
Mid Grnd Rnd tribs 4	B	4	B	7						
Lower Meadow Cr	B	7	A	3						
McCoy Cr	B	8	A	4						
Upper Meadow Cr	C	13	C	9						
Upper Grnd Rnd R 1	A	2	A	6						
Fly Cr	B	8	A	5						
Sheep Cr (GR)	B	4	A	2						
Limber Jim Cr	D	15	C	10						
Upper Grnd Rnd R 2	B	4	C	12						
Clear Cr (GR)	B	9	C	12						
Upper Grnd Rnd R 3	B	9	C	11						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Spring Chinook
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○								•					•				
Lower Grnd Rnd R 2	○													•				
Mid Grnd Rnd R 1	○																	
Mid Grnd Rnd R 2	○													•				●
Mid Grnd Rnd R 3	◯	○							•					•				●
Mid Grnd Rnd R 4	◯	◯												•		●		●
Mid Grnd Rnd tribs 4	○	○							•						●	•		●
Lower Meadow Cr	○	◯					•		•						●	●		•
McCoy Cr	○	◯					•		●			•			●	●		●
Upper Meadow Cr	○	○					•		•						●	●		
Upper Grnd Rnd R 1	◯	◯							•						•	●		●
Fly Cr	○	◯							•						●	●		•
Sheep Cr (GR)	○	◯							•						●	●		•
Limber Jim Cr		○							•						●	•		●
Upper Grnd Rnd R 2	○	○					•		•						●	•		●
Clear Cr (GR)	○	○							•						●			●
Upper Grnd Rnd R 3	○	○							●						●			●

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

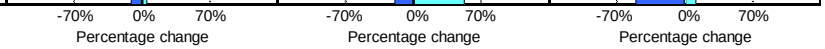
Joseph Creek Summer Steelhead
Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Joseph Creek Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	6	C	9						
Lower Joseph Cr	B	5	B	2						
Cottonwd Cr (Joseph)	B	3	B	7						
Joseph misc tribs	C	8	C	8						
Swamp Cr (Joseph)	B	4	B	5						
Upper Joseph Cr	C	7	B	3						
Crow Cr (Joseph)	C	9	B	6						
Lower Chesnimnus Cr	B	2	A	1						
Upper Chesnimnus Cr	A	1	B	3						



Baseline Diagnostic Report – Diagnostic Summary

Joseph Creek Summer Steelhead
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○					•		●									•
Lower Joseph Cr	◯	◯							•				●	•	⬤	•		•
Cottonwd Cr (Joseph)	◯	◯											•		⬤			●
Joseph misc tribs	○	○					•						●		●	•		⬤
Swamp Cr (Joseph)	◯	◯					•		•				●		●	•		●
Upper Joseph Cr	○	◯					•		•				●	•	●	●		●
Crow Cr (Joseph)	○	◯					•		•				●		⬤	●		●
Lower Chesnimnus Cr	◯	⬤					•		•				●		●	●		●
Upper Chesnimnus Cr	⬤	◯					•		•				•		●	•		●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ ● High	○ ● Medium	○ • Low	Indirect or General

1/ "Channel stability" applies to freshwater areas only.

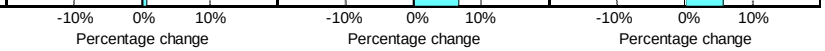
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Joseph Creek Summer Steelhead

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	9	E	8						
Lower Joseph Cr	E	9	E	7						
Cottonwd Cr (Joseph)	E	9	B	2						
Joseph misc tribs	E	9	E	8						
Swamp Cr (Joseph)	E	9	C	6						
Upper Joseph Cr	E	9	C	5						
Crow Cr (Joseph)	E	9	C	4						
Lower Chesnimnus Cr	E	9	B	1						
Upper Chesnimnus Cr	E	9	B	2						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Joseph Creek Summer Steelhead
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1																		○
Lower Joseph Cr															○			
Cottonwd Cr (Joseph)		◯													◯			○
Joseph misc tribs																		
Swamp Cr (Joseph)		○													○			
Upper Joseph Cr		○											○		○	◯		○
Crow Cr (Joseph)		○													○	○		○
Lower Chesnimnus Cr		◯													○	○		○
Upper Chesnimnus Cr		◯													○			○

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ ● High	○ ● Medium	○ • Low	Indirect or General

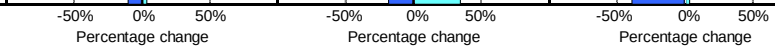
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Joseph Creek Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	C	9	C	9						
Lower Joseph Cr	B	7	B	2						
Cottonwd Cr (Joseph)	B	3	B	6						
Joseph misc tribs	B	7	C	8						
Swamp Cr (Joseph)	B	4	B	4						
Upper Joseph Cr	B	4	B	3						
Crow Cr (Joseph)	B	6	B	5						
Lower Chesnimnus Cr	A	2	A	1						
Upper Chesnimnus Cr	A	1	B	7						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Joseph Creek Summer Steelhead
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○					•		●									•
Lower Joseph Cr	◯	◯							•				●	•	●	•		•
Cottonwd Cr (Joseph)	◯	◯											•		⬤			●
Joseph misc tribs	◯	○					•						●		●	•		⬤
Swamp Cr (Joseph)	◯	◯					•						●		●	•		●
Upper Joseph Cr	◯	◯					•		•				●	•	●	●		●
Crow Cr (Joseph)	◯	◯					•		•				●		●	•		●
Lower Chesnimnus Cr	◯	◯					•		•				●		●	•		●
Upper Chesnimnus Cr	◯	◯					•						•		•	•		●

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

A	B	C	D & E
◯ High	○ Medium	○ Low	Indirect or General
●	●	•	

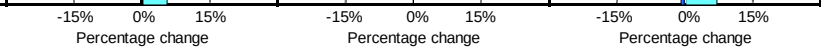
Lower Grande Ronde River Summer Steelhead Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Lower Grande Ronde River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	B	6	B	5						
Lower Joseph Cr	D	13	D	15						
Lower Grnd Rnd tribs 1	C	11	A	1						
Lower Wenaha R	A	4	C	13						
Crooked (Wenaha)	B	5	C	11						
Wenaha misc tribs	A	2	D	14						
Upper Wenaha R	A	2	B	6						
Wenaha Forks	A	1	C	11						
Lower Grnd Rnd R 2	D	13	B	10						
Courtney Cr	C	11	B	6						
Lower Mud Cr	C	9	A	3						
Upper Mud Cr	B	7	A	2						
Wildcat Cr	B	7	A	3						
Lower Grnd Rnd tribs 2	C	9	B	9						
Grossman Cr	D	13	B	8						



Baseline Diagnostic Report – Diagnostic Summary

Lower Grande Ronde River Summer Steelhead
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○			•		•		●				●	•	•			●
Lower Joseph Cr									•						•			●
Lower Grnd Rnd tribs 1	∘	◯					•		•				•		⬤	●		●
Lower Wenaha R	◯	∘													•			•
Crooked (Wenaha)	○	∘													•			•
Wenaha misc tribs	◯																	
Upper Wenaha R	◯	○																
Wenaha Forks	◯	∘																
Lower Grnd Rnd R 2		○			•		•		•				●	•	•	•		
Courtney Cr	∘	○					•		•				•		●	•		●
Lower Mud Cr	∘	◯					•		•				•		●	●		⬤
Upper Mud Cr	○	◯					•		•				•		●	●		⬤
Wildcat Cr	○	◯					•		•				•		●	●		●
Lower Grnd Rnd tribs 2	∘	○					•		•				•		●	•		⬤
Grossman Cr		○					•		•				•		•	●		⬤

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Lower Grande Ronde River Summer Steelhead

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	E	5	C	1						
Lower Joseph Cr	E	3	E	7						
Lower Grnd Rnd tribs 1	E	4	E	6						
Lower Wenaha R	E	5	E	11						
Crooked (Wenaha)	E	5	E	11						
Wenaha misc tribs	E	5	E	11						
Upper Wenaha R	E	5	E	11						
Wenaha Forks	E	5	E	11						
Lower Grnd Rnd R 2	E	2	E	8						
Courtney Cr	E	1	E	5						
Lower Mud Cr	E	5	E	3						
Upper Mud Cr	E	5	E	4						
Wildcat Cr	E	5	C	2						
Lower Grnd Rnd tribs 2	E	5	E	10						
Grossman Cr	E	5	E	9						

-5% 0% 5% Percentage change

-5% 0% 5% Percentage change

-5% 0% 5% Percentage change

Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Lower Grande Ronde River Summer Steelhead
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1		○																○
Lower Joseph Cr																		
Lower Grnd Rnd tribs 1																		
Lower Wenaha R																		
Crooked (Wenaha)																		
Wenaha misc tribs																		
Upper Wenaha R																		
Wenaha Forks																		
Lower Grnd Rnd R 2																		
Courtney Cr																		
Lower Mud Cr																		
Upper Mud Cr																		
Wildcat Cr		○																
Lower Grnd Rnd tribs 2																		
Grossman Cr																		

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
○ High	○ Medium	○ Low	Indirect or General
●	●	●	

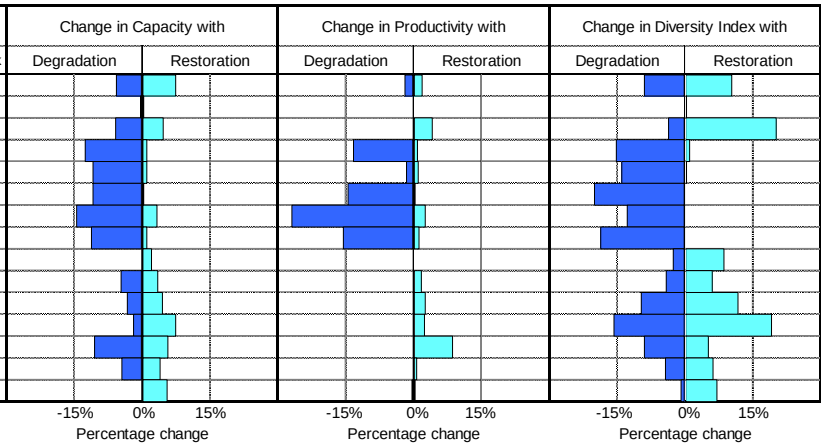
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Lower Grande Ronde River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	B	6	B	5						
Lower Joseph Cr	E	15	D	15						
Lower Grnd Rnd tribs 1	C	11	A	1						
Lower Wenaha R	A	4	C	13						
Crooked (Wenaha)	B	5	C	11						
Wenaha misc tribs	A	2	D	14						
Upper Wenaha R	A	2	B	6						
Wenaha Forks	A	1	C	11						
Lower Grnd Rnd R 2	D	13	B	10						
Courtney Cr	C	11	B	6						
Lower Mud Cr	C	9	A	4						
Upper Mud Cr	B	8	A	2						
Wildcat Cr	B	7	A	3						
Lower Grnd Rnd tribs 2	C	9	B	9						
Grossman Cr	D	13	B	6						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Lower Grande Ronde River Summer Steelhead
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○			•		•		●				•	•				•
Lower Joseph Cr									•						•			●
Lower Grnd Rnd tribs 1	∘	◯					•		•				•		⬤	●		●
Lower Wenaha R	◯	∘													•			•
Crooked (Wenaha)	○	∘													•			•
Wenaha misc tribs	◯																	
Upper Wenaha R	◯	○																
Wenaha Forks	◯	∘																
Lower Grnd Rnd R 2		○			•		•		•				●	•	•	•		
Courtney Cr	∘	○					•		•				•		●	•		●
Lower Mud Cr	∘	◯					•		•				•		●	●		⬤
Upper Mud Cr	○	◯					•		•				•		●	●		⬤
Wildcat Cr	○	◯					•		•				•		●	●		●
Lower Grnd Rnd tribs 2	∘	○					•		•				•		●	•		⬤
Grossman Cr		○					•		•				•		•	●		⬤

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	•	•	

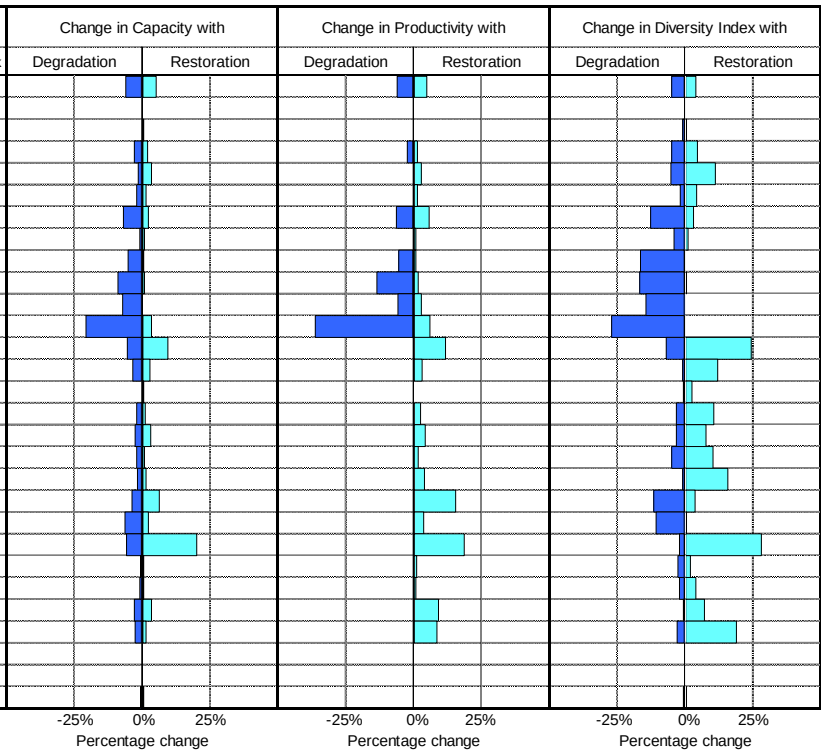
Wallowa River Summer Steelhead
Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Wallowa River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit	
	Category/rank		Category/rank	
Lower Grnd Rnd R 1	B	6	B	7
Wildcat Cr	E	27	E	27
Lower Grnd Rnd tribs 2	E	24	E	26
Lower Grnd Rnd R 2	C	9	C	15
Lower Wallowa R	D	15	B	10
Lower Wallowa tribs	D	19	C	17
Lower Minam R	B	3	B	11
Lower Minam tribs	D	15	D	22
Mid Minam tribs	B	5	E	25
Mid Minam R	B	2	D	20
Little Minam	B	4	C	18
Upper Minam	A	1	B	12
Mid Wallowa R	C	9	A	2
Deer Cr (Wallowa)	D	18	B	9
Mid Wallowa tribs	E	25	D	23
Rock Cr (Wallowa)	D	14	C	13
Lower Bear Cr (Wallowa)	C	12	B	6
Upper Bear Cr (Wallowa)	C	11	C	14
Whiskey Cr (Wallowa)	D	22	B	7
Lower Lostine R	C	8	B	5
Upper Lostine R	C	7	C	15
Upper Wallowa R	C	12	A	1
Spring Cr (Wallowa)	D	19	C	18
Upper Wallowa tribs	D	22	C	19
Hurricane Cr	D	19	B	4
Prairie Cr (Wallowa)	D	17	B	3
Wallowa Lake	E	27	E	27
Wallowa above lake	E	27	E	27
Mid Grnd Rnd R 1	E	26	E	24



Baseline Diagnostic Report – Diagnostic Summary

Wallowa River Summer Steelhead
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○							•					•				●
Wildcat Cr							•		•						•	•		•
Lower Grnd Rnd tribs 2									•									
Lower Grnd Rnd R 2	∘	∘			•				•				•	•	•			
Lower Wallowa R		○			•		•		●				●	●	•			●
Lower Wallowa tribs		∘			•		•		•				•	•	•			●
Lower Minam R	○	○					•		•					•	●			●
Lower Minam tribs							•		•									●
Mid Minam tribs	○																	•
Mid Minam R	○													•				●
Little Minam	○	∘																•
Upper Minam	◯	○																•
Mid Wallowa R	∘	◯			•		•		•				●	●	●	•		●
Deer Cr (Wallowa)		○			•		•		•		●		•	•	●			●
Mid Wallowa tribs					•		●		●				•	•	●	●		●
Rock Cr (Wallowa)		∘			•		•		•		●		•	•	●	●		●
Lower Bear Cr (Wallowa)	∘	○			•		•		•				•	•	●	●		●
Upper Bear Cr (Wallowa)	∘	∘			•		•		•				•	•	●	•		●
Whiskey Cr (Wallowa)		○			•		•		●				•	•	●	●		●
Lower Lostine R	∘	○			•		•		•				•	●		●		●
Upper Lostine R	∘	∘			•								•	•		•		
Upper Wallowa R	∘	◯			•		•		•		●		●	●	●	●	•	●
Spring Cr (Wallowa)		∘			●				•				•	•	•	●		●
Upper Wallowa tribs		∘			•		•		•				•	•	●	●		●
Hurricane Cr		○			•		•		•		●		•	•	●	●		●
Prairie Cr (Wallowa)		○			•		•		•				•	•	●	●		•
Wallowa Lake					•				•			•	•	●				●
Wallowa above lake					•		•		•	•			•	•				●
Mid Grnd Rnd R 1									•						•			●

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

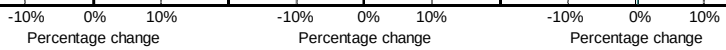
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wallowa River Summer Steelhead

