Supplement to the Wenatchee Subbasin Plan

November, 2004

Co-Planners:

Chelan County
Yakama Nation

Prepared by

Peven Consulting
Biological Consulting

Chuck Peven
3617 Burchvale Rd.
Wenatchee, WA 98801
(509) 662-1839
ckpeven@charter.net

Introduction

The purpose of this report is to provide brevity and additional clarification to the Wenatchee Subbasin Management Plan for adoption into the Northwest Power & Conservation Council's (NPCC) Fish and Wildlife Program. This report is a summary and an addendum to the Wenatchee Subbasin Plan and is not intended to be a replacement for that document. For a complete understanding of the subbasin vision, goals, management strategies and objectives and near term opportunities, readers must refer to the Wenatchee Subbasin Plan.

The NPCC clearly defined five areas where the Plan needed improvement before it would be considered acceptable:

1. Key Limiting Factors: An explanation of the key factors limiting the biological potential of the selected focal species in the subbasin (referencing the existing assessment);

2. Prioritization of Limiting Factors: A prioritization of which limiting factors should be addressed first (if possible, and again referencing the existing assessment);

3. Objectives: An identification of objectives and strategies, with an explanation demonstrating how particular strategies will address the limiting factors identified;

4. Management Strategies: Either a prioritization of strategies (related to the priority limiting factors) or a description of a "prioritization framework," that is, the criteria/considerations and procedures designed to develop and prioritize proposed actions in future project selection processes consistent with the assessment and related strategies; and

5. Artificial Production: A discussion of how artificial production is treated in the assessment; objectives and strategies, including a description of how artificial and natural production are related to the habitat objectives and strategies (the work described in this subtask may be subsumed within the work described subtask c.; it is identified here as a separate subtask for clarity only, not because it must be an independent element of the supplement).

Key Limiting Factors

Factors limiting the biological potential of the selected focal species were identified in the Assessment (Chapter 4) of the Subbasin Plan. An explanation of these factors follows and is arranged per Assessment Unit (AU).

Lower Wenatchee River

Limiting factors within this AU are primarily related to urbanization, railroad and road building, and other land use practices. The effects of these actions have resulted in a highly channelized stream, loss of riparian habitat and floodplain function, and other specific effects described below.

- Land development, state highway and railroad construction have resulted in a reduction in channel migration, woody debris recruitment, and gravel recruitment.
- Riparian habitat and off-channel habitat have been significantly lost or degraded.
- Late summer stream flows are often critically low throughout this reach.
- Floodplain function has been impaired by development, causing extremes in the peaks and nadir of the hydrograph.
- Stream temperatures often are high, which is contributed to by loss of floodplain function, riparian habitat and low stream flows.

Middle Wenatchee River

There are no urban areas within this AU, and most impacts are the result of the main highway and railroad that abut the Wenatchee River. Some of the smaller tributaries suffer from passage problems caused by roads and other conditions.

- The state highway negatively affects riparian function and LWD recruitment, which decreases habitat diversity within the mainstem channel.
- Fish passage barriers exist in tributary streams.

Mission Creek

This AU has been impacted from forestry practices, agricultural, and other land use developments. In the very lower portion, urbanization has created many factors that limit natural production of focal species.

- In-channel conditions have been significantly altered by channel straightening, channelization and simplification.
- Low flows and high stream temperatures prevent or impede access to spawning grounds for spring Chinook, reduce the available rearing habitat in these areas and constrain access to rearing habitat elsewhere in the watershed.
- Diversion dams and culverts create fish passage barriers from the lower end of the watershed and progressing upstream, reducing access to spawning and rearing habitat.
- Stream temperatures in the Mission Creek watershed tend to be naturally elevated during the summer months and exacerbated by management activities, water diversions, and habitat degradation.
- Naturally intermittent flows are exacerbated by surface water diversions and ground water withdrawals.
- Most of the riparian habitat in the naturally narrowing valley has been converted to orchards, pasture or hay production with thin bands of cottonwood/shrubs adjacent to the confined and downcut channel.

Peshastin Creek

This AU has been heavily impacted by highway construction and channel re-routing. Historically, mining is believed to have adversely affected salmonid production. Other forestry and land use practices have negatively affected production of focal species.

- The loss of channel sinuosity, channel complexity, floodplain function, and riparian habitat, including off-channel habitat, within the channel migration zone has had the greatest impact on salmonid production in the watershed.
- A water diversion dam in Peshastin Creek (lower 2 miles) presents a barrier from mid June through October partially blocking migrating spring Chinook salmon, and bull trout.
- Low stream flows in lower Peshastin Creek impedes upstream migration, reduce rearing habitat, and likely contribute to elevated water temperature exceeding regulatory standards.
- Loss of riparian habitat resulting from land development and state highway reduces quantity and quality of spawning and rearing habitat.

Chumstick Creek

This unit has been impacted by land use practices, and fish movement and migration is limited by blockages.

- Channel migration is limited and channel complexity is impaired by state highway, the railroad, private land development, and forest roads.
- Land development and high road density affects sediment delivery.
- The North Road county culvert at RM 0.3 is a full passage barrier to spring chinook and a partial passage barrier to steelhead.
- Forty percent of the riparian vegetation along the mainstem Chumstick and Eagle creeks, in addition to other smaller tributaries, has been disturbed by agricultural and urban encroachment, historic railroad development, logging, and high riparian road densities.

Icicle Creek

Riparian and floodplain attributes in this AU have been impacted in it's lower reaches by land use practices, including hatchery activities, which include a total passage barrier and water diversion. In the upper portion of the watershed, irrigation withdrawals reduce water quantity and may decrease water quality in the lower portions of the watershed.

- Low stream flows.
- Channel complexity and function in lower Icicle Creek.
- Irrigation screens at RM 5.7 and 4.5 need improvement.
- Fish passage.

Nason Creek

This assessment unit has been heavily impacted by construction of a railroad and the state highway. Other land use practices have also affected production of focal species.

- Channel migration is limited, and channel structure is simplified.
- Lost fish passage to wetlands, side channels and oxbows.
- Passage obstructions into and within the tributaries.
- Sediment delivery from roads.
- Canopy loss on harvested upland habitat.

- Brook trout interactions (competition and predation).

Little Wenatchee River
Most of this watershed is protected through USFS management, however past management practices have created negative interactions between focal species (e.g., bull trout) and exotic species (brook trout).

- Brook trout competition and interbreeding threatens bull trout populations.

White River
Most of this watershed is protected through USFS management, however past management practices have created negative interactions between focal species (e.g., bull trout) and exotic species (brook trout). Land use practices and the existing road impacts have degraded riparian and channel conditions the lower portion of the watershed.

- Wetland complexes in lower watershed could have better connectivity to the stream channel.
- Brook trout competition and interbreeding threatens bull trout populations.

Chiwawa River
This assessment unit has the best preserved habitat within the subbasin, but past management practices (introduction of brook trout) have cause negative interactions with some focal species.

- Brook trout competition and interbreeding threatens bull trout populations.

Prioritization of limiting factors

Determining which limiting factors should be addressed first is currently occurring within the State Salmon Recovery and local 2514 Watershed Planning processes for the Wenatchee River. Conclusions from these processes are expected to be available in year 2006 and will serve to update this Subbasin Plan at that time. Management Actions identified as having highest priority for any individual species were viewed as having high priority for that Assessment Unit. Within these efforts, priorities are categorized as "restoration" and "protection." The following table depicts the general findings and priorities from those efforts.

Table 1. Primary limiting factors and relative rankings of importance for implementation.

Assessment Unit	Primary Limiting Factors	Restoration Priority	Protection Priority	Rational
Lower Wenatchee	Riparian habitat and off-channel habitat have been significantly lost or degraded Floodplain function has been impaired by development, causing extremes in the peaks and nadir of the hydrograph	H	M	Key migration corridor Key rearing and over-winter habitat Potential steelhead spawning, late-run chinook spawning
Middle	The state highway negatively affects riparian function and LWD recruitment, which	M	H	Key migration corridor

Wenatchee	influences habitat diversity within the mainstem channel. Fish passage barriers exist in tributary streams.			Key rearing and over-winter habitat Steelhead spawning, late-run chinook spawning
Mission Creek	In-channel conditions have been significantly altered by channel straightening, channelization and simplification. Low flows and associated high stream temperatures prevent or impede access to spawning grounds for spring chinook, reduce the available rearing habitat in these areas and constrain access to rearing habitat elsewhere in the watershed. Diversion dams and culverts create fish passage barriers from the lower end of the watershed and progressing upstream, significantly reducing access to spawning and rearing habitat Most of the riparian habitat in the naturally narrowing valley has been converted to orchards, pasture or hay production with thin bands of cottonwood/shrubs adjacent to the confined channel.	M	M	Potential to increase population diversity Steelhead and coho currently spawn Juvenile Chinook rearing
Peshastin Creek	The loss of channel sinuosity, floodplain function, and riparian habitat including off-channel habitat within the channel migration zone. A water diversion dam presents a barrier from mid June through October partially blocking migrating spring chinook salmon, and migrating bull trout Low stream flows in lower Peshastin Creek impedes upstream migration, reduce rearing habitat, and likely contribute to elevated water temperature Elevated water temperatures exceed regulatory standards Loss of riparian habitat resulting from land development and state high way reduces quantity and quality of spawning and rearing habitat.	H	H	Steelhead, spring chinook, coho and bull trout spawning and rearing
Chumstick Creek	Channel migration is limited by state high way, the railroad, private land development, and forest roads. Land development and high road density affects sediment delivery. The North Road county culvert at RM 0.3 is a full passage barrier to spring chinook and a partial passage barrier to steelhead. Loss of the riparian vegetation along the mainstem Chumstick and Eagle creeks, in addition to other smaller tributaries, has been disturbed by agricultural and urban encroachment, historic railroad development,	M	L	Potential increase in rearing habitat Potential to increase population diversity

	logging, and high riparian road densities.			
Icicle Creek	Low stream flows Channel function in lower Icicle Creek Irrigation screens at RM 5.7 and 4.5 need updating Fish passage	H	H	Steelhead, spring chinook, coho, and bull trout spawning, rearing, migration Potential to increase population diversity
Nason Creek	Channel migration is limited, and channel structure is simplified Lost fish passage from the wetlands and oxbows to Nason Creek Obstructions to Tributary and obstructions in the tributaries. Sediment delivery from roads Canopy loss on harvested upland habitat Brook trout interactions (competition and predation).	H	M	Steelhead, spring chinook, coho, and bull trout spawning, rearing, migration Potential to increase population diversity
Little Wenatchee River	Competition and Predation by brook trout	L	H	Steelhead, spring chinook, bull trout spawning, rearing, migration Potential coho reintroduction
White River	Competition and Predation by brook trout Wetland complexes in lower watershed could have better connectivity to the stream channel	L	H	Steelhead, spring chinook, bull trout spawning, rearing, migration Potential coho reintroduction
Chiwawa River	Competition and Predation by brook trout	L	H	Steelhead, spring chinook, bull trout spawning, rearing, migration Potential coho reintroduction