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	D	10	C	9						
Wildcat Cr	D	7	D	21						
Lower Grnd Rnd tribs 2	D	9	D	21						
Lower Grnd Rnd R 2	D	5	D	21						
Lower Wallowa R	D	7	D	16						
Lower Wallowa tribs	D	10	D	18						
Lower Minam R	D	10	C	8						
Lower Minam tribs	D	10	D	17						
Mid Minam tribs	D	10	D	21						
Mid Minam R	D	10	D	21						
Little Minam	D	10	D	21						
Upper Minam	D	10	D	21						
Mid Wallowa R	D	10	B	6						
Deer Cr (Wallowa)	C	4	C	13						
Mid Wallowa tribs	B	1	D	20						
Rock Cr (Wallowa)	D	10	B	3						
Lower Bear Cr (Wallowa)	C	3	C	12						
Upper Bear Cr (Wallowa)	D	10	C	14						
Whiskey Cr (Wallowa)	D	10	B	1						
Lower Lostine R	D	10	B	4						
Upper Lostine R	D	10	C	14						
Upper Wallowa R	B	1	B	6						
Spring Cr (Wallowa)	D	10	C	9						
Upper Wallowa tribs	D	10	C	11						
Hurricane Cr	D	10	B	2						
Prairie Cr (Wallowa)	D	10	B	4						
Wallowa Lake	D	10	D	21						
Wallowa above lake	D	10	D	21						
Mid Grnd Rnd R 1	D	5	D	19						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Wallowa River Summer Steelhead
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	**Relative loss**	**Relative gain**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1		○																○
Wildcat Cr																		
Lower Grnd Rnd tribs 2																		
Lower Grnd Rnd R 2																		
Lower Wallowa R																		○
Lower Wallowa tribs																		
Lower Minam R		○													○			◯
Lower Minam tribs																		○
Mid Minam tribs																		
Mid Minam R																		
Little Minam																		
Upper Minam																		
Mid Wallowa R		◯					○		○						◯			◯
Deer Cr (Wallowa)	•	○									◯							
Mid Wallowa tribs	●														○			○
Rock Cr (Wallowa)		◯					○		○		◯		○		◯	○		◯
Lower Bear Cr (Wallowa)	•	○																◯
Upper Bear Cr (Wallowa)		○													○			○
Whiskey Cr (Wallowa)		◯					○		○				○		◯	◯		◯
Lower Lostine R		◯														○		◯
Upper Lostine R		○																
Upper Wallowa R	●	◯					○		○		◯		○		◯	○		◯
Spring Cr (Wallowa)		○			○				○				○		○	◯		◯
Upper Wallowa tribs		○					○		○				○		◯	○		◯
Hurricane Cr		◯					○		○		◯				○	○		◯
Prairie Cr (Wallowa)		◯					○		○						◯			•
Wallowa Lake																		
Wallowa above lake																		
Mid Grnd Rnd R 1									○						○			◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ ● High	○ ● Medium	○ • Low	Indirect or General

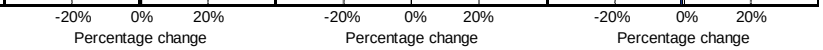
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Wallowa River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	B	6	B	4						
Wildcat Cr	E	29	E	29						
Lower Grnd Rnd tribs 2	E	26	E	28						
Lower Grnd Rnd R 2	C	11	C	11						
Lower Wallowa R	D	18	B	7						
Lower Wallowa tribs	E	24	C	17						
Lower Minam R	B	3	C	10						
Lower Minam tribs	D	20	D	21						
Mid Minam tribs	B	5	E	25						
Mid Minam R	B	2	D	19						
Little Minam	B	4	D	23						
Upper Minam	A	1	C	11						
Mid Wallowa R	C	8	A	2						
Deer Cr (Wallowa)	D	19	B	9						
Mid Wallowa tribs	E	25	D	23						
Rock Cr (Wallowa)	C	14	C	16						
Lower Bear Cr (Wallowa)	D	16	B	6						
Upper Bear Cr (Wallowa)	D	17	C	14						
Whiskey Cr (Wallowa)	C	12	C	11						
Lower Lostine R	C	9	B	5						
Upper Lostine R	C	10	C	15						
Upper Wallowa R	C	7	A	1						
Spring Cr (Wallowa)	D	20	D	21						
Upper Wallowa tribs	D	20	D	20						
Hurricane Cr	D	15	B	8						
Prairie Cr (Wallowa)	C	13	B	3						
Wallowa Lake	E	26	E	27						
Wallowa above lake	D	20	D	18						
Mid Grnd Rnd R 1	E	28	E	26						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Wallowa River Summer Steelhead
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	○	○							•					•				•
Wildcat Cr							•		•						•	•		•
Lower Grnd Rnd tribs 2									•									
Lower Grnd Rnd R 2	∘	∘			•				•				•	•	•			
Lower Wallowa R		○			•		•		•				●	●	•			•
Lower Wallowa tribs		∘			•		•		•				•	•				●
Lower Minam R	○	∘					•		•					•	●			⬤
Lower Minam tribs							•		•									⬤
Mid Minam tribs	○																	•
Mid Minam R	○													•				●
Little Minam	○																	•
Upper Minam	◯	∘																•
Mid Wallowa R	∘	◯			•		•		•				•	●	●	•		●
Deer Cr (Wallowa)		○			•		•		•				•	•	●			●
Mid Wallowa tribs					•		•		●				•	•	●	●		●
Rock Cr (Wallowa)	∘	∘			•								•	•	●	•		•
Lower Bear Cr (Wallowa)		○			•		•		•				•	•	●	●		●
Upper Bear Cr (Wallowa)		∘			•		•		•				•	•	●	•		•
Whiskey Cr (Wallowa)	∘	∘			•		•						•	•	●	•		•
Lower Lostine R	∘	○			•		•		•				•	●		●		●
Upper Lostine R	∘	∘			•								•	•		•		
Upper Wallowa R	∘	◯			•								•	●	⬤	•	•	●
Spring Cr (Wallowa)					•				•				•	•	•	•		●
Upper Wallowa tribs					•		•		•				•	•	●	●		●
Hurricane Cr		○			•		•		•				•	•	●	•		●
Prairie Cr (Wallowa)	∘	○			•		•		•				•	•	●	●		•
Wallowa Lake					•				•			•	•	●				●
Wallowa above lake					•		•		•	•			•	•				⬤
Mid Grnd Rnd R 1									•									•

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
⬤	•	•	

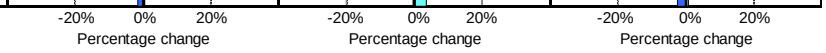
Upper Grande Ronde River Summer Steelhead Graphic Diagnostic Reports

Baseline Diagnostic Report – Tornado Chart

Upper Grande Ronde River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category	rank	Category	rank	Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	B	3	B	16						
Lower Grnd Rnd R 2	B	5	C	25						
Grossman Cr	E	39	E	40						
Lower Grnd Rnd tribs 2	E	38	E	39						
Lower Wallowa R	D	35	E	38						
Mid Grnd Rnd R 1	C	22	D	36						
Mid Grnd Rnd tribs 1	D	30	C	31						
Lower Lookglass Cr	C	11	C	23						
Little Lookglass Cr	B	6	B	12						
Upper Lookglass Cr	B	4	C	27						
Mid Grnd Rnd R 2	C	9	C	22						
Mid Grnd Rnd tribs 2	C	18	C	31						
Phillips Cr	B	2	A	5						
Lower Indian Cr	B	7	B	17						
Upper Indian Cr	B	1	C	26						
Lower Willow Cr	D	34	C	20						
Upper Willow Cr	C	16	B	10						
Mid Grnd Rnd R 3	D	31	B	18						
Lower Catherine Cr	D	35	C	34						
Lower Catherine tribs	E	39	C	29						
Mid Catherine Cr	C	12	A	4						
Mid Catherine tribs	D	28	B	14						
SF Catherine Cr	C	16	C	34						
NF Caterine Cr.	C	9	C	29						
Lower 5-points Cr	D	37	B	15						
Upper 5-points Cr	C	23	C	24						
Rock Cr (GR)	C	12	B	11						
Mid Grnd Rnd R 4	C	25	A	1						
Mid Grnd Rnd tribs 4	C	23	A	2						
Lower Meadow Cr	C	20	B	13						
McCoy Cr	D	32	A	8						
Upper Meadow Cr	C	12	A	7						
Upper Grnd Rnd R 1	C	8	A	3						
Fly Cr	D	29	A	8						
Sheep Cr (GR)	C	20	A	6						
Limber Jim Cr	D	27	C	19						
Upper Grnd Rnd R 2	C	15	C	28						
Meadowbrook Cr	D	32	D	36						
Clear Cr (GR)	C	19	C	21						
Upper Grnd Rnd R 3	D	26	C	31						



Baseline Diagnostic Report – Diagnostic Summary

Upper Grande Ronde River Summer Steelhead
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Lower Grnd Rnd R 1	High	High							Low					Low				Medium
Lower Grnd Rnd R 2	High	Medium							Low					Low	Low			
Grossman Cr																		
Lower Grnd Rnd tribs 2									Low									
Lower Wallowa R									Low					Low	Low			
Mid Grnd Rnd R 1	Medium						Low		Low				Low		Low			Medium
Mid Grnd Rnd tribs 1		Medium					Low		Low						Medium	Low		Medium
Lower Lookglass Cr	Medium	Medium					Low		Low					Low	Medium			Medium
Little Lookglass Cr	High	High					Low		Low						Medium			Medium
Upper Lookglass Cr	High	Medium												Low	Low			Medium
Mid Grnd Rnd R 2	Medium	Medium					Low		Medium				Low	Low	Medium	Medium		Medium
Mid Grnd Rnd tribs 2	Medium	Medium					Low		Low						Low	Medium		Medium
Phillips Cr	High	High					Low		Low						Medium	Medium		Medium
Lower Indian Cr	High	High					Low		Low				Low		Low	Medium		Medium
Upper Indian Cr	High	Medium													Medium			Medium
Lower Willow Cr		Medium					Low		Medium				Low	Low	Medium	Medium		Medium
Upper Willow Cr	Medium	High					Low		Low				Low			Medium		Medium
Mid Grnd Rnd R 3		High	Low				Low		Low					Low	Medium	Low		Medium
Lower Catherine Cr		Medium	Low				Low		Low				Low	Medium	Medium	Medium		
Lower Catherine tribs		Medium					Low		Low						Medium	Low	Medium	Medium
Mid Catherine Cr	Medium	High			Low		Low		Medium				Low	Low	Medium	Medium		Medium
Mid Catherine tribs		High					Low		Medium					Low	Medium	Medium	Medium	Medium
SF Catherine Cr	Medium	Medium													Medium			Low
NF Caterine Cr.	Medium	Medium													Medium	Low		Medium
Lower 5-points Cr		High					Low		Low						Medium	Medium		Medium
Upper 5-points Cr	Medium	Medium					Low		Low						Medium	Medium		Low
Rock Cr (GR)	Medium	High													Medium	Low		Medium
Mid Grnd Rnd R 4	Medium	High	Low				Low		Medium	Low			Low	Low	Medium	Medium		Medium
Mid Grnd Rnd tribs 4	Medium	High					Low		Low						Medium	Low		Medium
Lower Meadow Cr	Medium	High					Low		Low				Low		Medium	Medium		Medium
McCoy Cr		High					Low		Low						Medium	Medium		Medium
Upper Meadow Cr	Medium	High					Low		Low						Medium	Medium		Medium
Upper Grnd Rnd R 1	Medium	High					Low		Low				Low		Medium	Medium		Medium
Fly Cr		High													Medium	Low		Low
Sheep Cr (GR)	Medium	High													Medium	Medium		Medium
Limber Jim Cr		Medium													Medium			Medium
Upper Grnd Rnd R 2	Medium	Medium					Low		Low						Medium	Low		Medium
Meadowbrook Cr							Low		Low						Medium			Medium
Clear Cr (GR)	Medium	Medium													Medium			Medium
Upper Grnd Rnd R 3		Medium													Medium			Medium

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
High	Medium	Low	Indirect or General

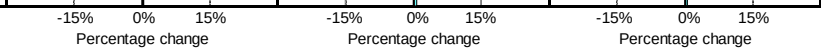
Scenario Profile Report – Tornado Chart

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Summer Steelhead

Change in Performance Due to Scenario's Effect within Geographic Area

Geographic Area	Loss category		Gain category		Loss or Gain in Capacity		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Loss	Gain	Loss	Gain	Loss	Gain
Lower Grnd Rnd R 1	D	3	D	32						
Lower Grnd Rnd R 2	D	2	E	36						
Grossman Cr	D	3	E	36						
Lower Grnd Rnd tribs 2	D	3	E	36						
Lower Wallowa R	D	3	E	36						
Mid Grnd Rnd R 1	D	3	D	29						
Mid Grnd Rnd tribs 1	D	3	C	22						
Lower Lookglass Cr	D	3	C	15						
Little Lookglass Cr	D	3	B	10						
Upper Lookglass Cr	D	3	C	28						
Mid Grnd Rnd R 2	D	3	C	24						
Mid Grnd Rnd tribs 2	D	3	C	15						
Phillips Cr	D	3	A	4						
Lower Indian Cr	D	3	B	8						
Upper Indian Cr	D	3	B	12						
Lower Willow Cr	D	3	C	20						
Upper Willow Cr	D	3	B	5						
Mid Grnd Rnd R 3	D	3	B	12						
Lower Catherine Cr	D	3	B	12						
Lower Catherine tribs	C	1	E	36						
Mid Catherine Cr	D	3	A	2						
Mid Catherine tribs	D	3	B	9						
SF Catherine Cr	D	3	C	17						
NF Caterine Cr.	D	3	B	12						
Lower 5-points Cr	D	3	C	22						
Upper 5-points Cr	D	3	C	24						
Rock Cr (GR)	D	3	B	10						
Mid Grnd Rnd R 4	D	3	A	3						
Mid Grnd Rnd tribs 4	D	3	B	6						
Lower Meadow Cr	D	3	C	18						
McCoy Cr	D	3	C	24						
Upper Meadow Cr	D	3	B	7						
Upper Grnd Rnd R 1	D	3	A	1						
Fly Cr	D	3	E	35						
Sheep Cr (GR)	D	3	E	33						
Limber Jim Cr	D	3	E	34						
Upper Grnd Rnd R 2	D	3	C	18						
Meadowbrook Cr	D	3	D	31						
Clear Cr (GR)	D	3	C	27						
Upper Grnd Rnd R 3	D	3	D	30						



Scenario Profile Report – Change in Habitat Factors Summary

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Summer Steelhead
Summary of Scenario Effects on Survival Factors and Overall Performance

Relative loss or gain by area			Change in attribute impact on survival due to scenario															
Geographic area	Relative loss	Relative gain	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Lower Grnd Rnd R 1																		○
Lower Grnd Rnd R 2																		
Grossman Cr																		
Lower Grnd Rnd tribs 2																		
Lower Wallowa R																		
Mid Grnd Rnd R 1									○						○			◯
Mid Grnd Rnd tribs 1		○					○		○						◯	○		◯
Lower Lookglass Cr		○							○						○			◯
Little Lookglass Cr		◯													◯			◯
Upper Lookglass Cr		○													○			◯
Mid Grnd Rnd R 2		○					○		◯				○		◯	◯		◯
Mid Grnd Rnd tribs 2		○					○		○						○			◯
Phillips Cr		◯					○		○						◯	◯		◯
Lower Indian Cr		◯					○		○						○	○		◯
Upper Indian Cr		◯													○			◯
Lower Willow Cr		○					○		◯				○		◯	○		◯
Upper Willow Cr		◯					○		○							○		◯
Mid Grnd Rnd R 3		◯					○		○						◯	○		◯
Lower Catherine Cr		◯					○		○				○		◯	◯		◯
Lower Catherine tribs	●						○		○						◯	○		◯
Mid Catherine Cr		◯			○		○		◯				○		◯	○		◯
Mid Catherine tribs		◯					○		◯						◯			◯
SF Catherine Cr		○													◯			○
NF Caterine Cr.		◯													◯	○		◯
Lower 5-points Cr		○					○		○						◯	○		◯
Upper 5-points Cr		○													◯			○
Rock Cr (GR)		◯													◯			◯
Mid Grnd Rnd R 4		◯					○		◯	○			○		◯	◯		◯
Mid Grnd Rnd tribs 4		◯													◯			◯
Lower Meadow Cr		○													◯	○		◯
McCoy Cr		○													◯	○		○
Upper Meadow Cr		◯													◯			◯
Upper Grnd Rnd R 1		◯					○		○						◯	◯		◯
Fly Cr																		
Sheep Cr (GR)																		
Limber Jim Cr																		
Upper Grnd Rnd R 2		○													○	○		◯
Meadowbrook Cr															◯			◯
Clear Cr (GR)		○													◯			◯
Upper Grnd Rnd R 3															◯			◯

1/ Greatest absolute value of factor change (whether gain or loss) is shown for area (reaches may differ in gain or loss).