Objectives

The objectives are both habitat and biologically based. The objectives are used to describe physical and biological changes that need to take place to achieve the vision. Objectives are geared toward *directly addressing the limiting factors* and should be measurable.

Limiting factor per Assessment Unit (AU) and the objectives associated with addressing those limiting factors are listed below.

Lower Wenatchee River Assessment Unit

Limiting factor: Flow extremes:

- Decrease severity of high flow events by increasing in-channel structural diversity and restoring geo-fluvial processes by 2025.
- Increase efficiency of water withdrawal to eliminate need for diverting extraneous conveyance water during August and September by 2020.

Limiting factor: loss or degradation of riparian and floodplain condition and function:

- Reestablish riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts to riparian areas from development within the riparian area by 2015.
- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

Middle Wenatchee River Assessment Unit

Limiting factors: Riparian function and LWD recruitment:

- Improve riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025.
- Increase/maintain the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity in tributary streams through conservation or active restoration when feasible, by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Maintain and enhance wetland complexes, enhance ground water recharge by 2025.
- Remove bank armoring/dikes where applicable by 2025.
- Protect/enhance geo-fluvial processes and floodplain function where applicable by 2025.
- Maintain and enhance in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2010.
- Protect and increase in-stream structures (complex log structures) by 2020.
- Increase stream bank stability using active and passive restoration techniques by 2015.

- Maintain and enhance habitat diversity by increasing off-channel habitat, backwaters with cover, and low energy refugia by 2025.
- Increase LWD to 20 pieces per mile (12”diameter > 35 ft length), restore large wood complexes and provide adequate sources for future woody debris recruitment in the riparian areas by 2025.

Limiting factor: Fish passage within tributaries

- Allow unimpeded fish passage by 2010.

Mission Creek Assessment Unit

Limiting factor: Riparian condition:

- Maintain riparian vegetation corridors and associated stream canopies and provide a minimum of 75% of the estimated historic condition, where feasible by 2025
- Maintain/enhance the number of large trees and complex riparian communities for natural recruitment of LWD by 2025.

Limiting factor: In-channel condition:

- Improve riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025.
- Maintain and enhance in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2010.

Limiting factor: fish passage due to obstructions and temperature:

- Allow unimpeded fish passage throughout the tributaries by 2010.
- Reduce impact of high temperature on incubation, rearing, and migrating adults so it does not exceed the 7 day average maximum within any reach by 2020.

Peshastin Creek Assessment Unit

Limiting factor: loss or degradation of riparian condition and floodplain condition:

- Reestablish riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts to riparian areas from development within the riparian area by 2015.
- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

Limiting factor: fish passage due to obstructions and reduced flow:

- Allow unimpeded fish passage throughout the tributaries by 2010.
- Reduce impact, and increase efficiency of water withdrawal during August and September by 2020.

Chumstick Creek Assessment Unit

Limiting factor: loss or degradation of riparian condition and floodplain condition:

- Reestablish riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts to riparian areas from development within the riparian area by 2015.
- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

Limiting factor: fish passage due to obstructions and reduced flow:

- Allow unimpeded fish passage by 2010.

Icicle Creek Assessment Unit

Limiting factor: loss or degradation floodplain condition in lower portion:

- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

Limiting factor: fish passage due to obstructions and reduced flow:

- Allow unimpeded fish passage by 2010.
- Increase efficiency of water withdrawal to eliminate need for diverting extraneous conveyance water during August and September by 2020.

Nason Creek Assessment Unit

Limiting factor: loss or degradation of riparian condition and floodplain condition:

- Reestablish riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts to riparian areas from development within the riparian area by 2015.
- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

<u>Limiting factor: fish passage due to obstructions and reduced flow:</u>

- Allow unimpeded fish passage through human-caused obstructions throughout the tributaries by 2010.
- Evaluate potential passage of anadromous fish past RM 5.8 (the rock slide).

<u>Limiting factor: sedimentation:</u>

- Decrease substrate embededness conditions throughout the Assessment Unit by 2020.

Little Wenatchee River Assessment Unit

<u>Limiting factor: competition and predation by brook trout</u>

- Eliminate or reduce impacts of eastern brook trout and by 2025.

White River Assessment Unit

<u>Limiting factor: competition and predation by brook trout</u>

- Eliminate or reduce impacts of eastern brook trout and by 2025.

<u>Limiting factor: better connectivity of wetland complexes with main channel</u>

- Increase, improve and/or reconnect floodplain (off-channel) habitats, where feasible, by 2025.

Chiwawa River Assessment Unit

<u>Limiting factor: competition and predation by brook trout</u>

- Eliminate or reduce impacts of eastern brook trout and by 2025.

In the table below we show how each objective may help reduce the impact of multiple limiting factors.

Table 2. Comparison of limiting factors and the suggested strategies to improve them throughout the Wenatchee subbasin.

	Biological Limiting Factors								
Objectives	**Flow extremes (high or low)**	**Temperature**	**Riparian Condition**	**Floodplain Condition**	**In-Channel Condition**	**LWD Recruit.**	**Passage**	**Sedimentation**	**Exotic Species Interact.**
Decrease severity of high flow events by increasing in-channel structural diversity and restoring geo-fluvial processes by 2025.	X		X	X	X	X			
Reestablish /improve riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.		X	X	X	X	X			
Protect/enhance geo-fluvial processes and floodplain function by 2025.	X	X	X	X	X	X			
Remove bank armoring/dikes where applicable and appropriate by 2025.			X	X					
Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.			X	X	X	X			
Reduce impacts to riparian areas from development within the riparian area by 2015.			X	X		X			
Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.			X		X	X			
Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.			X	X					
Maintain and enhance wetland complexes, enhance ground water recharge by 2025.	X	X	X	X	X	X			
Maintain and enhance in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2010.	X				X				
Allow unimpeded fish passage throughout the tributaries by 2010.						X			
Increase LWD to 20 pieces per mile (12"diameter > 35 ft length), restore large wood complexes and provide adequate sources for future woody debris recruitment in the riparian areas by 2025.			X			X			
Maintain and enhance habitat diversity by increasing off-channel habitat, backwaters with cover and low energy refugia by 2025.	X		X	X	X	X	X		
Increase stream bank stability using active and passive restoration techniques by 2015.			X	X	X	X			
Protect and increase in-stream structures (complex log structures) by 2020					X	X			
Reduce impact of high temperature on incubation, rearing, and migrating adults so it does not exceed the 7 day average maximum within any reach by 2020.		X							
Increase efficiency of water withdrawal to eliminate the need for diverting extraneous conveyance water during August and September by 2020.	X	X		X					
Decrease substrate embededness conditions throughout the Assessment Unit by 2020.								X	
Eliminate or reduce impacts of eastern brook trout and by 2025.									X

Management Strategies

Strategies are a general set of actions that are geared toward accomplishing the biological objectives. Strategies will serve as guidance on proposed projects in the future to achieve the objectives.

Below we break out the suggested management strategies combined for all assessment units, and separating out strategies when they apply to only one or a few assessment units.

Water Quality

Temperature:

- Moderate summer and winter water temperatures by improving riparian and floodplain conditions
- Evaluate the effect of temperatures using FLIR, or other technology, on current and potential life histories and habitat use both spatially and temporally.
- Study egg/juvenile overwinter survival.
- Evaluate effects of low temperatures on the productivity of native species.
- Initiate analysis and monitoring of anchor / frazil ice and its effects on macro-invertebrates and fish (spawning and over-winter rearing habitat) and the relationship, if any, to riparian vegetation and floodplain conditions.
- Evaluate effects of side channels and off channel habitat on instream summer temperatures.

Water Quantity

- Investigate and implement programs designed to increase efficiency of water withdrawal in order to eliminate need for diverting extraneous conveyance water.
- Decrease summer surface water withdrawals by converting stream withdrawals to ground water wells.
- Continue to improve irrigation efficiencies within the subbasin.
- Enhance mainstem flows by improving overall watershed vegetative and hydrologic conditions.

Riparian/Floodplain

Riparian Condition:

- Increase nutrient recruitment of detritus from riparian vegetation by increasing riparian growth and floodplain connectivity.
- Protect and enhance riparian vegetation along unstable stream banks.
- Protect / enhance fluvial processes and floodplain function.
- Preserve high quality riparian patches as refuge habitats.
- Define hyporheic zone with natural flow regimes.
- Evaluate fish use of off channel habitats.

- Prevent direct access of livestock to streams via fencing.

Floodplain Condition – Connectivity:

- Reconnect and increase side-channel habitat to the main stream channel.
- Where appropriate, establish areas where natural channel migration can occur.

In-Channel

In-Channel**:**

- Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will enhance salmonid habitat diversity, habitat quality and quantity and channel-integrity.

LWD:

- Restore large wood complexes, passively and actively.

Pool frequency and quality:

- Passively and actively restore in-stream structures that will increase juvenile rearing habitat and geo-fluvial processes that will encourage pool formation.

Ecologic

General

- Initiate/improve public outreach programs to eliminate harassment and poaching.
- Evaluate the feasibility and implement where appropriate, the introduction of beneficial species to the watershed or subbasin.
- Initiate/improve/continue noxious weed control.
- Evaluate carrying capacity for space and food resources to determine if elevated competition is occurring.

Hatchery:

- Continue to evaluate ecologic interactions between hatchery and naturally produced fish.
- Continue evaluating spawning interaction between hatchery and naturally produced fish.

Supplementation:

- Continue to evaluate the use of supplementation to enhance and sustain the productivity of wild and naturally-spawning populations of focal species through the use of innovative artificial propagation methods.
- Consider the use of supplementation where wild population productivity does not meet conservation and rebuilding goals prescribed by the fishery managers. A supplementation hatchery is properly operated as an adjunct to the natural production system in a watershed.
- Consider the use of supplementation for implementing mitigation actions required of human activities known to cause specific unavoidable mortalities to wild and natural salmonid populations.