Key to amount of change in factor (corresponding Loss/Gain Category letter also shown)

A	B	C	D & E
◯ ● High	○ ● Medium	○ • Low	Indirect or General

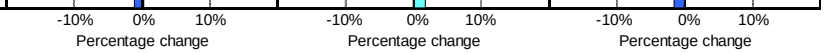
Scenario Diagnostic Report – Tornado Chart

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures After Scenario Implementation

Geographic Area	Protection benefit		Restoration benefit		Change in Capacity with		Change in Productivity with		Change in Diversity Index with	
	Category/rank		Category/rank		Degradation	Restoration	Degradation	Restoration	Degradation	Restoration
Lower Grnd Rnd R 1	B	9	A	6						
Lower Grnd Rnd R 2	B	6	B	11						
Grossman Cr	E	40	E	40						
Lower Grnd Rnd tribs 2	D	38	E	39						
Lower Wallowa R	D	37	E	38						
Mid Grnd Rnd R 1	C	30	D	30						
Mid Grnd Rnd tribs 1	C	33	D	30						
Lower Lookglass Cr	C	20	C	25						
Little Lookglass Cr	B	14	C	19						
Upper Lookglass Cr	C	17	C	28						
Mid Grnd Rnd R 2	B	7	B	14						
Mid Grnd Rnd tribs 2	C	21	D	35						
Phillips Cr	A	1	B	16						
Lower Indian Cr	B	14	C	26						
Upper Indian Cr	B	5	D	34						
Lower Willow Cr	C	31	C	22						
Upper Willow Cr	B	11	B	13						
Mid Grnd Rnd R 3	B	8	B	16						
Lower Catherine Cr	C	28	D	33						
Lower Catherine tribs	D	38	C	21						
Mid Catherine Cr	A	3	A	8						
Mid Catherine tribs	B	14	C	20						
SF Catherine Cr	C	22	D	36						
NF Caterine Cr.	B	10	D	32						
Lower 5-points Cr	C	27	B	11						
Upper 5-points Cr	C	25	C	23						
Rock Cr (GR)	B	13	B	16						
Mid Grnd Rnd R 4	A	4	A	4						
Mid Grnd Rnd tribs 4	B	12	A	1						
Lower Meadow Cr	C	19	B	9						
McCoy Cr	C	29	A	5						
Upper Meadow Cr	C	18	A	7						
Upper Grnd Rnd R 1	A	2	B	10						
Fly Cr	C	31	A	3						
Sheep Cr (GR)	C	22	A	2						
Limber Jim Cr	C	33	B	15						
Upper Grnd Rnd R 2	C	24	C	29						
Meadowbrook Cr	D	36	D	36						
Clear Cr (GR)	C	26	C	24						
Upper Grnd Rnd R 3	D	35	C	27						



Scenario Diagnostic Report – Diagnostic Summary

75% Attribute scalar applied at 100 years

Upper Grande Ronde River Summer Steelhead
Protection and Restoration Strategic Priority Summary After Scenario Implementation

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Lower Grnd Rnd R 1	○	◯							•					•				•
Lower Grnd Rnd R 2	○	○							•					•	•			
Grossman Cr																		
Lower Grnd Rnd tribs 2									•									
Lower Wallowa R									•					•	•			
Mid Grnd Rnd R 1	∘								•				•					•
Mid Grnd Rnd tribs 1	∘														●			●
Lower Lookglass Cr	∘	∘					•		•					•	•			●
Little Lookglass Cr	○	∘													●			●
Upper Lookglass Cr	∘	∘												•				●
Mid Grnd Rnd R 2	○	○							●				•	•	●	•		●
Mid Grnd Rnd tribs 2	∘														•	•		●
Phillips Cr	◯	○													•	●		●
Lower Indian Cr	○	∘														●		●
Upper Indian Cr	○														•			●
Lower Willow Cr	∘	∘					•		•				•	•	●	●		●
Upper Willow Cr	○	○					•		•							●		•
Mid Grnd Rnd R 3	○	○												•		•		●
Lower Catherine Cr	∘												•	●		•		
Lower Catherine tribs		∘													•		●	•
Mid Catherine Cr	◯	◯			•				•				•	•	•	●		●
Mid Catherine tribs	○	∘							•					•	•	●	●	●
SF Catherine Cr	∘														•			•
NF Caterine Cr.	○																	•
Lower 5-points Cr	∘	○					•		•						●	•		●
Upper 5-points Cr	∘	∘													●	●		•
Rock Cr (GR)	○	○													●	•		●
Mid Grnd Rnd R 4	◯	◯												•	•	•		●
Mid Grnd Rnd tribs 4	○	◯													●	•		●
Lower Meadow Cr	∘	○							•						●	●		●
McCoy Cr	∘	◯					•		•						●	●		●
Upper Meadow Cr	∘	◯													●	●		●
Upper Grnd Rnd R 1	◯	○													•	●		●
Fly Cr	∘	◯													●	•		•
Sheep Cr (GR)	∘	◯													●	●		●
Limber Jim Cr	∘	○													●			●
Upper Grnd Rnd R 2	∘	∘													●	•		●
Meadowbrook Cr							•								●			●
Clear Cr (GR)	∘	∘													●			●
Upper Grnd Rnd R 3		∘													●			●

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
◯ High	○ Medium	∘ Low	Indirect or General
●	●	•	

1/ "Channel stability" applies to freshwater areas only.

Appendix 8-C

Literature Cited

Lichatowich, J., L. Mobrand, L. Lestelle, and T. Vogel. 1995. An approach to the diagnosis and treatment of depleted Pacific salmon populations in Pacific Northwest watersheds. Fisheries 20(1):10-18.

APPENDIX 8-D
Stream Reach Descriptions and Diagnostic Units

Stream reaches used in the Grande Ronde EDT analysis are listed here with the following information: sequence number, reach name, associated stream name, reach description, diagnostic unit name, and reach length in miles (current condition). Reaches are ordered beginning at the Grande Ronde mouth, then proceeding upstream to the next reach and branching off into tributaries as they are encountered. Each tributary is then followed in the same manner until its uppermost reach is attained, with the next reach on the list being the reach just upstream of the tributary that had been followed. In this manner, the entire stream reach network is identified.

Diagnostic units identified here were used in Appendix 8-C. Reaches with a length of 0.0 miles are sites of some type of a fish passage barrier.

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
1	Grande Ronde-1	Grande Ronde R	From mouth at Columbia R to Joseph Cr	Lower Grnd Rnd R 1	4.39
2	Joseph Cr-1	Joseph Cr	From mouth at Grande Ronde R to Cottonwood Cr	Lower Joseph Cr	4.32
3	Cottonwood Cr-1 (Joseph)	Cottonwood Cr (Jos)	From mouth at Joseph Cr to Horse Cr	Cottonwd Cr (Joseph)	1.57
4	Horse Cr	Horse Cr	From mouth at Cottonwood Cr to Chaffer Canyon	Cottonwd Cr (Joseph)	4.36
5	Cottonwood Cr-2 (Joseph)	Cottonwood Cr (Jos)	From Horse Cr to Broady	Cottonwd Cr (Joseph)	2.31
6	Broady Cr-1	Broady Cr	From mouth at Cottonwood Cr to WF	Cottonwd Cr (Joseph)	6.75
7	Broady Cr WF	Broady Cr	From mouth to below 4200 ft level	Cottonwd Cr (Joseph)	1.80
8	Broady Cr-2	Broady Cr	From WF to 3800 ft level	Cottonwd Cr (Joseph)	1.34
9	Cottonwood Cr-3 (Joseph)	Cottonwood Cr (Jos)	From Broady Cr to 4800 ft level just above Howard cut off Trail	Cottonwd Cr (Joseph)	12.52
10	Joseph Cr-2	Joseph Cr	From Cottonwood Cr to Peavine Cr	Lower Joseph Cr	21.62
11	Peavine Cr (Joseph)	Peavine Cr (Jos)	From mouth at Joseph Cr to 4000 ft level	Joseph misc tribs	3.41
12	Joseph Cr-3	Joseph Cr	From Peavine Cr to Swamp Cr	Lower Joseph Cr	7.55
13	Swamp Cr-1	Swamp Cr	From mouth at Joseph Cr to Davis Cr	Swamp Cr (Joseph)	3.18
14	Davis Cr	Davis Cr	From mouth at Swamp Cr to above 4200 ft level	Swamp Cr (Joseph)	9.58
15	Swamp Cr-2	Swamp Cr	From Davis Cr to Arkansas Hollow	Swamp Cr (Joseph)	19.24
16	Joseph Cr-4	Joseph Cr	From Swamp Cr to Cougar Cr	Upper Joseph Cr	6.09
17	Cougar Cr (Joseph)	Cougar Cr (Jos)	From mouth at Joseph Cr to 3600 ft level	Joseph misc tribs	2.13
18	Joseph Cr-5	Joseph Cr	From Cougar Cr to Sumac Cr	Upper Joseph Cr	7.08
19	Sumac Cr	Sumac Cr	From mouth at Joseph Cr to above 3600 ft level at fork	Joseph misc tribs	1.54
20	Joseph Cr-6	Joseph Cr	From Sumac Cr to Crow/Chesnimnus Cr confluence	Upper Joseph Cr	1.48
21	Crow Cr-1	Crow Cr	From mouth at Joseph Cr to Elk Cr	Crow Cr (Joseph)	0.71
22	Elk Cr-1 (Joseph)	Elk Cr	From mouth at Crow Cr to Little Elk Cr	Crow Cr (Joseph)	1.92
23	Little Elk Cr	Little Elk Cr	From mouth at Elk Cr to first trib in SE corner of section 33	Crow Cr (Joseph)	0.23
24	Elk Cr-2 (Joseph)	Elk Cr	From Little Elk Cr to fork between 4300 and 4400 ft level	Crow Cr (Joseph)	9.19
25	Crow Cr-2	Crow Cr	From Elk Cr to trib in SW corner of section 19	Crow Cr (Joseph)	12.58
26	Chesnimnus Cr-1	Chesnimnus Cr	From mouth at Joseph Cr to Gooseberry Cr	Lower Chesnimnus Cr	3.54
27	Gooseberry Cr	Gooseberry Cr	From mouth at Chesnimnus Cr to trib just below 3800 ft level	Lower Chesnimnus Cr	1.68
28	Chesnimnus Cr-2	Chesnimnus Cr	From Gooseberry Cr to Butte Cr	Lower Chesnimnus Cr	0.42
29	Butte Cr (Chesnimnus)	Butte Cr	From mouth at Chesnimnus Cr to fork above 4000 ft level	Lower Chesnimnus Cr	5.34
30	Chesnimnus Cr-3	Chesnimnus Cr	From Butte Cr to Peavine Cr	Lower Chesnimnus Cr	2.92
31	Peavine Cr-1 (Chesnimnus)	Peavine Cr (Ches)	From mouth at Chesnimnus Cr to McCarty Gulch	Lower Chesnimnus Cr	1.12
32	McCarty Gulch	McCarty Gulch	From mouth at Peavine Cr to 4-wheel drive road at 4080 ft level	Lower Chesnimnus Cr	1.85
33	Peavine Cr-2 (Chesnimnus)	joseph creek	From McCarty Gulch to Telephone Gulch	Lower Chesnimnus Cr	1.60
34	Telephone Gulch Cr	joseph creek	From mouth at Peavine Cr to trib at 4010 ft level	Lower Chesnimnus Cr	0.70
35	Peavine Cr-3 (Chesnimnus)	Peavine Cr (Ches)	From Telephone Gulch to EF/WF confluence	Lower Chesnimnus Cr	2.61
36	Peavine Cr EF (Chesnimnus)	EF Peavine Cr (Ches)	From mouth at Peavine Cr/WF confuence to above 4600 ft level	Lower Chesnimnus Cr	2.53
37	Peavine Cr WF (Chesnimnus)	WF Peavine Cr (Ches)	From mouth at Peavine Cr/WF confuence to above 4500 ft level	Lower Chesnimnus Cr	1.51

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
38	Chesnimnus Cr-4	Chesnimnus Cr	From Peavine Cr to Pine Cr	Lower Chesnimnus Cr	1.56
39	Pine Cr-1	Pine Cr	From mouth at Chesnimnus Cr to Alder/Salmon Cr confluence	Lower Chesnimnus Cr	2.11
40	Alder Cr-1 (Chesnimnus)	Alder Cr	From mouth at Pine Cr to Alder Cr trib above 3800 ft level	Lower Chesnimnus Cr	1.41
41	Alder Cr Trib (Chesnimnus)	Alder Cr tributary	From mouth at Alder Cr to 2nd trib at 3930 ft level	Lower Chesnimnus Cr	1.38
42	Alder Cr-2 (Chesnimnus)	Alder Cr	From Alder Cr trib above 3800 ft level to Forest Boundary	Lower Chesnimnus Cr	1.27
43	Salmon Cr-1	Salmon Cr	From mouth at Pine Cr to Dry Salmon	Lower Chesnimnus Cr	2.38
44	Dry Salmon	Dry Salmon Cr	From mouth at Salmon Cr to 3980 ft level	Lower Chesnimnus Cr	0.78
45	Salmon Cr-2	Salmon Cr	From Dry Salmon to 1/4 mile below 4300 ft level	Lower Chesnimnus Cr	4.64
46	Pine Cr-2	Pine Cr	From Alder/Salmon Cr to 1/4 mile above 4400 ft level	Lower Chesnimnus Cr	9.85
47	Chesnimnus Cr-5	Chesnimnus Cr	From Pine Cr to Doe Cr	Upper Chesnimnus Cr	3.56
48	Doe Cr	Doe Cr	From mouth at Chesnimnus Cr to 1/4 mile upstream	Upper Chesnimnus Cr	0.61
49	Chesnimnus Cr-6	Chesnimnus Cr	From Doe Cr to Billy Cr	Upper Chesnimnus Cr	2.22
50	Billy Cr	Billy Cr	From mouth at Chesnimnus Cr to forks below 4600 ft level	Upper Chesnimnus Cr	3.48
51	Chesnimnus Cr-7	Chesnimnus Cr	From Billy Cr to Devils Run	Upper Chesnimnus Cr	1.57
52	Devils Run Cr-1	Devils Run Cr	From mouth at Chesnimnus Cr to Poison Cr	Upper Chesnimnus Cr	0.67
53	Poison Cr	Poison Cr	From mouth at Devils Run Cr to trib from Bear Paw Spring	Upper Chesnimnus Cr	0.50
54	Devils Run Cr-2	Devils Run Cr	From Poison Cr to Summit Cr	Upper Chesnimnus Cr	1.76
55	Summit Cr	Summit Cr	From mouth at Devils Run Cr to road crossing at 5200 ft level on the SF	Upper Chesnimnus Cr	2.72
56	Devils Run Cr-3	Devils Run Cr	From Summit Cr to TNT Gulch	Upper Chesnimnus Cr	1.30
57	TNT Gulch	TNT Gulch	From mouth at Devils Run Cr to 4600 ft level	Upper Chesnimnus Cr	1.30
58	Devils Run Cr-4	Devils Run Cr	From TNT Gulch to fork below 4800 ft level	Upper Chesnimnus Cr	1.74
59	Chesnimnus Cr-8	Chesnimnus Cr	From Devils Run to Vance Draw	Upper Chesnimnus Cr	4.91
60	Vance Draw_A	Vance Draw	From mouth at Chesnimnus Cr to culvert at short spur off 4695 road	Upper Chesnimnus Cr	0.26
60	Vance Draw_Obstr_B	Vance Draw	Culvert at short spur off 4695 road.	Upper Chesnimnus Cr	0.00
60	Vance Draw_C	Vance Draw	From culvert at short spur off 4695 road to 2nd trib in SW corner of section 2	Upper Chesnimnus Cr	0.25
61	Chesnimnus Cr-9_A	Chesnimnus Cr	From Vance Draw to culvert at 4690-930 road.	Upper Chesnimnus Cr	3.52
61	Chesnimnus Cr-9_Obstr_B	Chesnimnus Cr	Culvert at 4690-930 road	Upper Chesnimnus Cr	0.00
61	Chesnimnus Cr-9_C	Chesnimnus Cr	From culvert at 4690-930 road to NF/SF confluence	Upper Chesnimnus Cr	0.88
62	Chesnimnus Cr NF	NF Chesnimnus Cr	From mouth at Chesnimnus Cr/SF confluence to 1st Rsv in Thomas Meadow	Upper Chesnimnus Cr	1.03
63	Chesnimnus Cr SF_A	SF Chesnimnus Cr	From mouth at Chesnimnus Cr/NF confluence to culvert on 4625 road	Upper Chesnimnus Cr	1.04
63	Chesnimnus Cr SF_Obstr_B	SF Chesnimnus Cr	Culvert on 4625 road	Upper Chesnimnus Cr	0.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
63	Chesnimnus Cr SF_C	SF Chesnimnus Cr	From culvert on 4625 road to fork just below 4700 ft level	Upper Chesnimnus Cr	0.35
64	Grande Ronde-2	Grande Ronde R	From Joseph Cr to Shumaker Cr	Lower Grnd Rnd R 1	11.17
65	Shumaker Cr	Shumaker Cr	From mouth at Grande Ronde R to Garden Gulch	Lower Grnd Rnd tribs 1	1.34
66	Grande Ronde-3	Grande Ronde R	From Shumaker Cr to Deer Cr	Lower Grnd Rnd R 1	3.47
67	Deer Cr (GR)	Deer Cr (GR)	From mouth at Grande Ronde R to forks below 2200 ft level	Lower Grnd Rnd tribs 1	2.82
68	Grande Ronde-4	Grande Ronde R	From Deer Cr to Buford Cr	Lower Grnd Rnd R 1	6.32
69	Buford Cr-1	Buford Cr	From mouth at Grande Ronde R to Applegate Canyon	Lower Grnd Rnd tribs 1	4.50
70	Applegate Canyon	Applegate Canyon	From mouth to Spring below Hwy 3	Lower Grnd Rnd tribs 1	1.05
71	Buford Cr-2	Buford Cr	From Applegate Canyon to 2800 ft level	Lower Grnd Rnd tribs 1	0.82
72	Grande Ronde-5	Grande Ronde R	From Buford Cr to Rattlesnake Cr	Lower Grnd Rnd R 1	0.55
73	Rattlesnake Cr-1	Rattlesnake Cr	From mouth at Grande Ronde R to culvert at Hwy 129	Lower Grnd Rnd tribs 1	1.35
74	Rattlesnake Cr-2_Obstr	Rattlesnake Cr	Culvert at Hwy 129	Lower Grnd Rnd tribs 1	0.00
75	Rattlesnake Cr-3	Rattlesnake Cr	From culvert at Hwy 129 to West Branch	Lower Grnd Rnd tribs 1	0.27
76	Rattlesnake Cr W Branch	Rattlesnake Cr	From mouth at Rattlesnake Cr to trib just below 2200 ft level	Lower Grnd Rnd tribs 1	0.93
77	Rattlesnake Cr-4	Rattlesnake Cr	From West Branch to trib just above 2000 ft level	Lower Grnd Rnd tribs 1	0.80
78	Grande Ronde-6	Grande Ronde R	From Rattlesnake Cr to Cottonwood Cr/Hatchery release site (very close together on GR)	Lower Grnd Rnd R 1	2.43
79	Cottonwood Cr-1 (GR)	Cottonwood Cr (GR)	From mouth at Grande Ronde R to Diversion Dam just below 1400 ft level	Lower Grnd Rnd tribs 1	0.24
80	Cottonwood Cr-2 (GR)_Obstr	Cottonwood Cr (GR)	Diversion Dam for Rearing Ponds just below 1400 ft level	Lower Grnd Rnd tribs 1	0.00
81	Cottonwood Cr-3 (GR)	Cottonwood Cr (GR)	From Diversion Dam just below 1400 ft level to EF/Devil's Canyon confluence	Lower Grnd Rnd tribs 1	2.29
82	Grande Ronde-7	Grande Ronde R	From Cottonwood Cr/Hatchery release site to Bear Cr	Lower Grnd Rnd R 1	1.64
83	Bear Cr-1 (1st GR)	Bear Cr (1st GR)	From mouth at Grande Ronde R to EF/WF confluence	Lower Grnd Rnd tribs 1	1.67
84	Bear CR EF (1st GR)	Bear Cr (1st GR)	From mouth at Bear Cr/WF confluence to Falls just below 4000 ft level	Lower Grnd Rnd tribs 1	4.99
85	Bear CR WF (1st GR)	Bear Cr (1st GR)	From mouth at Bear Cr/EF confluence to Spring above 2200 ft level	Lower Grnd Rnd tribs 1	1.95
86	Grande Ronde-8	Grande Ronde R	From Bear Cr to Cougar Cr	Lower Grnd Rnd R 1	0.38
87	Cougar Cr (GR)	Cougar Cr (GR)	From mouth at Grande Ronde R to trib just above 2000 ft level	Lower Grnd Rnd tribs 1	1.39
88	Grande Ronde-9	Grande Ronde R	From Cougar Cr to Menatchee Cr	Lower Grnd Rnd R 1	5.31
89	Menatchee Cr	Menatchee Cr	From mouth to Impassable Natural Falls just above WF confluence	Lower Grnd Rnd tribs 1	3.03
90	Grande Ronde-10	Grande Ronde R	From Menatchee Cr to Grouse Cr	Lower Grnd Rnd R 1	3.98
91	Grouse Cr- 1	Grouse Cr	From mouth at Grande Ronde R to first\second combination road crossing culvert at 2400 ft level	Lower Grnd Rnd tribs 1	1.82
92	Grouse Cr- 2_Obstr	Grouse Cr	Culvert at first/second combination road crossing at 2400 ft level	Lower Grnd Rnd tribs 1	0.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
93	Grouse Cr- 3	Grouse Cr	From first/second combination culvert at 2400 ft level to third culvert at 2800 ft level	Lower Grnd Rnd tribs 1	0.49
94	Grouse Cr- 4_Obstr	Grouse Cr	Culvert at third road crossing at 2800 ft level	Lower Grnd Rnd tribs 1	0.00
95	Grouse Cr- 5	Grouse Cr	From third culvert at 2800 ft level to fourth culvert at 3200 ft level	Lower Grnd Rnd tribs 1	1.55
96	Grouse Cr- 6_Obstr	Grouse Cr	Culvert at fourth road crossing at 3200 ft level	Lower Grnd Rnd tribs 1	0.00
97	Grouse Cr- 7	Grouse Cr	From fourth culvert at 3200 ft level to impassable culvert at Grouse Flat Road just inside Forest Boundary	Lower Grnd Rnd tribs 1	0.98
98	Grande Ronde-11	Grande Ronde R	From Grouse Cr to Bear Cr	Lower Grnd Rnd R 1	4.26
99	Bear Cr (2nd GR)	Bear Cr (2nd GR)	From mouth at Grande Ronde R to Falls at 2200 ft level	Lower Grnd Rnd tribs 1	1.75
100	Grande Ronde-12	Grande Ronde R	From Bear Cr to Wenaha River	Lower Grnd Rnd R 1	1.17
101	Wenaha-1	Wenaha R	From mouth at Grande Ronde R to Crooked Cr	Lower Wenaha R	6.67
102	Crooked Cr-1	Wenaha	From mouth at Wenaha R to First Cr	Crooked (Wenaha)	4.50
103	First Cr	Wenaha	From mouth at Crooked Cr to trib just above 2600 ft level	Crooked (Wenaha)	1.86
104	Crooked Cr-2	Wenaha	From First Cr to Melton Cr	Crooked (Wenaha)	0.66
105	Melton Cr	Wenaha	From mouth at Crooked Cr to 2nd trib at 2900 ft level	Crooked (Wenaha)	1.66
106	Crooked Cr-3	Wenaha	From Melton to Second Cr	Crooked (Wenaha)	1.41
107	Second Cr	Wenaha	From mouth at Crooked Cr to trib just below 3200 ft level	Crooked (Wenaha)	2.05
108	Crooked Cr-4	Wenaha	From Second Cr to Third Cr	Crooked (Wenaha)	1.09
109	Third Cr	Wenaha	From mouth at Crooked Cr to Trout Cr	Crooked (Wenaha)	3.41
110	Wenaha-2	Wenaha R	From Crooked Cr to Weller Cr	Lower Wenaha R	5.91
111	Weller Cr	Wenaha	From mouth at Wenaha R to 2500 ft level	Wenaha misc tribs	0.72
112	Wenaha-3	Wenaha R	From Weller Cr to Butte Cr	Upper Wenaha R	1.91
113	Butte Cr-1 (Wenaha)	Wenaha	From mouth at Wenaha R to confluence of WF/EF (and other tribs)	Wenaha misc tribs	7.13
114	Butte Cr-2 (Wenaha)	Wenaha	From mouth of WF at the confluence of EF to Rainbow Cr	Wenaha misc tribs	2.02
115	Wenaha-4	Wenaha R	From Butte Cr to Rock Cr	Upper Wenaha R	2.85
116	Rock Cr (Wenaha)	Wenaha	From mouth at Wenaha R to State Line	Wenaha misc tribs	4.21
117	Wenaha-5	Wenaha R	From Rock Cr to Slick Ear/Beaver Cr	Upper Wenaha R	3.94
118	Slick Ear Cr	Wenaha	From mouth at Wenaha R to trib at 3500 ft level	Wenaha misc tribs	2.10
119	Beaver Cr (Wenaha)	Wenaha	From mouth at Wenaha R to trib below State Line	Wenaha misc tribs	3.42
120	Wenaha-6	Wenaha R	From Beaver/Slick Ear Cr confluence to NF/SF confluence	Upper Wenaha R	0.48
121	Wenaha NF	NF Wenaha R	From mouth at Wenaha R/SF confluence to trib at 3900 ft level	Wenaha Forks	7.97
122	Wenaha SF-1	SF Wenaha R	From mouth at Wenaha R/SF to Jaussaud Cr	Wenaha Forks	2.63
123	Jaussaud Cr	Jaussaud Cr	From mouth at Wenaha SF to 3400 ft level	Wenaha Forks	0.86
124	Wenaha SF-2	SF Wenaha R	From Jaussaud Cr to Milk Cr	Wenaha Forks	3.32
125	Milk Cr (Wenaha)	Milk Cr (Wen)	From mouth at Wenaha SF to Falls above 4400 ft level	Wenaha Forks	5.23
126	Wenaha SF-3	SF Wenaha R	From Milk Cr to forks at 4000 ft level	Wenaha Forks	2.20
127	Grande Ronde-13	Grande Ronde R	From Wenaha R to Courtney Cr	Lower Grnd Rnd R 2	1.14
128	Courtney Cr-1	Courtney Cr	From mouth at Grande Ronde R to Little Courtney Cr	Courtney Cr	3.06
129	Little Courtney Cr	Little Courtney Cr	From mouth at Courtney Cr to 2290 ft level	Courtney Cr	0.83
130	Courtney Cr-2	Courtney Cr	From Little Courtney Cr to Bobcat Cr	Courtney Cr	3.50
131	Bobcat Cr	Bobcat Cr	From mouth at Courtney Cr to forks below Forest Boundary	Courtney Cr	1.54
132	Courtney Cr-3	Courtney Cr	From Bobcat Cr to Shamrock Cr	Courtney Cr	0.50