White, Little Wenatchee, and Chiwawa rivers

Exotic species management

- Reduce or eliminate brook trout by removing harvest limit and encouraging public participation through education.
- Hold annual fishing derbies for brook trout.
- Electro-fish brook trout off spawning grounds.

Nason Creek

Sediment:

- Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel.
- Continue monitoring sediment yield on an annual basis.
- Reduce localized streambank erosion.

Table 3. Comparison of management strategies and biological objectives.

Objectives	**Strategies**							
	Reduce impacts of water withdrawal	*Moderate summer and winter temperature*	*Increase riparian area and function*	*Increase off -channel habitat*	*Increase in-channel diversity and structure*	*Increase or improve passage*	*Reduce sediment*	*Reduce or eliminate brook trout*
Decrease severity of high flow events by increasing in-channel structural diversity and restoring geo-fluvial processes by 2025.		X	X	X	X			
Reestablish /improve riparian vegetation corridors and associated stream canopies to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.		X	X	X				
Protect/enhance geo-fluvial processes and floodplain function by 2025.	X	X	X	X	X		X	
Remove bank armoring/dikes where applicable and appropriate by 2025.				X				
Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration where feasible by 2025.			X	X	X			
Reduce impacts to riparian areas from development within the riparian area by 2015.		X	X	X	X			
Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.			X		X			
Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.				X	X			
Maintain and enhance wetland complexes, enhance ground water recharge by 2025.	X	X		X				
Maintain and enhance in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2010.	X				X			
Allow unimpeded fish passage throughout the tributaries by 2010.				X		X		
Increase LWD to 20 pieces per mile (12"diameter > 35 ft length), restore large wood complexes and provide adequate sources for future woody debris recruitment in the riparian areas by 2025.			X		X			
Maintain and enhance habitat diversity by increasing off-channel habitat, backwaters with cover and low energy refugia by 2025.	X	X		X				
Increase stream bank stability using active and passive restoration techniques by 2015.			X				X	
Protect and increase in-stream structures (complex log structures) by 2020					X			
Reduce impact of high temperature on incubation, rearing, and migrating adults so it does not exceed the 7 day average maximum within any reach by 2020.	X	X				X		
Increase efficiency of water withdrawal to eliminate the need for diverting extraneous conveyance water during August and September by 2020.	X	X						
Decrease substrate embededness conditions throughout the Assessment Unit by 2020.						X		
Eliminate or reduce impacts of eastern brook trout and by 2025.							X	

Prioritization of strategies

Wenatchee subbasin planners have adopted a generalized framework for prioritization of management actions that will benefit fish and wildlife resources in the Wenatchee subbasin (Figure 1). To keep the process manageable, we suggest a relatively simple analyses weighing biological benefit against the feasibility and cost of each strategy (Figure 2). Projects that are determined to be less feasible are not necessarily assigned a lesser priority, rather are anticipated to be implemented over a longer time interval.

The framework

The first step in prioritizing the suite of recommended strategies would be to assign a qualitative ranking of the biological benefit to each strategy (Table 4). This ranking would be based on how well each strategy addresses the limiting factors and objectives that are described within the Plan.

The second step in prioritizing strategies is to rank the feasibility of the strategies (Tables 4, 5). Criteria used for ranking could range from professional (e.g., biologist, engineers, etc.) and stakeholder (e.g., land owner) judgment to an in-depth feasibility study (which will be needed eventually). It is important to define what "feasibility" means. In Table 5, we suggest criteria that could be used, including, but not limited to the 1) timing of implementation and 2) acceptance of the various strategies by local stakeholders and government.

Third, strategies should then be ranked based on cost (Table 4). Various methods can be used to determine cost (eventually this would need solid information based on the feasibility study before a project is proposed for funding), but can at first be qualitatively (i.e., order of magnitude) assessed. For example, building a storage reservoir to boost flows would cost more than water conservation measures.

After strategies are ranked on feasibility and cost, they can then be compared to biological benefit (Figure 3). Those projects that show the least cost and are relatively highly ranked on feasibility and have high biological benefit should be assigned the highest prioritization. This is further accomplished by assigning a tier to each category as described in Figure 4 (top graph).

The highest priority projects would be grouped in the category (lowest cost, highest feasibility and greatest biological benefit, the second highest priority would be low cost, high feasibility and moderate biological benefit, etc. (Table 6).

To demonstrate how this framework can be used, we have used the main strategies outlined above from Table 3 and used the proposed process to prioritize the main strategies recommended within the Plan (Tables 4, 5; Figures 3, 4).

It is not the intent of this example to suggest final prioritization, since this remains to be coordinated with all stakeholders (see above).