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
133	Shamrock Cr	Shamrock Cr	From mouth at Courtney Cr to forks below 3200 ft level	Courtney Cr	1.66
134	Courtney Cr-4	Courtney Cr	From Shamrock Cr to road crossing below 4400 ft level	Courtney Cr	5.25
135	Grande Ronde-14	Grande Ronde R	From Courtney Cr to Mud Cr	Lower Grnd Rnd R 2	5.48
136	Mud Cr-1	Mud Cr	From mouth at Grande Ronde R to Buck Cr	Lower Mud Cr	4.05
137	Buck Cr-1 (GR)	Buck Cr (Mud)	From mouth at Mud Cr to Burnt Cr	Lower Mud Cr	8.41
138	Burnt Cr	Burnt Cr (Buck)	From mouth at Buck Cr to Burnt Spring at 4600 ft level	Lower Mud Cr	2.90
139	Buck Cr-2 (GR)	Buck Cr (Mud)	From Burnt Cr to 4600 ft level	Lower Mud Cr	3.53
140	Mud Cr-2	Mud Cr	From Buck Cr to Tope Cr	Lower Mud Cr	4.98
141	Tope Cr	Tope Cr	From mouth at Mud Cr to fork in headwaters at SE corner of section 20	Upper Mud Cr	13.93
142	Mud Cr-3	Mud Cr	From Tope Cr to McAlister Cr	Upper Mud Cr	0.99
143	McAlister Cr	McAlister Cr	From mouth at Mud Cr to forks above road 3021 in section 6	Upper Mud Cr	8.14
144	Mud Cr-4	Mud Cr	From McAlister Cr to Sled Cr	Upper Mud Cr	4.85
145	Sled Cr-1	Sled Cr	From mouth at Mud Cr to Evans Cr	Upper Mud Cr	2.72
146	Evans Cr	Evans Cr (Sled)	From mouth at Sled Cr to road crossing just below headwaters springs	Upper Mud Cr	1.72
147	Sled Cr-2	Sled Cr	From Evans Cr to road crossing just below springs	Upper Mud Cr	1.24
148	Mud Cr-5	Mud Cr	From Sled Cr to Tepee Cr	Upper Mud Cr	0.71
149	Tepee Cr	Tepee Cr	From mouth at Mud Cr to fork below road crossing at SW corner of section 32	Upper Mud Cr	2.21
150	Mud Cr-6	Mud Cr	From Tepee Cr to McCubbin Cr	Upper Mud Cr	0.19
151	McCubbin Cr	McCubbin Cr	From mouth at Mud Cr to 4500 ft level	Upper Mud Cr	2.25
152	Mud Cr-7_C	Mud Cr	From culvert on 3201 road to road crossing at SW corner of section 23	Upper Mud Cr	5.57
152	Mud Cr-7_A	Mud Cr	From McCubin Cr to culvert on 3201 road	Upper Mud Cr	1.48
152	Mud Cr-7_Obstr_B	Mud Cr	Culvert on 3201 road	Upper Mud Cr	0.00
153	Grande Ronde-15	Grande Ronde R	From Mud Cr to Wild Cat Cr	Lower Grnd Rnd R 2	1.42
154	Wildcat Cr-1	Wildcat Cr	From mouth at Grande Ronde R to Wallupa Cr	Wildcat Cr	3.50
155	Wallupa Cr_C	Wallupa Cr	From culvert at County 501 road to Bishop Cr	Wildcat Cr	1.29
155	Wallupa Cr_Obstr_B	Wallupa Cr	Culvert at County 501 road	Wildcat Cr	0.00
155	Wallupa Cr_A	Wallupa Cr	From mouth at Wildcat Cr to culvert at County 501 road	Wildcat Cr	5.48
156	Bishop Cr	Bishop Cr	From mouth at Wallupa Cr to Gravel Pit at 4000 ft level	Wildcat Cr	1.99
157	Wildcat Cr-2	Wildcat Cr	From Wallupa Cr to trib from Yellow Jacket Spring	Wildcat Cr	8.36
157	Wildcat Cr-2_Obstr_A	Wildcat Cr	Culvert at lower end of Wildcat Cr-2	Wildcat Cr	0.00
158	Grande Ronde-16	Grande Ronde R	From Wild Cat Cr to Ward Canyon	Lower Grnd Rnd R 2	2.51
159	Ward Canyon	Ward Canyon	From mouth at Grande Ronde R to 2100 ft level	Lower Grnd Rnd tribs 2	0.49
160	Grande Ronde-17	Grande Ronde R	From Ward Canyon to Sickfoot Cr	Lower Grnd Rnd R 2	2.43
161	Sickfoot Cr	Sickfoot Cr	From mouth at Grande Ronde R to 3400 ft level	Lower Grnd Rnd tribs 2	3.90
162	Grande Ronde-18	Grande Ronde R	From Sickfoot Cr to Grossman Cr	Lower Grnd Rnd R 2	4.51
163	Grossman Cr-1	Grossman Cr	From mouth at Grande Ronde R to EF	Grossman Cr	2.12
164	Grossman Cr EF	EF Grossman Cr	From mouth at Grossman Cr to trib just above 2600 ft level	Grossman Cr	1.01
165	Grossman Cr-2	Grossman Cr	From EF to Deep Cr	Grossman Cr	1.54
166	Deep Cr	Deep Cr (Grossman)	From mouth at Grossman Cr to Falls 1/8th of a mile upstream	Grossman Cr	0.17
167	Grossman Cr-3	Grossman Cr	From Deep Cr to road crossing at 4120 ft level (Jaussaug Meadow)	Grossman Cr	7.45

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
168	Grande Ronde-19	Grande Ronde R	From Grossman Cr to Elbow Cr	Lower Grnd Rnd R 2	1.71
169	Elbow Cr	Elbow Cr	From mouth at Grande Ronde R to fork at 3600 ft level	Lower Grnd Rnd tribs 2	3.98
170	Grande Ronde-20	Grande Ronde R	From Elbow Cr to Bear Cr	Lower Grnd Rnd R 2	1.63
171	Bear Cr (3rd GR)	Bear Cr (3rd GR)	From mouth at Grande Ronde R to forks at 3400 ft level	Lower Grnd Rnd tribs 2	3.60
172	Grande Ronde-21	Grande Ronde R	From Bear Cr to Alder Cr	Lower Grnd Rnd R 2	4.59
173	Alder Cr (GR)	Alder Cr (GR)	From mouth at Grande Ronde R to 2400 ft level	Lower Grnd Rnd tribs 2	0.55
174	Grande Ronde-22	Grande Ronde R	From Alder Cr to Meadow Cr	Lower Grnd Rnd R 2	1.75
175	Meadow Cr (1st GR)	Meadow Cr (1st GR)	From mouth at Grande Ronde R to 2400 ft level	Lower Grnd Rnd tribs 2	0.42
176	Grande Ronde-23	Grande Ronde R	From Meadow Cr to Clear Cr	Lower Grnd Rnd R 2	2.79
177	Clear Cr (1st GR)	Clear Cr (1st GR)	From mouth at Grande Ronde R to forks at 2600 ft level	Lower Grnd Rnd tribs 2	1.05
178	Grande Ronde-24	Grande Ronde R	From Clear Cr to Sheep Cr	Lower Grnd Rnd R 2	4.24
179	Sheep Cr-1 (1st GR)	Sheep Cr (1st GR)	From mouth at Grande Ronde R to Falls at 2600 ft level	Lower Grnd Rnd tribs 2	1.20
180	Sheep Cr-2 (1st GR)	Sheep Cr (1st GR)	From Falls at 2600 ft level to road crossing in NE corner of section 28	Lower Grnd Rnd tribs 2	3.66
181	Grande Ronde-25	Grande Ronde R	From Sheep Cr to Wallowa R	Lower Grnd Rnd R 2	1.66
182	Wallowa-1	Wallowa R	From mouth at Grande Ronde R to Howard Cr	Lower Wallowa R	3.45
183	Howard Cr	Howard Cr	From mouth at Wallowa R to fork just below Howard Meadow	Lower Wallowa tribs	8.31
184	Wallowa-2	Wallowa R	From Howard Cr to Fisher Cr	Lower Wallowa R	2.06
185	Fisher Cr	Fisher Cr	From mouth at Wallowa R to 1st trib from the N in section 12	Lower Wallowa tribs	0.34
186	Wallowa-3	Wallowa R	From Fisher Cr to Minam	Lower Wallowa R	4.45
187	Minam-1	Minam R	From mouth at Wallowa R to Squaw Cr	Lower Minam R	2.58
188	Squaw Cr (Minam)	Squaw Cr (Minam)	From mouth at Minham R to 3300 ft level	Lower Minam tribs	2.46
189	Minam-2	Minam R	From Squaw Cr to Gunderson Cr	Lower Minam R	2.16
190	Gunderson Cr	Gunderson Cr	From mouth at Minham R to 1/2 mile upstream	Lower Minam tribs	0.55
191	Minam-3	Minam R	From Gunderson Cr to Cougar Cr	Lower Minam R	5.01
192	Cougar Cr (Minam)	Cougar Cr (Minam)	From mouth at Minham R to 3000 ft level	Mid Minam tribs	0.26
193	Minam-4	Minam R	From Cougar Cr to Trout Cr	Mid Minam R	0.53
194	Trout Cr (Minam)	Trout Cr (Minam)	From mouth at Minham R to 6000 ft level	Mid Minam tribs	9.53
195	Minam-5	Minam R	From Trout Cr to Murphy Cr	Mid Minam R	2.33
196	Murphy Cr	Murphy Cr	From mouth at Minham R to fork at 4700 ft level	Mid Minam tribs	4.93
197	Minam-6	Minam R	From Murphy Cr to Little Minam Cr	Mid Minam R	5.73
198	Little Minam Cr-1	Little Minam R	From mouth at Minham R to Falls at 3920 ft level	Little Minam	5.31
199	Little Minam Cr-2_Obstr	Little Minam R	Falls at 3920 ft level	Little Minam	0.00
200	Little Minam Cr-3	Little Minam R	From Falls at 3920 ft level to Boulder Cr	Little Minam	2.16
201	Boulder Cr	Boulder Cr	From mouth at Little Minham Cr to 6000 ft level	Little Minam	3.15
202	Little Minam Cr-4	Little Minam R	From Boulder Cr to Dobbin Cr	Little Minam	4.55
203	Dobbin Cr	Dobbin Cr	From mouth at Little Minham R to headwaters at 6400 ft level	Little Minam	3.71
204	Little Minam Cr-5	Little Minam R	From Dobbin Cr to 6000 ft level	Little Minam	2.70
205	Minam-7	Minam R	From Little Minam Cr to North Minam R	Upper Minam	13.23
206	Minam N-1	North Minam R	From mouth at Minham R to Falls at 4600 ft level	Upper Minam	1.10
207	Minam N-2_Obstr	North Minam R	Falls at 4600 ft level	Upper Minam	0.00
208	Minam N-3	North Minam R	From Falls at 4600 ft level to upper end North Minam Meadows	Upper Minam	4.57