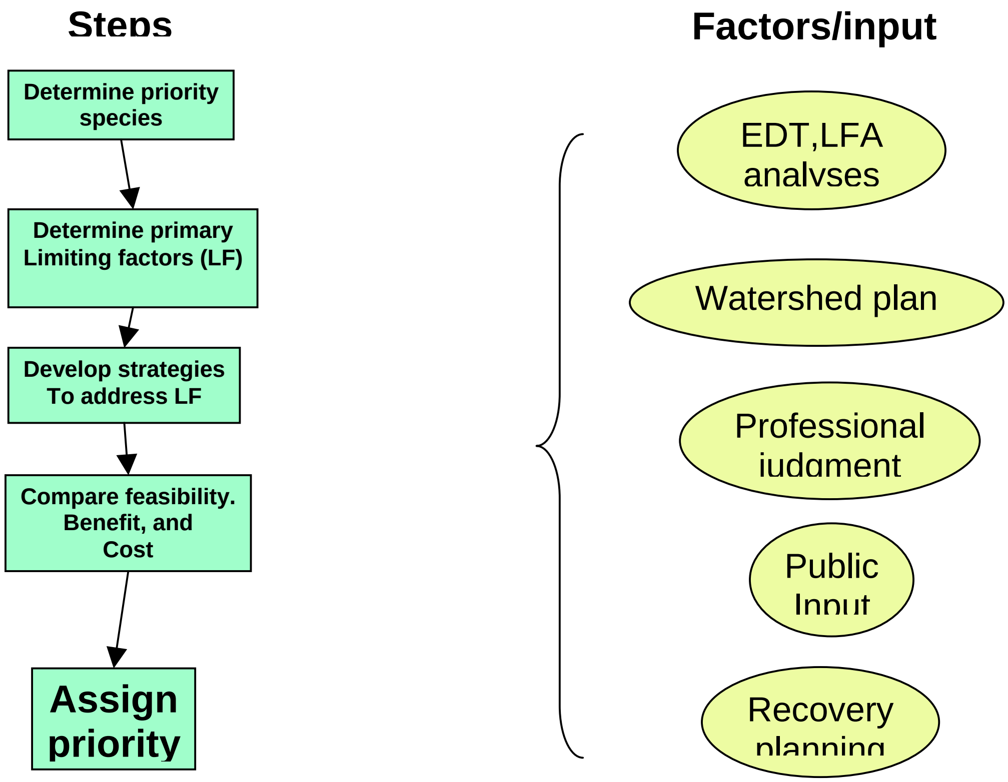
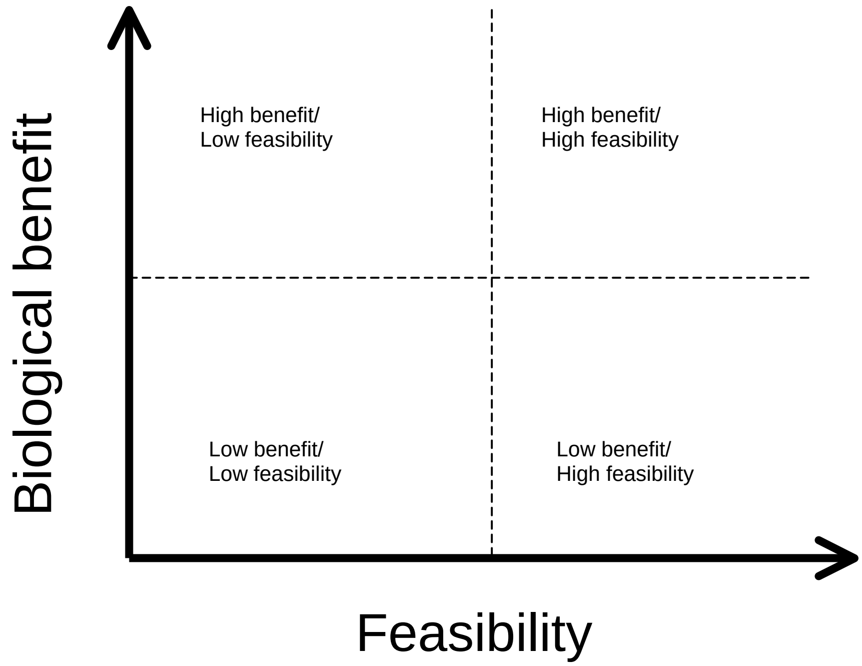


Figure 1. Simplified diagram of factors influencing strategy development and prioritization for the Wenatchee Subbasin Plan.



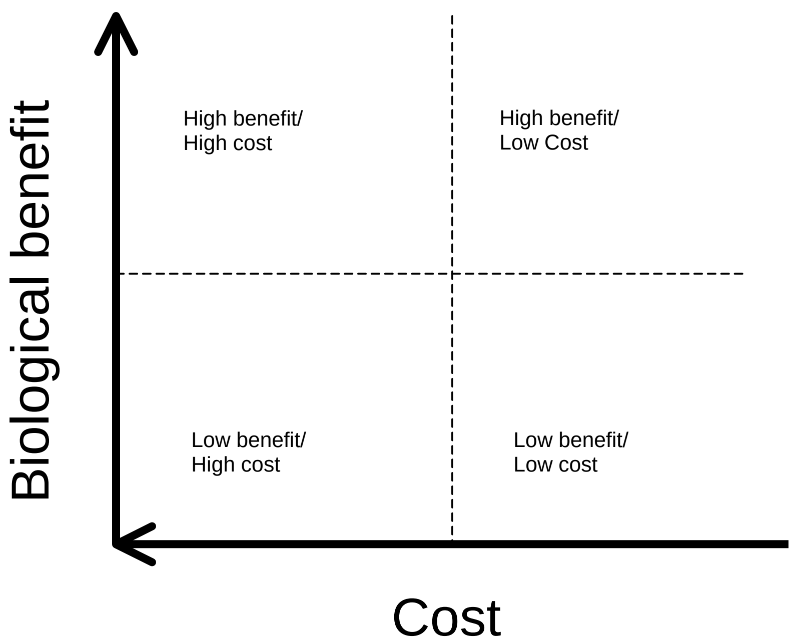


Figure 2. Comparison and ranking of **relative** feasibility and cost of strategies to biological benefit.