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
209	Minam-8	Minam R	From North Minam R to Elk Cr	Upper Minam	8.91
210	Elk Cr-1 (Minam)	Elk Cr (Minam)	From mouth at Minham R to EF Elk	Upper Minam	1.09
211	Elk Cr EF (Minam)	EF Elk Cr (Minam)	From mouth to Falls 1/4 mile upstream	Upper Minam	0.37
212	Elk Cr-2 (Minam)	Elk Cr (Minam)	From EF Elk to the Falls at 6000 ft level	Upper Minam	1.32
213	Minam-9	Minam R	From Elk Cr to Falls below Pop Cr near 5800 ft level	Upper Minam	5.40
214	Wallowa-4	Wallowa R	From Minam R to Deer Cr	Mid Wallowa R	1.46
215	Deer Cr-1 (Wallowa)_Obstr	Deer Cr (Wallowa)	Big Canyon Acc Adlt Collection at mouth at Wallowa R of Deer Cr	Deer Cr (Wallowa)	0.00
216	Deer Cr-2 (Wallowa)	Deer Cr (Wallowa)	From Big Canyon AAC/mouth to Sage Cr	Deer Cr (Wallowa)	10.22
217	Sage Cr-1_Obstr	Sage Cr	Culvert at mouth at Sage Cr	Deer Cr (Wallowa)	0.00
218	Sage Cr-2	Sage Cr	From culvert at mouth of Sage Cr to trib just above 4600 ft level	Deer Cr (Wallowa)	1.40
219	Deer Cr-3 (Wallowa)	Deer Cr (Wallowa)	From Sage Cr to fork just N of Wilderness Boundary	Deer Cr (Wallowa)	6.69
220	Wallowa-5	Wallowa R	From Deer Cr to Fountain Canyon in section 36 at Rest Area (16.5 RM)	Mid Wallowa R	4.66
221	Fountain Canyon	Fountain Canyon	From mouth at Wallowa R to Gravel Pit	Mid Wallowa tribs	0.24
222	Wallowa-6	Wallowa R	From Fountain Canyon in section 36 at Rest Area (16.5 RM) to Water Canyon	Mid Wallowa R	1.54
223	Water Canyon_Obstr_B	Water Canyon	Culvert on Water Canyon Road approx 0.7 miles upstream of Water Canyon mouth	Mid Wallowa tribs	0.00
223	Water Canyon_C	Water Canyon	From culvert on Water Canyon Road approx 0.7 miles upstream of Water Canyon mouth to 3200 ft level	Mid Wallowa tribs	0.81
223	Water Canyon_A	Water Canyon	From mouth at Wallowa R to culvert on Water Canyon Road approx 0.7 miles upstream of mouth	Mid Wallowa tribs	0.67
224	Wallowa-7	Wallowa R	From Water Canyon to Rock Cr	Mid Wallowa R	0.86
225	Rock Cr-1 (Wallowa)	Rock Cr (Wallowa)	From mouth at Wallowa R to Dry Cr	Rock Cr (Wallowa)	0.00
226	Dry Cr-1 (Wallowa)	Dry Cr (Wallowa)	From mouth at Rock Cr to Lower Valley Diversion at 2850 ft level	Rock Cr (Wallowa)	3.00
227	Dry Cr-2 (Wallowa)_Obstr	Dry Cr (Wallowa)	Lower Valley Diversion at 2850 ft level	Rock Cr (Wallowa)	0.00
228	Dry Cr-3 (Wallowa)	Dry Cr (Wallowa)	From Lower Valley Diversion at 2850 ft level to Reagin Gulch	Rock Cr (Wallowa)	0.46
229	Reagin Gulch	Reagin Gulch	From mouth at Dry Cr to road crossing in SE corner of section 16	Rock Cr (Wallowa)	2.01
230	Dry Cr-4 (Wallowa)	Dry Cr (Wallowa)	From Reagin Gulch to fork above Troy/Powattka Road in NW corner of section 17	Rock Cr (Wallowa)	5.35
231	Rock Cr-2 (Wallowa)	Rock Cr (Wallowa)	From Dry Cr to fork just above 3600 ft level	Rock Cr (Wallowa)	6.28
232	Wallowa-8	Wallowa R	From Rock Cr to Bear Cr	Mid Wallowa R	3.73
233	Bear Cr-1 (Wallowa)_C	Bear Cr (Wallowa)	From rock weirs (a series) a short distance from Bear Creek mouth to Chamberlin Ditch	Lower Bear Cr (Wallowa)	2.56
233	Bear Cr-1 (Wallowa)_Obstr_B	Bear Cr (Wallowa)	Rock weirs (a series) a short distance from Bear Creek mouth (assumed to be 0.25 miles)	Lower Bear Cr (Wallowa)	0.00
233	Bear Cr-1 (Wallowa)_A	Bear Cr (Wallowa)	From mouth at Wallowa R to rock weirs (a series) a short distance from Bear Creek mouth (assumed to be 0.25 miles)	Lower Bear Cr (Wallowa)	0.25
234	Bear Cr-2 (Wallowa)_Obstr_A	Bear Cr (Wallowa)	Diversion structure on Bear Cr for Chamberlin Ditch	Lower Bear Cr (Wallowa)	0.00
234	Bear Cr-2 (Wallowa)	Bear Cr (Wallowa)	From Chamberlin Ditch to Little Bear	Lower Bear Cr (Wallowa)	4.72
235	Little Bear Cr-1	Little Bear Cr (Wallowa)	From mouth at Bear Cr to fork at 4500 ft level	Upper Bear Cr (Wallowa)	3.79
236	Little Bear Cr-2	Little Bear Cr (Wallowa)	From fork at 4500 ft level to Diversion for Allen Canyon Ditch	Upper Bear Cr (Wallowa)	2.64
237	Little Bear Cr-3_Obstr	Little Bear Cr (Wallowa)	Diversion for Allen Canyon Ditch	Upper Bear Cr (Wallowa)	0.00
238	Little Bear Cr-4	Little Bear Cr (Wallowa)	From Diversion for Allen Canyon Ditch to just below 6000 ft level	Upper Bear Cr (Wallowa)	0.56

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
239	Bear Cr-3 (Wallowa)	Bear Cr (Wallowa)	From Little Bear Cr to Doc Cr	Upper Bear Cr (Wallowa)	1.50
240	Doc Cr	Doc Cr	From mouth at Bear Cr to 4800 ft level	Upper Bear Cr (Wallowa)	1.60
241	Bear Cr-4 (Wallowa)	Bear Cr (Wallowa)	From Doc Cr to Goat Cr	Upper Bear Cr (Wallowa)	3.85
242	Goat Cr	Goat Cr	From mouth at Bear Cr to Falls just below 5000 ft level	Upper Bear Cr (Wallowa)	1.01
243	Bear Cr-5 (Wallowa)	Bear Cr (Wallowa)	From Goat Cr to Falls just above Saddle Basin Cr	Upper Bear Cr (Wallowa)	3.20
244	Wallowa-9	Wallowa R	From Bear Cr to Whiskey Cr	Mid Wallowa R	1.51
245	Whiskey Cr-1 (Wallowa)_C	Whiskey Cr	From bridge/apron structure at the Whiskey/Warnock intersection to SF	Whiskey Cr (Wallowa)	4.95
245	Whiskey Cr-1 (Wallowa)_Obstr_B	Whiskey Cr	Bridge/apron structure at the Whiskey/Warnock intersection	Whiskey Cr (Wallowa)	0.00
245	Whiskey Cr-1 (Wallowa)_A	Whiskey Cr	From mouth at Wallowa R to bridge/apron structure at the Whiskey/Warnock intersection	Whiskey Cr (Wallowa)	1.56
246	Whiskey Cr SF (Wallowa)	Whiskey Cr	From mouth at Whiskey Cr to forks in SW corner of section 2	Whiskey Cr (Wallowa)	1.34
247	Whiskey Cr-2 (Wallowa)	Whiskey Cr	From SF to MF/NF confluence	Whiskey Cr (Wallowa)	1.90
248	Whiskey Cr MF (Wallowa)	MF Whiskey Cr	From mouth at WhiskeyCr/NF confluence to canyon of Hicks Spring in section 9	Whiskey Cr (Wallowa)	4.28
249	Whiskey Cr NF-1 (Wallowa)	NF Whiskey Cr	From mouth at WhiskeyCr/MF confluence to Straight Whiskey Cr	Whiskey Cr (Wallowa)	0.13
250	Straight Whiskey Cr	Straight Whiskey Cr	From mouth to 3840 ft level	Whiskey Cr (Wallowa)	0.95
251	Whiskey Cr NF-2 (Wallowa)	NF Whiskey Cr	From Straight Whiskey Cr to 4200 ft level	Whiskey Cr (Wallowa)	2.76
252	Wallowa-10	Wallowa R	From Whiskey Cr to Lostine	Mid Wallowa R	2.05
253	Lostine-1	Lostine R	From mouth at Wallowa R to Gravel Pit/Weir in NE corner of section 30	Lower Lostine R	0.70
254	Lostine-2_Obstr	Lostine R	Weir in NE corner of section 30	Lower Lostine R	0.00
255	Lostine-3	Lostine R	From Weir in NE corner of section 30 to Clear Water Ditch	Lower Lostine R	2.28
256	Lostine-4	Lostine R	From Clear Water Ditch to Cross Country Ditch	Lower Lostine R	2.33
257	Lostine-5_A	Lostine R	From Cross Country Ditch to unnamed water diversion structure approx 1.9 miles upstream of Cross Country Ditch	Lower Lostine R	1.91
257	Lostine-5_C	Lostine R	From unnamed water diversion structure approx 1.9 miles upstream of Cross Country Ditch to Sheep Ridge Ditch	Lower Lostine R	1.76
257	Lostine-5_Obstr_B	Lostine R	Unnamed water diversion structure approx 1.9 miles upstream of Cross Country Ditch	Lower Lostine R	0.00
258	Lostine-6_A	Lostine R	From Sheep Ridge Ditch diversion to Sheep Ridge Dam	Lower Lostine R	0.60
258	Lostine-6_C	Lostine R	From Sheep Ridge Dam to Six Mile Bridge in section 10	Lower Lostine R	2.98
258	Lostine-6_Obstr_B	Lostine R	Sheep Ridge Dam	Lower Lostine R	0.00
258	Lostine-6_Obstr_A	Lostine R	Diversion for Sheep Ridge Ditch	Lower Lostine R	0.00
259	Lostine-7	Lostine R	From Six Mile Bridge in section 10 to Lake Cr	Upper Lostine R	5.91
260	Lake Cr	Lake Cr	From mouth at Lostine to Hunter Falls	Upper Lostine R	0.36
261	Lostine-8	Lostine R	From Lake Cr to fork/Falls just below 5800 ft level	Upper Lostine R	6.71
262	Wallowa-11	Wallowa R	From Lostine to Parsnip Cr	Upper Wallowa R	3.03
263	Parsnip Cr	Parsnip Cr	From mouth at Wallowa R to spring near 3200 ft level	Upper Wallowa tribs	0.70
264	Wallowa-12_Obstr_B	Wallowa R	Unnamed water diversion approx 5.5 miles upstream of Parsnip Cr on the Wallowa R	Upper Wallowa R	0.00
264	Wallowa-12_A	Wallowa R	From Parsnip Cr to unnamed water diversion approx 5.5 miles upstream on the Wallowa R	Upper Wallowa R	4.53

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
264	Wallowa-12_C	Wallowa R	From unnamed water diversion approx 5.5 miles upstream of Parsnip Cr to Spring Cr	Upper Wallowa R	6.96
265	Spring Cr-1 (Wallowa)	Spring Cr (Wallowa)	From mouth at Wallowa R to Hatchery Obstruction at 3700 ft level	Spring Cr (Wallowa)	1.20
266	Spring Cr-2 (Wallowa)_Obstr	Spring Cr (Wallowa)	Hatchery Obstruction at 3700 ft level	Spring Cr (Wallowa)	0.00
267	Spring Cr-3 (Wallowa)	Spring Cr (Wallowa)	From Hatchery Obstruction at 3700 ft level to Alder Slope Ditch	Spring Cr (Wallowa)	2.75
268	Wallowa-13	Wallowa R	From Spring Cr to Trout Cr	Upper Wallowa R	0.20
269	Trout Cr (Wallowa)	Trout Cr (Wallowa)	From mouth at Wallowa R to end of valley in section 23	Upper Wallowa tribs	3.33
270	Wallowa-14	Wallowa R	From Trout Cr to Hurricane Cr	Upper Wallowa R	0.76
271	Hurricane Cr-1	Hurricane Cr	From mouth at Wallowa R to Lower Alder Slope Ditch	Hurricane Cr	4.04
272	Hurricane Cr-2	Hurricane Cr	From Lower Alder Slope Ditch to Moonshine Ditch Diversion Dam	Hurricane Cr	3.63
273	Hurricane Cr-3_Obstr	Hurricane Cr	Moonshine Ditch Diversion Dam	Hurricane Cr	0.00
274	Hurricane Cr-4	Hurricane Cr	From Moonshine Ditch Diversion Dam to Fall/Cascade at 4600 ft level	Hurricane Cr	0.47
275	Hurricane Cr-5_Obstr	Hurricane Cr	Fall/Cascade at 4600 ft level	Hurricane Cr	0.00
276	Hurricane Cr-6	Hurricane Cr	From Fall/Cascade at 4600 ft level to Slick Rock Falls just below Slick Rock Cr	Hurricane Cr	4.57
277	Wallowa-15	Wallowa R	From Hurricane Cr to Prairie Cr	Upper Wallowa R	0.31
278	Prairie Cr-1_Obstr_B	Prairie Cr	SW 2nd Bridge located adjacent to Enterprise City Park	Prairie Cr (Wallowa)	0.00
278	Prairie Cr-1_C	Prairie Cr	From SW 2nd Bridge located adjacent to Enterprise City Park to Hayes Fork, just upstream Hwy 82	Prairie Cr (Wallowa)	3.46
278	Prairie Cr-1_A	Prairie Cr	From mouth at Wallowa R to SW 2nd Bridge located adjacent to Enterprise City Park	Prairie Cr (Wallowa)	1.01
279	Hayes Fork	Hayes Fork	From culvert on Crow Creek Road at mouth of Hayes Fork to Springs at section line 17/16	Prairie Cr (Wallowa)	1.27
279	Hayes Fork_Obstr_A	Hayes Fork	Squashed pipe-arch structure on Crow Creek Road at mouth of Hayes Fork	Prairie Cr (Wallowa)	0.00
280	Prairie Cr-2	Prairie Cr	From Hayes Fork to OK Gulch Fork, trib in NW corner of section 8	Prairie Cr (Wallowa)	0.79
281	OK Gulch Fork_A	OK Gulch Fork	From mouth at Prairie Cr to squashed pipe-arch on unnamed road approx 1.7 miles from stream mouth	Prairie Cr (Wallowa)	1.69
281	OK Gulch Fork_Obstr_B1	OK Gulch Fork	Squashed pipe-arch on unnamed road approx 1.7 miles from stream mouth	Prairie Cr (Wallowa)	0.00
281	OK Gulch Fork_C2_A	OK Gulch Fork	From squashed pipe-arch on unnamed road approx 1.7 miles from stream mouth to another squashed pipe-arch on unnamed road approx 6.8 miles from stream mouth	Prairie Cr (Wallowa)	1.91
281	OK Gulch Fork_C2_Obstr_B2	OK Gulch Fork	Squashed pipe-arch on unnamed road approx 6.8 miles from stream mouth	Prairie Cr (Wallowa)	0.00
281	OK Gulch Fork_C3_C	OK Gulch Fork	From squashed pipe-arch on unnamed road approx 6.8 miles from stream mouth to Farmers Ditch Weir at 4050 ft level	Prairie Cr (Wallowa)	1.50
282	Prairie Cr-3_C	Prairie Cr	From culvert at McFetridge Lane on Prairie Cr approx 2 miles upstream of OK Gulch Fork to Dobbin Ditch	Prairie Cr (Wallowa)	1.13
282	Prairie Cr-3_Obstr_A	Prairie Cr	Culvert on unnamed road on Prairie Cr immediately upstream of OK Gulch Fork	Prairie Cr (Wallowa)	0.00
282	Prairie Cr-3_Obstr_B	Prairie Cr	Culvert at McFetridge Lane on Prairie Cr approx 2 miles upstream of OK Gulch Fork	Prairie Cr (Wallowa)	0.00
282	Prairie Cr-3_A	Prairie Cr	From culvert on unnamed road on Prairie Cr immediately upstream of OK Gulch Fork to culvert on McFetridge Lane approx 2 miles upstream	Prairie Cr (Wallowa)	0.83

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
283	Prairie Cr-4_C5_A	Prairie Cr	From Squashed pipe-arch on Grote Lane to box culvert on the Imnaha Hwy	Prairie Cr (Wallowa)	0.40
283	Prairie Cr-4_C3_A	Prairie Cr	From circular culvert approx 1.5 miles upstream of Dobbin Ditch on Bicenntenial Lane to wood water diversion located approx 3.5 miles upstream of Dobbin Ditch	Prairie Cr (Wallowa)	2.03
283	Prairie Cr-4_C2_Obstr_B2	Prairie Cr	Circular culvert approx 1.5 miles upstream of Dobbin Ditch on Bicenntenial Lane	Prairie Cr (Wallowa)	0.00
283	Prairie Cr-4_C2_A	Prairie Cr	From circular culvert approx 1.25 miles upstream of Dobbin Ditch on Bicenntenial Lane to next culvert upstream approx 0.25 miles further on Bicenntenial Lane	Prairie Cr (Wallowa)	0.24
283	Prairie Cr-4_C6_A	Prairie Cr	From box culvert on the Imnaha Hwy to squashed pipe-arch located upstream approx 0.7 miles (unnamed road)	Prairie Cr (Wallowa)	0.74
283	Prairie Cr-4_C4_A	Prairie Cr	From wood water diversion located approx 3.5 miles upstream of Dobbin Ditch to squashed pipe-arch located approx 0.5 miles upstream	Prairie Cr (Wallowa)	0.46
283	Prairie Cr-4_C4_Obstr_B4	Prairie Cr	Squashed pipe-arch on Grote Lane	Prairie Cr (Wallowa)	0.00
283	Prairie Cr-4_A	Prairie Cr	From Dobbin Ditch to circular culvert approx 1.25 miles upstream on Bicenntenial Lane	Prairie Cr (Wallowa)	1.26
283	Prairie Cr-4_C5_Obstr_B5	Prairie Cr	Box culvert on the Imnaha Hwy	Prairie Cr (Wallowa)	0.00
283	Prairie Cr-4_C6_Obstr_B6	Prairie Cr	Squashed pipe-arch located upstream of the Imnaha Hwy approx 0.7 miles (on unnamed road)	Prairie Cr (Wallowa)	0.00
283	Prairie Cr-4_C3_Obstr_B3	Prairie Cr	Wood water diversion located approx 3.5 miles upstream of Dobbin Ditch	Prairie Cr (Wallowa)	0.00
283	Prairie Cr-4_C7_C	Prairie Cr	From squashed pipe-arch located upstream of the Imnaha Hwy approx 0.7 miles (on unnamed road) to National Forest Boundary	Prairie Cr (Wallowa)	3.81
283	Prairie Cr-4_Obstr_B1	Prairie Cr	Circular culvert approx 1.25 miles upstream of Dobbin Ditch on Bicenntenial Lane	Prairie Cr (Wallowa)	0.00
284	Wallowa-16	Wallowa R	From Prairie Cr to Little Hurricane Cr	Upper Wallowa R	0.06
285	Little Hurricane Cr	Little Hurricane Cr	From mouth at Wallowa R to 3800 ft level	Upper Wallowa tribs	1.45
286	Wallowa-17_C	Wallowa R	From hatchery water intake diversion approx 0.1 miles upstream of Little Hurricane Cr to diversion above Dorrance Road at 3995 ft level	Upper Wallowa R	4.62
286	Wallowa-17_Obstr_B	Wallowa R	Hatchery water intake diversion approx 0.1 miles upstream of Little Hurricane Cr	Upper Wallowa R	0.00
286	Wallowa-17_A	Wallowa R	From Little Hurricane Cr to hatchery water intake diversion approx 0.1 miles upstream	Upper Wallowa R	0.10
287	Wallowa-18_Obstr	Wallowa R	Diversion above Dorrance Road at 3995 ft level	Upper Wallowa R	0.00
288	Wallowa-19_C2_Obstr_B2	Wallowa R	Big Bend Ditch Diversion Dam	Upper Wallowa R	0.00
288	Wallowa-19_Obstr_B1	Wallowa R	Unnamed diversion dam located near rodeo grounds in Joseph	Upper Wallowa R	0.00
288	Wallowa-19_C2_A	Wallowa R	From unnamed diversion dam located near rodeo grounds in Joseph to Big Bend Ditch Diversion Dam	Upper Wallowa R	0.29
288	Wallowa-19_A	Wallowa R	From water diversion above Dorrance Road to unnamed diversion dam located approx 2 miles upstream (near rodeo grounds in Joseph)	Upper Wallowa R	1.97
288	Wallowa-19_C3_C	Wallowa R	From Big Bend Ditch Diversion Dam to Wallowa Lake Dam	Upper Wallowa R	1.50
289	Wallowa-20_Obstr	Wallowa R	Dam at Wallowa Lake	Wallowa Lake	0.00
290	Wallowa-21	Wallowa R	From Dam at Wallowa Lake to head of lake	Wallowa Lake	3.94
291	Wallowa-22	Wallowa R	From head of Wallowa Lake to Falls about 4600 ft level	Wallowa above lake	1.06
292	Grande Ronde-26	Grande Ronde R	From Wallowa to Duncan Cr	Mid Grnd Rnd R 1	3.09

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
293	Duncan Canyon	Duncan Canyon	From mouth at Grande Ronde R to Miller Road at section line 10/11	Mid Grnd Rnd tribs 1	4.62
294	Grande Ronde-27	Grande Ronde R	From Duncan Cr to Lookingglass Cr	Mid Grnd Rnd R 1	0.68
295	Lookingglass Cr-1	Lookingglass Cr	From mouth at Grande Ronde R to Jarboe Cr	Lower Lookglass Cr	2.20
296	Jarboe Cr	Jarboe Cr	From mouth at Lookingglass Cr to Falls at 3700 ft level	Lower Lookglass Cr	3.50
297	Lookingglass Cr-2	Lookingglass Cr	From Jarboe Cr to Hatchery/Lookingglass Falls	Lower Lookglass Cr	0.27
298	Lookingglass Cr-3_Obstr	Lookingglass Cr	Hatchery/Lookingglass Falls	Lower Lookglass Cr	0.00
299	Lookingglass Cr-4	Lookingglass Cr	From Hatchery/Lookingglass Falls to Little Lookingglass Cr	Lower Lookglass Cr	1.26
300	Little Lookingglass Cr-1	Little Lookingglass Cr	From mouth at Lookingglass Cr to Mottet Cr	Little Lookglass Cr	1.60
301	Mottet Cr	Mottet Cr	From mouth at Little Lookingglass Cr to Jubilee Lake	Little Lookglass Cr	6.86
302	Little Lookingglass Cr-2	Little Lookingglass Cr	From Mottet Cr to Buzzard Cr	Little Lookglass Cr	4.38
303	Buzzard Cr	Buzzard Cr	From mouth at Little Lookingglass Cr to road crossing in NE corner of section 9	Little Lookglass Cr	2.93
304	Little Lookingglass Cr-3	Little Lookingglass Cr	From Buzzard Cr to Unnamed Trib just above 4000 ft level	Little Lookglass Cr	1.73
305	Little Lookingglass Trib	Little Lookingglass trib	From mouth to road crossing in NE corner of section 11	Little Lookglass Cr	0.45
306	Little Lookingglass Cr-4	Little Lookingglass Cr	From Unnamed Trib just above 4000 ft level to road crossing near section line 2/11	Little Lookglass Cr	0.74
307	Lookingglass Cr-5	Lookingglass Cr	From Little Lookingglass Cr to Eagle Cr	Upper Lookglass Cr	3.93
308	Eagle Cr	Eagle Cr	From mouth at Lookingglass Cr to 3300 ft level	Upper Lookglass Cr	1.52
309	Lookingglass Cr-6	Lookingglass Cr	From Eagle Cr to Summer Cr	Upper Lookglass Cr	2.07
310	Summer Cr	LookingGlass	From mouth at Lookingglass Cr to Swamp Cr	Upper Lookglass Cr	1.94
311	Lookingglass Cr-7	Lookingglass Cr	From Summer Cr to Falls at 4500 ft level	Upper Lookglass Cr	4.67
312	Grande Ronde-28	Grande Ronde R	From Lookingglass Cr to Rysdam Canyon	Mid Grnd Rnd R 2	1.32
313	Rysdam Canyon	Rysdam Canyon	From mouth at Grande Ronde R to Merritt Lane Road in SE corner of section 21	Mid Grnd Rnd tribs 1	5.54
314	Grande Ronde-29	Grande Ronde R	From Rysdam Canyon to Cabin Cr	Mid Grnd Rnd R 2	1.29
315	Cabin Cr-1	Cabin Cr	From mouth at Grande Ronde R to SF/NF confluence	Mid Grnd Rnd tribs 2	1.54
316	Cabin Cr SF_A	SF Cabin Cr	From mouth at Cabin Cr/NF confluence to culvert at start of Robinson Rd. Road mi. 11.65	Mid Grnd Rnd tribs 2	0.34
316	Cabin Cr SF_Obstr_B	SF Cabin Cr	Culvert at start of Robinson Rd. Road mi. 11.65	Mid Grnd Rnd tribs 2	0.00
316	Cabin Cr SF_C	SF Cabin Cr	From culvert at start of Robinson Rd to 2900 ft level	Mid Grnd Rnd tribs 2	1.33
317	Cabin Cr NF_Obstr_B	NF Cabin Cr	County road culvert	Mid Grnd Rnd tribs 2	0.00
317	Cabin Cr NF_A	NF Cabin Cr	From mouth at Cabin Cr/SF confluence to county road culvert	Mid Grnd Rnd tribs 2	1.64
317	Cabin Cr NF_C	NF Cabin Cr	From County road culvert to 3400 ft level	Mid Grnd Rnd tribs 2	1.91
318	Grande Ronde-30	Grande Ronde R	From Cabin Cr to Gordon Cr	Mid Grnd Rnd R 2	7.94
319	Gordon Cr-1	Gordon Cr	From mouth at Grande Ronde R to Medicine Cr	Mid Grnd Rnd tribs 2	0.65
320	Medicine Cr	Medicine Cr	From mouth at Gordon Cr to 2900 ft level	Mid Grnd Rnd tribs 2	2.24
321	Gordon Cr-2	Gordon Cr	From Medicine Cr to 3400 ft level	Mid Grnd Rnd tribs 2	6.50
322	Grande Ronde-31	Grande Ronde R	From Gordon Cr to Phillips/Clark Cr	Mid Grnd Rnd R 2	3.21
323	Phillips Cr-1_A	Phillips Cr	From mouth at Grande Ronde R to unnamed diversion dam in Elgin	Phillips Cr	1.10

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
323	Phillips Cr-1_Obstr_B	Phillips Cr	Unnamed diversion dam in Elgin	Phillips Cr	0.00
323	Phillips Cr-1_C	Phillips Cr	From unnamed diversion dam in Elgin to Little Phillips Cr	Phillips Cr	3.27
324	Little Phillips Cr	Little Phillips Cr	From mouth at Phillips Cr to 4400 ft level	Phillips Cr	7.65
325	Phillips Cr-2	Phillips Cr	From Little Phillips Cr to Bailey Cr	Phillips Cr	1.85
326	Bailey Cr	Bailey Cr	From mouth at Phillips Cr to fork at 3600 ft level	Phillips Cr	2.21
327	Phillips Cr-3	Phillips Cr	From Bailey Cr to Phillips Cr EF	Phillips Cr	4.20
328	Phillips Cr EF-1	EF Phillips Cr	From mouth at Phillips Cr to Pedro Cr	Phillips Cr	1.11
329	Pedro Cr	Pedro Cr	From mouth at Phillips Cr EF to headwaters at 4780 ft level	Phillips Cr	3.53
330	Phillips Cr EF-2	EF Phillips Cr	From Pedro Cr to 4400 ft level	Phillips Cr	2.68
331	Phillips Cr-4	Phillips Cr	From Phillips Cr EF to 4200 ft level	Phillips Cr	3.57
332	Clark Cr-1	Clark Cr	From mouth at Grande Ronde R to NF of Clark Cr	Phillips Cr	5.94
333	Clark Cr NF_A	NF Clark Cr	From mouth at Clark Cr to county road culvert	Phillips Cr	2.68
333	Clark Cr NF_Obstr_B	NF Clark Cr	County road culvert	Phillips Cr	0.00
333	Clark Cr NF_C	NF Clark Cr	From County road culvert to road crossing above 4200 ft level	Phillips Cr	5.86
334	Clark Cr-2	Clark Cr	From Clark Cr NF to MF	Phillips Cr	0.27
335	Clark Cr MF	MF Phillips Cr	From mouth at Clark Cr to 3500 ft level	Phillips Cr	2.05
335	Clark Cr MF_Obstr_A	Clark Cr	Culvert at lower end of Clark Cr MF	Phillips Cr	0.00
336	Clark Cr-3	Clark Cr	From MF to Falls at 3750 ft level	Phillips Cr	3.47
337	Clark Cr-4	Clark Cr	Falls at 3750 ft level to Falls at 4400 ft level	Phillips Cr	2.48
338	Clark Cr-5	Clark Cr	From Falls at 4400 ft level to headwaters in SE corner of section 6	Phillips Cr	4.50
339	Grande Ronde-32	Grande Ronde R	From Phillips/Clark Cr to Indian Cr	Mid Grnd Rnd R 2	2.37
340	Indian Cr-1	Indian Cr	From mouth at Grande Ronde R to Shaw Cr	Lower Indian Cr	3.30
341	Shaw Cr	Shaw Cr	From mouth at Indian Cr to 3100 ft level	Lower Indian Cr	1.92
342	Indian Cr-2	Indian Cr	From Shaw Cr to Little Indian Cr	Lower Indian Cr	6.00
343	Little Indian Cr	Little Indian Cr	From mouth at Indian Cr to road crossing at 4100 ft level	Lower Indian Cr	2.53
344	Indian Cr-3	Indian Cr	From Little Indian Cr to Indian Cr NF	Upper Indian Cr	1.28
345	Indian Cr NF	NF Indian Cr	From mouth at Indian Cr to road crossing at section line 3/2	Upper Indian Cr	2.50
346	Indian Cr-4_C	Indian Cr	From USFS culvert to Camp Cr	Upper Indian Cr	0.85
346	Indian Cr-4_Obstr_B	Indian Cr	USFS culvert	Upper Indian Cr	0.00
346	Indian Cr-4_A	Indian Cr	From Indian Cr NF to USFS culvert	Upper Indian Cr	4.75
347	Camp Cr	Camp Cr	From mouth at Indian Cr to 5200 ft level	Upper Indian Cr	1.33
348	Indian Cr-5	Indian Cr	From Camp Cr to Indian Cr EF	Upper Indian Cr	1.41
349	Indian Cr EF_A	EF Indian Cr	From mouth at Indian Cr to USFS culvert	Upper Indian Cr	1.15
349	Indian Cr EF_Obstr_B	EF Indian Cr	USFS culvert	Upper Indian Cr	0.00
349	Indian Cr EF_C	EF Indian Cr	From USFS culvert to trail crossing in section 32	Upper Indian Cr	1.70
350	Indian Cr-6	Indian Cr	From Indian Cr EF to 6000 ft level	Upper Indian Cr	2.68
351	Grande Ronde-33	Grande Ronde R	From Indian Cr to Willow Cr	Mid Grnd Rnd R 2	4.21
352	Willow Cr-1_A	Willow Cr	From mouth at Grande Ronde R to unnamed diversion dam	Lower Willow Cr	3.79
352	Willow Cr-1_Obstr_B	Willow Cr	Unnamed diversion dam	Lower Willow Cr	0.00
352	Willow Cr-1_C	Willow Cr	From unnamed diversion dam to Mill Cr	Lower Willow Cr	1.40
353	Mill Cr (Willow)	Mill Cr (Willow)	From mouth at Willow Cr to fork below Sanderson Springs	Lower Willow Cr	5.46
354	Willow Cr-2	Willow Cr	From Mill Cr to End Cr	Lower Willow Cr	2.13
355	End Cr_A	End Cr	From mouth at Willow Cr to culvert approx 2.5 miles from End Cr mouth	Lower Willow Cr	2.52
355	End Cr_C_A	End Cr	From culvert approx 2.5 miles from End Cr mouth to culvert approx 3 miles from mouth	Lower Willow Cr	0.53
355	End Cr_C_Obstr_B	End Cr	Culvert approx 3 miles from mouth	Lower Willow Cr	0.00
355	End Cr_C_C	End Cr	From culvert approx 3 miles from mouth to road crossing above 3200 ft level on Fizzell Cr	Lower Willow Cr	0.98
355	End Cr_Obstr_B	End Cr	Culvert approx 2.5 miles from End Cr mouth	Lower Willow Cr	0.00
356	Willow Cr-3	Willow Cr	From End Cr to Coon Cr	Lower Willow Cr	2.06
357	Coon Cr_Obstr_B	Coon Cr	Culvert approx 1.5 miles from mouth	Lower Willow Cr	0.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
357	Coon Cr_C	Coon Cr	From culvert approx 1.5 miles from mouth to 3400 ft level	Lower Willow Cr	1.21
357	Coon Cr_A	Coon Cr	From mouth at Willow Cr to unnamed culvert approx 1.5 miles from mouth	Lower Willow Cr	1.49
358	Willow Cr-4	Willow Cr	From Coon Cr to Dry Cr	Lower Willow Cr	0.37
359	Dry Cr-1 (Willow)_Obstr_B	Dry Cr (Willow)	Unnamed dam approx 1.9 miles from mouth	Upper Willow Cr	0.00
359	Dry Cr-1 (Willow)_C_C	Dry Cr (Willow)	From unnamed culvert approx 2.6 miles from mouth at Willow Cr to Finley Cr	Upper Willow Cr	7.07
359	Dry Cr-1 (Willow)_C_Obstr_B	Dry Cr (Willow)	Unnamed culvert approx 2.6 miles from mouth at Willow Cr	Upper Willow Cr	0.00
359	Dry Cr-1 (Willow)_C_A	Dry Cr (Willow)	From unnamed dam approx 1.9 miles from mouth at Willow Cr to unnamed culvert approx 2.6 miles from mouth	Upper Willow Cr	0.67
359	Dry Cr-1 (Willow)_A	Dry Cr (Willow)	From mouth at Willow Cr to unnamed dam approx 1.9 miles from mouth	Upper Willow Cr	1.90
360	Finley Cr	Finley Cr	From mouth at Dry Cr to 3800 ft level	Upper Willow Cr	2.69
361	Dry Cr-2 (Willow)	Dry Cr (Willow)	From Finley Cr to fork at section line 18/19	Upper Willow Cr	3.86
362	Willow Cr-5	Willow Cr	From Dry Cr to Smith/Fir/Lewis confluence	Upper Willow Cr	0.75
363	Smith Cr_C	Smith Cr	From unnamed culvert approx 2 miles from mouth at Willow/Fir/Lewis confluence to 3600 ft level	Upper Willow Cr	3.07
363	Smith Cr_A	Smith Cr	From mouth at Willow/Fir/Lewis confluence to unnamed culvert approx 2 miles from mouth	Upper Willow Cr	2.09
363	Smith Cr_Obstr_B	Smith Cr	Unnamed culvert approx 2 miles from mouth	Upper Willow Cr	0.00
364	Fir Cr_A	Fir Cr	From mouth at Willow Cr/Smith/Lewis confluence to unnamed culvert approx 2.2 miles from mouth	Upper Willow Cr	2.24
364	Fir Cr_C	Fir Cr	From unnamed culvert approx 2.2 miles from mouth at Willow Cr/Smith/Lewis confluence to 3600 ft level	Upper Willow Cr	1.53
364	Fir Cr_Obstr_B	Fir Cr	Unnamed culvert approx 2.2 miles from mouth	Upper Willow Cr	0.00
365	Lewis Branch	Lewis Branch	From mouth at Willow Cr/Smith/Fir confluence to 3200 ft level	Upper Willow Cr	2.02
366	Grande Ronde-34_B	Grande Ronde R	Placeholder located just upstream of the State Ditch, at what is now called the mouth of Catherine Cr	Mid Grnd Rnd R 3	0.00
366	Grande Ronde-34_A	Grande Ronde R	From Willow Cr to State Ditch/Catherine Cr confluence in section 10	Mid Grnd Rnd R 3	10.45
367	Catherine Cr-1_Obstr_B1	Catherine Cr	Fleet's Loop Dam on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C2_Obstr_B2	Catherine Cr	Fleet Reservoir Dam 2 on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C3_Obstr_B3	Catherine Cr	Grays Slough Dam on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C2_A	Catherine Cr	From Fleet's Loop Dam approx 4.25 miles upstream from mouth at Grande Ronde R/State Ditch in section 10 to Fleet Reservoir Dam 2	Lower Catherine Cr	1.31
367	Catherine Cr-1_C5_A	Catherine Cr	From Elmer's Reservoir Dam 1 to Elmer's Reservoir Dam 4 on lower Catherine Creek	Lower Catherine Cr	0.60
367	Catherine Cr-1_C3_A	Catherine Cr	From Fleet Reservoir Dam 2 to Grays Slough Dam on lower Catherine Creek	Lower Catherine Cr	0.92
367	Catherine Cr-1_C5_Obstr_B5	Catherine Cr	Elmer's Reservoir Dam 4 on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C6_A	Catherine Cr	From Elmer's Reservoir Dam 4 to Elmer's Reservoir Dam 2 (upstream of no. 4) on lower Catherine Creek	Lower Catherine Cr	0.56
367	Catherine Cr-1_C6_Obstr_B6	Catherine Cr	Elmer's Reservoir Dam 2 on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C7_A	Catherine Cr	From Elmer's Reservoir Dam 2 to Elmer's Reservoir Dam 3 on lower Catherine Creek	Lower Catherine Cr	0.24