Table 4. Example for ranking strategy priorities within the Wenatchee Subbasin. (Values displayed are for illustrative purposes only.)

		Strategy							
		Reduce impacts of water withdrawal	Moderate summer and winter temperature	Increase riparian area and function	Increase off – channel habitat	Increase in-channel diversity and structure	Increase or improve passage	Reduce sediment	Reduce or eliminate brook trout
Variable	**Rank**								
	1								
	1.5								
Biological Benefit	2							x	
	2.5		x				x		
	3	x		x	x	x			
	3.5								x
	1								
	1.5		x						
Feasibility	2	x						x	
	2.5			x	x		x		x
	3					x			
	3.5								
	1								
	1.5			x					x
Relative cost	2				x			x	
	2.5		x			x	x		
	3	x							
	3.5								

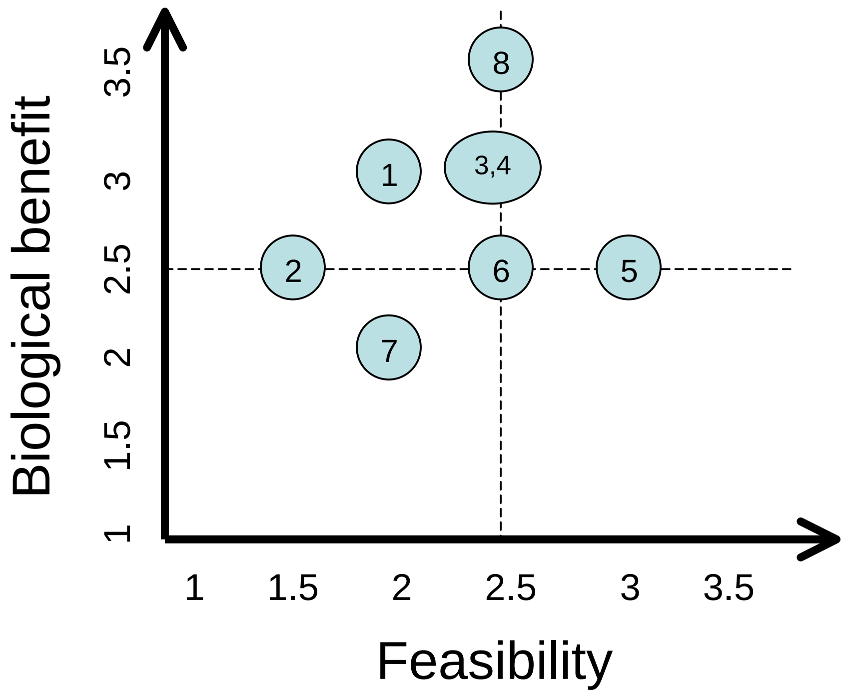
Note: Feasibility values from Table 5. Relative cost values are inverted (i.e., higher the value, the lower the cost).

Table 5. Example of a matrix of criteria for defining feasibility. (Values displayed are for illustrative purposes only.)

Criteria						
Strategy	Strategy #	Time to implement[1]	"Constructability"	Acceptance by local govt.	Acceptance from local stakeholders	Avg. score
Reduce impacts of water withdrawal	1	3	2	1.5	1.5	2
Moderate summer and winter temperature	2	1.5	1	2	2	1.6
Increase riparian area and function	3	2.5	2.5	2	2	2.3
Increase off –channel habitat	4	2.5	3	2	2.5	2.5
Increase in-channel diversity and structure	5	3	3	2.5	3	2.9
Increase or improve passage	6	2.5	3	2	3	2.6
Reduce sediment	7	2	1.5	2	2	1.9
Reduce or eliminate brook trout	8	3	3	2	2	2.5

[1]Values for time to implement are 1 = > 10 years; 2 = 5-10 years; 3 = < 5 years