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
367	Catherine Cr-1_C7_Obstr_B7	Catherine Cr	Elmer's Reservoir Dam 3 on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C7_C	Catherine Cr	From Elmer's Reservoir Dam 3 on lower Catherine Creek to Mill Cr	Lower Catherine Cr	9.78
367	Catherine Cr-1_C4_Obstr_B4	Catherine Cr	Elmer's Reservoir Dam 1 on lower Catherine Creek	Lower Catherine Cr	0.00
367	Catherine Cr-1_C4_A	Catherine Cr	From Grays Slough Dam to Elmer's Reservoir Dam 1 on lower Catherine Creek	Lower Catherine Cr	6.16
367	Catherine Cr-1_A	Catherine Cr	From mouth at Grande Ronde R/State Ditch in section 10 to Fleet's Loop Dam approx 4.25 miles upstream	Lower Catherine Cr	4.25
368	Mill Cr-1 (Catherine)	Mill Cr (Catherine)	From mouth at Catherine Cr to habitat change at 2700 ft level	Lower Catherine tribs	1.34
369	Mill Cr-2 (Catherine)_Obstr_B	Mill Cr (Catherine)	Unnamed Union County culvert	Lower Catherine tribs	0.00
369	Mill Cr-2 (Catherine)_A	Mill Cr (Catherine)	From Habitat Change at 2700 ft level to unnamed culvert located approx 3/4 distance to Diversion above 4400 ft level	Lower Catherine tribs	5.36
369	Mill Cr-2 (Catherine)_C	Mill Cr (Catherine)	From unnamed Union County culvert to Diversion above 4400 ft level	Lower Catherine tribs	1.87
370	Catherine Cr-2	Catherine Cr	From Mill Cr to Ladd Cr	Mid Catherine Cr	6.98
371	Ladd Cr-1	Ladd Cr	From mouth at Catherine Cr to West edge of Marsh Area at 2705 ft level	Mid Catherine tribs	4.89
372	Ladd Cr-2	Ladd Cr	From West edge of Marsh Area at 2705 ft level to Hwy 84 crossing at 3000 ft level	Mid Catherine tribs	2.56
373	Catherine Cr-3_C2_Obstr_B2	Catherine Cr	Upper Davis Dam	Mid Catherine Cr	0.00
373	Catherine Cr-3_C2_A	Catherine Cr	From Lower Davis Dam to Upper Davis Dam	Mid Catherine Cr	0.46
373	Catherine Cr-3_A	Catherine Cr	From Ladd Cr to Lower Davis Dam	Mid Catherine Cr	2.94
373	Catherine Cr-3_Obstr_B1	Catherine Cr	Lower Davis Dam	Mid Catherine Cr	0.00
373	Catherine Cr-3_C3_Obstr_B3	Catherine Cr	Unnamed diversion dam on Catherine Creek approx 800 ft upstream of Upper Davis Dam	Mid Catherine Cr	0.00
373	Catherine Cr-3_C4_C	Catherine Cr	From unnamed diversion dam on Catherine Cr to Little Cr	Mid Catherine Cr	0.80
373	Catherine Cr-3_C3_A	Catherine Cr	From Upper Davis Dam to Upper Davis Dam	Mid Catherine Cr	0.15
374	Little Cr-1	Little Cr	From mouth at Catherine Cr to Godley Road section 13	Mid Catherine tribs	2.28
375	Little Cr-2	Little Cr	From Godley Road section 13 to Falls at 3300 ft level	Mid Catherine tribs	6.92
376	Catherine Cr-4	Catherine Cr	From Little Cr to Pyles Canyon	Mid Catherine Cr	0.97
377	Pyles Canyon-1	Pyles Canyon	From mouth at Catherine Cr to start of canyon at 2820 ft level	Mid Catherine tribs	4.85
378	Pyles Canyon-2	Pyles Canyon	From start of the canyon at 2820 ft level to pond in SW corner of section 6	Mid Catherine tribs	2.06
379	Catherine Cr-5	Catherine Cr	From Pyles Canyon to start of dewatered section at 10th St	Mid Catherine Cr	2.48
380	Catherine Cr-6_A	Catherine Cr	From start of dewatered section at 10th St to Union Water Supply Dam	Mid Catherine Cr	0.20
380	Catherine Cr-6_C3_A	Catherine Cr	From unnamed dam to Schwackhammer Dam	Mid Catherine Cr	0.76
380	Catherine Cr-6_C4_C	Catherine Cr	From Schwackhammer Dam to State Ditch above Hwy 203 in section 29	Mid Catherine Cr	1.44
380	Catherine Cr-6_C3_Obstr_B3	Catherine Cr	Schwackhammer Dam	Mid Catherine Cr	0.00
380	Catherine Cr-6_C2_Obstr_B2	Catherine Cr	Unnamed dam approx 1/4 mile upstream of the Union Water Supply Dam	Mid Catherine Cr	0.00
380	Catherine Cr-6_C2_A	Catherine Cr	From Union Water Supply Dam to unnamed dam approx 1/4 mile upstream	Mid Catherine Cr	0.28
380	Catherine Cr-6_Obstr_B1	Catherine Cr	Union Water Supply Dam	Mid Catherine Cr	0.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
381	Catherine Cr-7_A	Catherine Cr	From State Ditch above Hwy 203 in section 29 to unnamed dam structure approx 1/3 mile upstream	Mid Catherine Cr	0.31
381	Catherine Cr-7_C	Catherine Cr	From unnamed dam structure located approx 1/3 mile upstream of State Ditch to Little Catherine/Milk Cr confluence	Mid Catherine Cr	7.50
381	Catherine Cr-7_Obstr_B	Catherine Cr	Unnamed dam structure approx 1/3 mile upstream from State Ditch	Mid Catherine Cr	0.00
381	Catherine Cr-7_Obstr_A	Catherine Cr	Unnamed dam downstream of the reach that begins at the State Ditch above Hwy 203 in section 29	Mid Catherine Cr	0.00
382	Little Catherine Cr_A	Little Catherine Cr	From mouth at Catherine Cr to unnamed culvert approx 3/4 mile upstream	Mid Catherine tribs	0.50
382	Little Catherine Cr_Obstr_B	Little Catherine Cr	Unnamed culvert approx 3/4 mile upstream from the stream's mouth	Mid Catherine tribs	0.00
382	Little Catherine Cr_C	Little Catherine Cr	From unnamed culvert approx 3/4 mile upstream from the stream's mouth to bed rock shute at 3400 ft level	Mid Catherine tribs	0.07
383	Milk Cr-1 (Catherine)	Milk Cr (Catherine)	From mouth at Little Catherine Cr to beginning of canyon at 3440 ft level	Mid Catherine tribs	1.60
383	Milk Cr-1 (Catherine)_Obstr_A	Milk Cr (Catherine)	Culvert owned by Oregon Department of Transportation on Milk Creek in vicinity of the stream mouth	Mid Catherine tribs	0.00
384	Milk Cr-2 (Catherine)	Milk Cr (Catherine)	From beginning of canyon at 3440 ft level to 4200 ft level	Mid Catherine tribs	2.41
385	Catherine Cr-8	Catherine Cr	From Little Catherine/Milk Cr confluence to Scout Cr	Mid Catherine Cr	3.53
386	Scout Cr	Scout Cr	From mouth at Catherine Cr to 3800 ft level	Mid Catherine tribs	0.40
387	Catherine Cr-9	Catherine Cr	From Scout Cr to SF/NF confluence	Mid Catherine Cr	1.01
388	Catherine Cr SF-1	SF Catherine Cr	From mouth at Catherine Cr/NF confluence to Sand Pass/Collins Cr confluence	SF Catherine Cr	5.63
389	Collins Cr	Collins Cr	From mouth at Catherine Cr SF to 5800 ft level	SF Catherine Cr	1.33
390	Sand Pass Cr	Sand Pass Cr	From mouth at Catherine Cr SF to 5400 ft level	SF Catherine Cr	0.71
391	Catherine Cr SF-2	SF Catherine Cr	From Sand Pass/Collins Cr confluence to 6200 ft level	SF Catherine Cr	2.43
392	Catherine Cr NF-1	NF Catherine Cr	From mouth at Catherine Cr/SF confluence to Buck Cr	NF Caterine Cr.	1.12
393	Buck Cr (Catherine)	Buck Cr (Catherine)	From mouth at Catherine Cr NF to 4300 ft level	NF Caterine Cr.	0.90
394	Catherine Cr NF-2	NF Catherine Cr	From Buck Cr to MF	NF Caterine Cr.	1.73
395	Catherine Cr MF	MF Catherine Cr	From mouth at Catherine Cr NF to 4700 ft level	NF Caterine Cr.	1.28
396	Catherine Cr NF-3	NF Catherine Cr	From MF to Falls at 6000 ft level	NF Caterine Cr.	6.73
397	Grande Ronde-35_A	Grande Ronde R	From Catherine Cr/lower end of the State Ditch in section 10 to upper end of the State Ditch in section 33	Mid Grnd Rnd R 3	4.44
397	Grande Ronde-35_B	Grande Ronde R	From upper end of State Ditch in section 33 to 2715 ft level at Gravel Pit East of Island City	Mid Grnd Rnd R 3	4.53
398	Grande Ronde-36_C	Grande Ronde R	From boulder/cascades barrier at Riverside Park to Orodell Diversion at 2810 ft level	Mid Grnd Rnd R 3	1.54
398	Grande Ronde-36_Obstr_B	Grande Ronde R	Boulder/cascades barrier at Riverside Park	Mid Grnd Rnd R 3	0.00
398	Grande Ronde-36_A	Grande Ronde R	From Gravel Pit East of Island City at 2715 ft level to boulder/cascades barrier at Riverside Park	Mid Grnd Rnd R 3	3.14
399	Grande Ronde-37_Obstr_A	Grande Ronde R	Orodell Diversion	Mid Grnd Rnd R 4	0.00
399	Grande Ronde-37_B	Grande Ronde R	From Orodell Diversion at 2810 ft level to Five Points Cr	Mid Grnd Rnd R 4	6.43
400	Five Points Cr-1	Five Points Cr	From mouth at Grande Ronde R to Pelican Cr	Lower 5-points Cr	1.37
401	Pelican Cr-1	Pelican Cr	From mouth at Five Points Cr to Dry Cr	Lower 5-points Cr	1.61
402	Dry Cr-1 (Five Points)	Dry Cr (Five Points)	From mouth at Pelican Cr to to California Gulch	Lower 5-points Cr	1.83
403	Calfornia Gulch_Obstr_B	Calfornia Gulch	Unnamed culvert on USFS road approximately 1.7 miles upstream of stream's mouth	Lower 5-points Cr	0.00

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403	Calfornia Gulch_C	Calfornia Gulch	From unnamed culvert on USFS road approximately 1.7 miles upstream of stream's mouth to pond at 3920 ft level	Lower 5-points Cr	2.90
403	Calfornia Gulch_A	Calfornia Gulch	TEST	Lower 5-points Cr	1.71
404	Dry Cr-2 (Five Points)_A	Dry Cr (Five Points)	From Calfornia Gulch to unnamed culvert owned by Oregon Dept Transportation approx 1/3 mile upstream	Lower 5-points Cr	0.35
404	Dry Cr-2 (Five Points)_C	Dry Cr (Five Points)	From unnamed culvert owned by Oregon Dept Transportation approx 1/3 mile upstream of Calfornia Gulch to headwaters in NW corner of section 1	Lower 5-points Cr	6.26
404	Dry Cr-2 (Five Points)_Obstr_B	Dry Cr (Five Points)	Unnamed culvert owned by Oregon Dept Transportation approx 1/3 mile upstream of California Gulch	Lower 5-points Cr	0.00
405	Pelican Cr-2	Pelican Cr	From Dry Cr to 3500 ft level	Lower 5-points Cr	2.33
406	Five Points Cr-2	Five Points Cr	From Pelican Cr to Fiddlers Hell	Upper 5-points Cr	7.72
407	Fiddlers Hell	Fiddlers Hell	From mouth at Five Points Cr to tribs below 4000 ft level	Upper 5-points Cr	0.91
408	Five Points Cr-3	Five Points Cr	From Fiddlers Hell to MF/Mt Emily Cr confluence	Upper 5-points Cr	3.93
409	Mt Emily	Mt Emily	From mouth at Five Points Cr to 5200 ft level	Upper 5-points Cr	2.88
410	Five Points MF	MF Five Points Cr	From mouth at Five Points/Mt Emily Cr confluence to 4900 ft level	Upper 5-points Cr	1.95
411	Grande Ronde-38	Grande Ronde R	From Five Points Cr to Rock Cr	Mid Grnd Rnd R 4	0.37
412	Rock Cr-1 (GR)	Rock Cr (GR)	From mouth at Grande Ronde R to Sheep Cr	Rock Cr (GR)	2.81
413	Sheep Cr (GR Rock)	Sheep Cr (GR Rock)	From mouth at Rock Cr to Deal Cr	Rock Cr (GR)	5.06
414	Rock Cr-2 (GR)	Rock Cr (GR)	From Sheep Cr to Little Rock Cr	Rock Cr (GR)	1.50
415	Little Rock Cr	Little Rock Cr	From mouth at Rock Cr to Beaver Drive in section 23	Rock Cr (GR)	7.11
416	Rock Cr-3 (GR)	Rock Cr (GR)	From Little Rock Cr to EF Rock Cr	Rock Cr (GR)	8.39
417	Rock Cr EF (GR)_C	EF Rock Cr	From USFS culvert approx 0.9 miles upstream of Rock Cr EF mouth to headwaters at 5750 ft level	Rock Cr (GR)	2.99
417	Rock Cr EF (GR)_Obstr_B	EF Rock Cr	USFS culvert approx 0.9 miles upstream of Rock Cr EF mouth	Rock Cr (GR)	0.00
417	Rock Cr EF (GR)_A	EF Rock Cr	From mouth at Rock Cr to USFS culvert approx 0.9 miles upstream	Rock Cr (GR)	0.89
418	Rock Cr-4 (GR)_C	Rock Cr (GR)	From USFS culvert approx 1.5 miles upstream of the confluence with EF Rock Cr to 5000 ft level	Rock Cr (GR)	0.61
418	Rock Cr-4 (GR)_Obstr_B	Rock Cr (GR)	USFS culvert approx 1.5 miles upstream of confluence with EF Rock Cr	Rock Cr (GR)	0.00
418	Rock Cr-4 (GR)_A	Rock Cr (GR)	From EF Rock Cr to USFS culvert approx 1.5 miles upstream	Rock Cr (GR)	1.48
419	Grande Ronde-39	Grande Ronde R	From Rock Cr to Whiskey Cr	Mid Grnd Rnd R 4	2.72
420	Whiskey Cr-1 (GR)	Whiskey Cr (GR)	From mouth at Grande Ronde R to Little Whiskey Cr	Mid Grnd Rnd tribs 4	2.94
421	Little Whiskey Cr	Little Whiskey Cr	From mouth at Whiskey Cr to 4000 ft level	Mid Grnd Rnd tribs 4	3.68
422	Whiskey Cr-2 (GR)	Whiskey Cr (GR)	From Little Whiskey Cr to 4700 ft level	Mid Grnd Rnd tribs 4	6.44
423	Grande Ronde-40	Grande Ronde R	From Whiskey Cr to Spring Cr	Mid Grnd Rnd R 4	1.04
424	Spring Cr-1 (GR)	Spring Cr (GR)	From mouth at Grande Ronde R to Spring Cr SF	Mid Grnd Rnd tribs 4	2.83
425	Spring Cr SF (GR)	SF Spring Cr (GR)	From mouth at Spring Cr to 3500 ft level	Mid Grnd Rnd tribs 4	2.76
426	Spring Cr-2 (GR)	Spring Cr (GR)	From Spring Cr SF to fork at section line 13/18	Mid Grnd Rnd tribs 4	4.79
427	Grande Ronde-41	Grande Ronde R	From Spring Cr to Jordan Cr	Mid Grnd Rnd R 4	1.38
428	Jordan Cr_Obstr_B	Jordan Cr	USFS culvert approx 11.1 miles upstream of Jordan Cr mouth	Mid Grnd Rnd tribs 4	0.00
428	Jordan Cr_C	Jordan Cr	From USFS culvert approx 11.1 miles upstream of Jordan Cr mouth to middle of section 4	Mid Grnd Rnd tribs 4	1.46

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
428	Jordan Cr_A	Jordan Cr	From mouth at Grande Ronde R to USFS culvert approx 11.1 miles upstream	Mid Grnd Rnd tribs 4	11.13
429	Grande Ronde-42	Grande Ronde R	From Jordan Cr to Bear Cr	Mid Grnd Rnd R 4	0.30
430	Bear Cr (4th GR)	Bear Cr (4th GR)	From mouth at Grande Ronde R to 3300 ft level	Mid Grnd Rnd tribs 4	2.26
431	Bear Cr Trib (4th GR)	Bear Cr (4th GR) trib	From mouth at Bear Cr to Hwy 244	Mid Grnd Rnd tribs 4	0.67
432	Grande Ronde-43	Grande Ronde R	From Bear Cr to Beaver Cr	Mid Grnd Rnd R 4	6.72
433	Beaver Cr-1 (GR)	Beaver Cr (GR)	From mouth at Grande Ronde R to Hoodoo Cr	Mid Grnd Rnd tribs 4	9.03
434	Hoodoo Cr	Hoodoo CR	From mouth at Beaver Cr to Falls at 4900 ft level	Mid Grnd Rnd tribs 4	1.60
435	Beaver Cr-2 (GR)_A	Beaver Cr (GR)	From Hoodoo Cr to USFS culvert approx 2.9 miles upstream	Mid Grnd Rnd tribs 4	2.85
435	Beaver Cr-2 (GR)_Obstr_B	Beaver Cr (GR)	USFS culvert approx 2.9 miles upstream of Hoodoo Cr	Mid Grnd Rnd tribs 4	0.00
435	Beaver Cr-2 (GR)_C	Beaver Cr (GR)	From USFS culvert approx 2.9 miles upstream of Hoodoo Cr to Dam at La Grande Rsv	Mid Grnd Rnd tribs 4	1.58
436	Grande Ronde-44	Grande Ronde R	From Beaver Cr to Meadow Cr	Mid Grnd Rnd R 4	1.52
437	Meadow Cr-1 (2nd GR)	Meadow Cr (2nd GR)	From mouth at Grande Ronde R to Dark Canyon	Lower Meadow Cr	0.72
438	Dark Canyon	Dark Canyon	From mouth at Meadow Cr to 4180 ft level	McCoy Cr	7.36
439	Meadow Cr-2 (2nd GR)	Meadow Cr (2nd GR)	From Dark Canyon to McCoy Cr	Lower Meadow Cr	1.38
440	McCoy Cr-1	McCoy Cr	From mouth at Meadow Cr to Mclntyre Cr	McCoy Cr	1.35
441	Mclntyre Cr	McIntyr Cr	From mouth at McCoy Cr to road 21 crossing in section 32	McCoy Cr	6.41
442	McCoy Cr-2	McCoy Cr	From Mclyntyre Cr to Syrup Cr	McCoy Cr	4.63
443	Syrup Cr	Syrup Cr	From mouth at McCoy Cr to 3800 ft level	McCoy Cr	1.73
444	McCoy Cr-3	McCoy Cr	From Syrup Cr to Ensign Cr	McCoy Cr	6.98
445	Meadow Cr-3 (2nd GR)	Meadow Cr (2nd GR)	From McCoy Cr to Marley Cr	Lower Meadow Cr	3.39
446	Marley Cr_Obstr_A	Marley Cr	Unnamed culvert on Marley Cr near the stream mouth; culvert is owned by Oregon Dept Transportation	Upper Meadow Cr	0.00
446	Marley Cr	Marley Cr	From mouth at Meadow Cr to fork at 4400 ft level	Lower Meadow Cr	5.32
447	Meadow Cr-4 (2nd GR)	Meadow Cr (2nd GR)	From Marley Cr to Burnt Corral Cr	Upper Meadow Cr	0.90
448	Burnt Corral Cr-1_C	Burnt Corral Cr	From unnamed culvert owned by Oregon Dept Transportation approx 1.7 miles upstream of stream mouth to Sullivan Gulch	Upper Meadow Cr	0.74
448	Burnt Corral Cr-1_Obstr_B	Burnt Corral Cr	Unnamed culvert owned by Oregon Dept Transportation approx 1.7 miles upstream of stream mouth	Upper Meadow Cr	0.00
448	Burnt Corral Cr-1_A	Burnt Corral Cr	From mouth at Meadow Cr to unnamed culvert owned by Oregon Dept Transportation approx 1.7 miles upstream	Upper Meadow Cr	1.79
449	Sullivan Gulch	Sullivan Gulch	From mouth at Burnt Corral Cr to headwaters in SE corner of section 27	Upper Meadow Cr	3.05
450	Burnt Corral Cr-2	Burnt Corral Cr	From Sullivan Gulch to Burnt Corral Cr EF	Upper Meadow Cr	1.93
451	Burnt Corral Cr EF_Obstr_A	EF Burnt Corral Cr	USFS culvert on Burnt Corral Cr EF near its mouth	Upper Meadow Cr	0.00
451	Burnt Corral Cr EF_Obstr_B	EF Burnt Corral Cr	USFS culvert approx 0.9 miles upstream of the stream mouth	Upper Meadow Cr	0.00
451	Burnt Corral Cr EF_C	EF Burnt Corral Cr	From USFS culvert approx 0.9 miles upstream of the stream mouth to 4650 ft level	Upper Meadow Cr	0.69
451	Burnt Corral Cr EF_A	EF Burnt Corral Cr	From mouth at Burnt Corral Cr to USFS culvert approx 0.9 miles upstream	Upper Meadow Cr	0.86
452	Burnt Corral Cr-3	Burnt Corral Cr	From Burnt Corral Cr EF to 4600 ft level	Upper Meadow Cr	1.68
453	Meadow Cr-5 (2nd GR)	Meadow Cr (2nd GR)	From Burnt Corral Cr to Battle Cr	Upper Meadow Cr	0.74
454	Battle Cr	Battle Cr	From mouth at Meadow Cr to road 2120 crossing in SE corner of section 14	Upper Meadow Cr	2.92
455	Meadow Cr-6 (2nd GR)	Meadow Cr (2nd GR)	From Battle Cr to Bear Cr	Upper Meadow Cr	2.42
456	Bear Cr (Meadow)	Meadow Cr (Meadow)	From mouth at Meadow Cr to trib in SW corner of section 16	Upper Meadow Cr	6.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
457	Meadow Cr-7 (2nd GR)	Meadow Cr (2nd GR)	From Bear Cr to Peet Cr	Upper Meadow Cr	7.88
458	Peet Cr_Obstr_A	Peet Cr	USFS culvert on Peet Cr near its mouth	Upper Meadow Cr	0.00
458	Peet Cr	Peet Cr	From mouth at Meadow Cr to 4200 ft level	Upper Meadow Cr	1.01
459	Meadow Cr-8 (2nd GR)	Meadow Cr (2nd GR)	From Peet Cr to Waucup Cr	Upper Meadow Cr	0.50
460	Waucup Cr_Obstr_A	Waucup Cr	USFS culvert on Waucup Cr near its mouth	Upper Meadow Cr	0.00
460	Waucup Cr	Waucup Cr	From mouth at Meadow Cr to 4300 ft level	Upper Meadow Cr	2.47
461	Meadow Cr-9 (2nd GR)_A	Meadow Cr (2nd GR)	From Waucup Cr confluence to USFS culvert approx 0.2 miles upstream	Upper Meadow Cr	0.18
461	Meadow Cr-9 (2nd GR)_C	Meadow Cr (2nd GR)	From USFS culvert approx 0.2 miles upstream of the confluence with Waucup Cr to 4300 ft level	Upper Meadow Cr	3.10
461	Meadow Cr-9 (2nd GR)_Obstr_B	Meadow Cr (2nd GR)	USFS culvert approx 0.2 miles upstream of Waucup Cr	Upper Meadow Cr	0.00
462	Grande Ronde-45	Grande Ronde R	From Meadow Cr to Warm Spr Cr	Upper Grnd Rnd R 1	2.58
463	Warm Springs Cr	Warm Springs Cr	From mouth at Grande Ronde R to 1 mile upstream	Mid Grnd Rnd tribs 4	1.00
464	Grande Ronde-46	Grande Ronde R	From Warm Spr Cr to Fly Creek	Upper Grnd Rnd R 1	2.01
465	Fly Cr-1	Fly Cr	From mouth at Grande Ronde R to Little Fly	Fly Cr	8.43
466	Little Fly Cr-1	Little Fly Cr	From mouth at Fly Cr to Lookout Cr	Fly Cr	1.02
467	Lookout Cr_C	Lookout Cr	From USFS culvert approx 3.2 miles upstream of Lookout Cr mouth on the 5160 Road to 4900 ft level	Fly Cr	1.20
467	Lookout Cr_A	Lookout Cr	From mouth at Little Fly Cr to USFS culvert approx 3.2 miles upstream on the 5160 Road	Fly Cr	3.24
467	Lookout Cr_Obstr_B	Lookout Cr	USFS culvert approx 3.2 miles upstream of Lookout Cr mouth on the 5160 Road	Fly Cr	0.00
468	Little Fly Cr-2_Obstr_B	Little Fly Cr	USFS culvert approx 3.75 miles upstream of Lookout Cr on the 5160 Road (site of headcut immediately upstream is part of barrier)	Fly Cr	0.00
468	Little Fly Cr-2_C	Little Fly Cr	From USFS culvert approx 3.75 miles upstream of Lookout Cr on the 5160 Road to 5100 ft level	Fly Cr	1.35
468	Little Fly Cr-2_A	Little Fly Cr	From Lookout Cr to USFS culvert approx 3.75 miles upstream on the 5160 Road	Fly Cr	3.75
469	Fly Cr-2	Fly Cr	From Little Fly Cr to Squaw Cr	Fly Cr	3.93
470	Squaw Cr (Fly)	Squaw Cr (Fly)	From mouth at Fly Cr to 4800 ft level	Fly Cr	1.85
471	Fly Cr-3	Fly Cr	From Squaw Cr to Umapine Cr	Fly Cr	0.96
472	Umapine Cr_Obstr_B	Umapine Cr	USFS culvert approx 1.2 miles upstream of Umapine mouth on the 5160 Road	Fly Cr	0.00
472	Umapine Cr_C	Umapine Cr	From USFS culvert approx 1.2 miles upstream of Umapine mouth on the 5160 Road to 5000 ft level	Fly Cr	0.92
472	Umapine Cr_A	Umapine Cr	From mouth at Fly Cr to USFS culvert approx 1.2 miles upstream on the 5160 Road	Fly Cr	1.19
473	Fly Cr-4	Fly Cr	From Umapine Cr to 4620 ft level	Fly Cr	0.57
474	Grande Ronde-47	Grande Ronde R	From Fly Creek to Sheep Cr	Upper Grnd Rnd R 1	9.31
475	Sheep Cr-1 (2nd GR)	Sheep Cr (2nd GR)	From mouth at Grande Ronde R to Dry/Chicken Cr confluence	Sheep Cr (GR)	1.07
476	Dry Cr (2nd GR Sheep)_C	Dry Cr (2nd GR Sheep)	From USFS culvert approx 3 miles upstream of Dry Cr mouth on the 5178 Road to 4500 ft level	Sheep Cr (GR)	0.61
476	Dry Cr (2nd GR Sheep)_Obstr_B	Dry Cr (2nd GR Sheep)	USFS culvert approx 3 miles upstream of Dry Cr mouth on the 5178 Road	Sheep Cr (GR)	0.00
476	Dry Cr (2nd GR Sheep)_A	Dry Cr (2nd GR Sheep)	From mouth at Sheep Cr to USFS culvert approx 3 miles upstream on the 5178 Road	Sheep Cr (GR)	2.92
477	Chicken Cr-1_A	Chicken Cr	From mouth at Sheep Cr to USFS culvert approx 2.3 miles upstream on the 5100 Road	Sheep Cr (GR)	2.30
477	Chicken Cr-1_C	Chicken Cr	From USFS culvert approx 2.3 miles upstream of Chicken Cr mouth on the 5100 Road to West Chicken Cr	Sheep Cr (GR)	0.09
477	Chicken Cr-1_Obstr_B	Chicken Cr	USFS culvert approx 2.3 miles upstream of Chicken Cr mouth on the 5100 Road	Sheep Cr (GR)	0.00

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
478	Chicken Cr W	WF Chicken Cr	From mouth at Chicken Cr to 4700 ft level	Sheep Cr (GR)	2.23
479	Chicken Cr-2	Chicken Cr	From West Chicken Cr to Indiana Cr	Sheep Cr (GR)	2.90
480	Indiana Cr_Obstr_B	Indiana Cr	USFS culvert approx 0.5 miles upstream of the Indiana Cr mouth on the 5100 Road	Sheep Cr (GR)	0.00
480	Indiana Cr_C	Indiana Cr	From USFS culvert approx 0.5 miles upstream of the Indiana Cr mouth on the 5100 Road to 5250 ft level	Sheep Cr (GR)	0.51
480	Indiana Cr_A	Indiana Cr	From mouth at Chicken Cr to USFS culvert approx 0.5 miles upstream on the 5100 Road	Sheep Cr (GR)	0.51
481	Sheep Cr-2 (2nd GR)	Sheep Cr (2nd GR)	From Dry/Chicken Cr confluence to Unnamed Trib from the S in section 33	Sheep Cr (GR)	2.16
482	Sheep Cr Trib (2nd GR)	Sheep Cr Trib (2nd GR)	From mouth (trib from the S in section 33) at Sheep Cr to 4350 ft level	Sheep Cr (GR)	1.49
483	Sheep Cr-3 (2nd GR)_A	Sheep Cr (2nd GR)	From Unnamed Trib from the S in section 33 to East Sheep Cr	Sheep Cr (GR)	2.84
483	Sheep Cr-3 (2nd GR)_C3_C	Sheep Cr (2nd GR)	From USFS culvert approx 5.4 miles upstream of the Unnamed Trib from the S on the 5182500 Road to E Sheep Cr	Sheep Cr (GR)	0.10
483	Sheep Cr-3 (2nd GR)_Obstr_B1	Sheep Cr (2nd GR)	USFS culvert approx 2.8 miles upstream of Unnamed Trib from the S on the 5160 Road	Sheep Cr (GR)	0.00
483	Sheep Cr-3 (2nd GR)_C2_A	Sheep Cr (2nd GR)	From USFS culvert approx 2.8 miles upstream of the Unnamed Trib from the S on the 5160 Road to USFS culvert further upstream approx 2.6 miles on the 5182500 Road	Sheep Cr (GR)	2.56
483	Sheep Cr-3 (2nd GR)_C2_Obstr_B2	Sheep Cr (2nd GR)	USFS culvert approx 5.4 miles upstream of the Unnamed Trib from the S on the 5182500 Road	Sheep Cr (GR)	0.00
484	Sheep Cr E (2nd GR)	EF Sheep Cr (2nd GR)	From mouth at Sheep Cr to 5800 ft level	Sheep Cr (GR)	5.80
485	Sheep Cr-4 (2nd GR)	Sheep Cr (2nd GR)	From East Sheep Cr to 4750 ft level	Sheep Cr (GR)	0.91
486	Grande Ronde-48	Grande Ronde R	From Sheep Cr to Limber Jim Cr	Upper Grnd Rnd R 1	3.06
487	Limber Jim Cr-1	Limber Jim Cr	From mouth at Grande Ronde R to Limber Jim Cr SF	Limber Jim Cr	0.68
488	Limber Jim Cr SF_A	SF Limber Jim Cr	From mouth at Limber Jim Cr to USFS culvert approx 0.2 miles upstream on the 5130013 Road	Limber Jim Cr	0.22
488	Limber Jim Cr SF_C	SF Limber Jim Cr	From USFS culvert approx 0.2 miles upstream of SF Limber Jim mouth to 4450 ft level	Limber Jim Cr	0.46
488	Limber Jim Cr SF_Obstr_B	SF Limber Jim Cr	USFS culvert approx 0.2 miles upstream of SF Limber Jim mouth on the 5130013 Road	Limber Jim Cr	0.00
489	Limber Jim Cr-2_Obstr_A	Limber Jim Cr	USFS culvert on Limber Jim Cr just upstream of confluence with SF Limber Jim Cr	Limber Jim Cr	0.00
489	Limber Jim Cr-2	Limber Jim Cr	From Limber Jim Cr SF to Limber Jim NF	Limber Jim Cr	1.13
490	Limber Jim Cr NF_Obstr_A	NF Limber Jim Cr	USFS culvert on NF Limber Jim Cr near its mouth	Limber Jim Cr	0.00
490	Limber Jim Cr NF	NF Limber Jim Cr	From mouth at Limber Jim Cr to 4500 ft level	Limber Jim Cr	0.62
491	Limber Jim Cr-3	Limber Jim Cr	From Limber Jim Cr NF to natural lava block at the 4900 ft level	Limber Jim Cr	2.60
492	Limber Jim Cr-4	Limber Jim Cr	From natural lava block at the 4900 ft level to Marion Cr	Limber Jim Cr	0.60
493	Marion Cr	Marion Cr	From mouth at Limber Jim Cr to headwaters at 5900 ft level	Limber Jim Cr	2.15
494	Limber Jim Cr-5	Limber Jim Cr	From Marion Cr to headwaters at 5700 ft level	Limber Jim Cr	1.54
495	Grande Ronde-49	Grande Ronde R	From Limber Jim Cr to Meadowbrook Cr	Upper Grnd Rnd R 2	0.54
496	Meadowbrook Cr	Meadowbrook Cr	From mouth at Grande Ronde R to 4950 ft level	Meadowbrook Cr	2.85
497	Grande Ronde-50	Grande Ronde R	From Meadowbrook Cr to Clear Cr	Upper Grnd Rnd R 2	2.32
498	Clear Cr-1 (2nd GR)	Clear Cr (2nd GR)	From mouth at Grande Ronde R to Little Clear Cr	Clear Cr (GR)	0.79
499	Little Clear Cr_Obstr_A	Little Clear Cr	USFS culvert on the 5135 Road at Little Clear Cr near its mouth	Clear Cr (GR)	0.00
499	Little Clear Cr	Little Clear Cr	From mouth at Clear Cr to 5100 ft level	Clear Cr (GR)	1.08

Seq_No	Reach name	Stream name	Description	Diagnostic unit	Length (mi)
500	Clear Cr-2 (2nd GR)	Clear Cr (2nd GR)	From Little Clear Cr to Unnamed Trib at 5700 ft level	Clear Cr (GR)	3.11
501	Clear Cr Trib-1 (2nd GR)	Clear Cr Trib (2nd GR)	From mouth at Clear Cr at 5700 ft level to Unnamed Trib at 6200 ft level	Clear Cr (GR)	1.64
502	Clear Cr Trib Trib (2nd GR)	Clear Cr Trib (2nd GR)	From mouth at Clear Cr trib at 6200 ft level to headwaters at near 6800 ft level	Clear Cr (GR)	1.32
503	Clear Cr Trib-2 (2nd GR)	Clear Cr Trib (2nd GR)	From Unnamed Trib at 6200 ft level to headwaters at near 6800 ft level	Clear Cr (GR)	1.27
504	Clear Cr-3 (2nd GR)	Clear Cr (2nd GR)	From Unnamed Trib at 5700 ft level to headwaters at 6900 ft level	Clear Cr (GR)	3.27
505	Grande Ronde-51	Grande Ronde R	From Clear Cr to Grande Ronde EF	Upper Grnd Rnd R 2	1.60
506	Grande Ronde EF_Obstr_A	EF Grande Ronde R	USFS culvert on EF Grande Ronde near its mouth	Upper Grnd Rnd R 3	0.00
506	Grande Ronde EF	EF Grande Ronde R	From mouth at Grande Ronde R to Falls just below Little Meadow Cr	Upper Grnd Rnd R 3	1.60
507	Grande Ronde-52	Grande Ronde R	From Grande Ronde EF to Tanner Gulch	Upper Grnd Rnd R 3	2.84
508	Tanner Gulch	Tanner Gulch	From mouth at Grande Ronde R to 5500 ft level	Upper Grnd Rnd R 3	0.54
509	Grande Ronde-53	Grande Ronde R	From Tanner Gulch to 5500 ft level	Upper Grnd Rnd R 3	0.40

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