Relative numbering: 1=low, 3=high



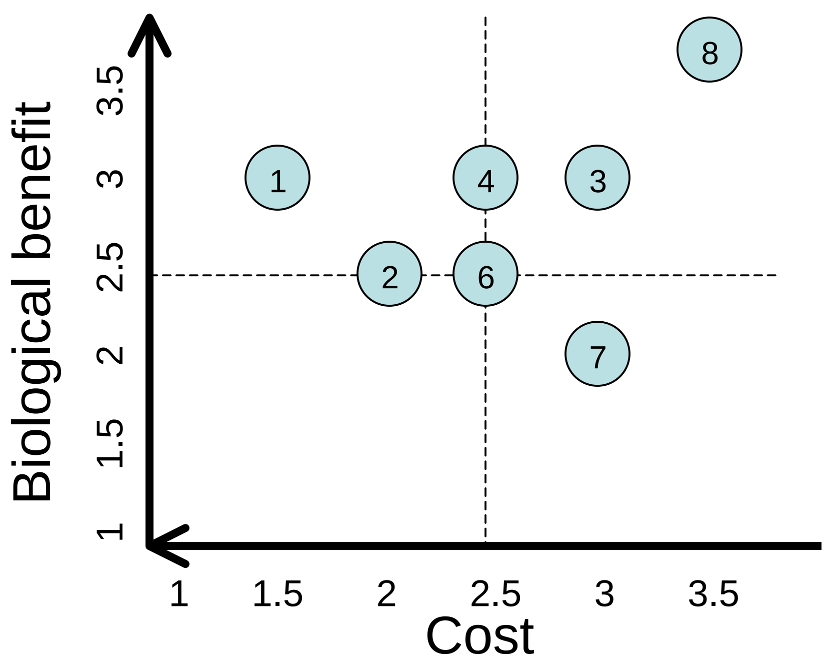
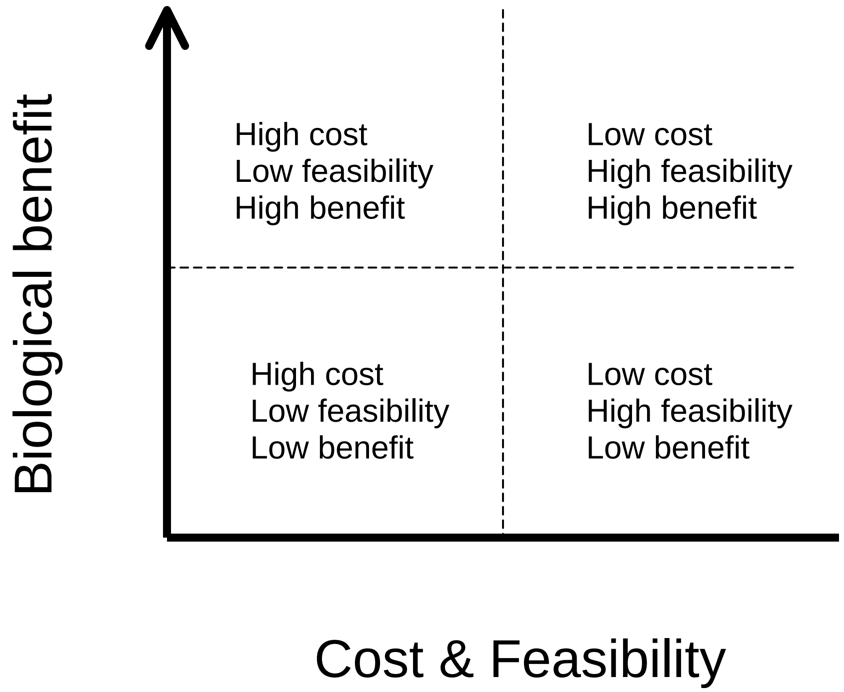


Figure 3. Relative comparison between biological benefit and feasibility and cost.

See Table 5 for definition of the numbers.



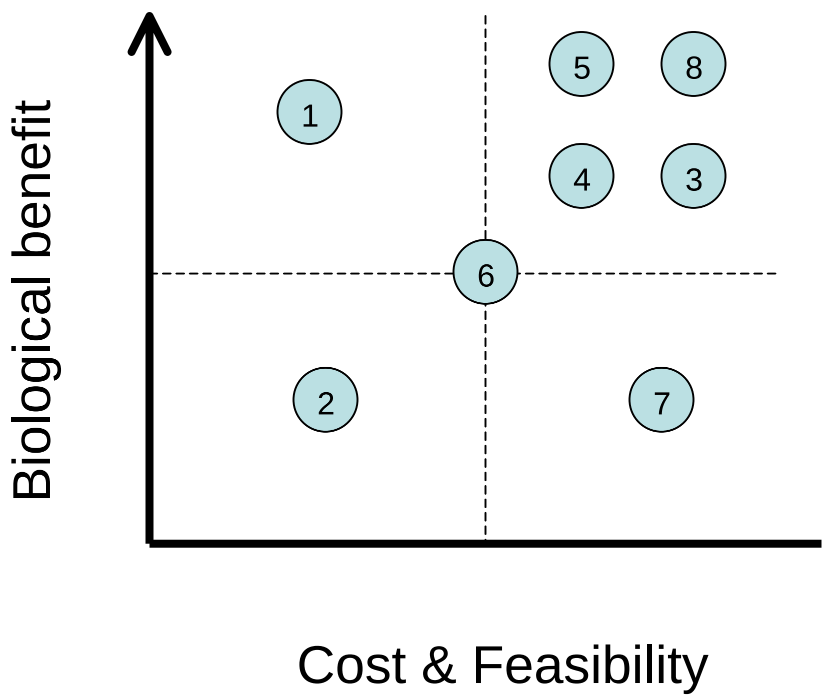


Figure 4. Relative cost and feasibility compared to biological benefit.

From the preceding exercise, the strategies are then ranked within a tier (Table 6).

Table 6. Suggested prioritization of strategies based on Table 4, and Figures 3 and 4. (Values displayed are for illustrative purposes only.)

Strategy	**Number (from graphs)**	**Tier**
Increase riparian area and function	3	**1**
Increase off –channel habitat	4	**1**
Increase in-channel diversity and structure	5	**1**
Reduce or eliminate brook trout	8	**1**
Increase or improve passage	6	**2**
Reduce sediment	7	**3**
Reduce impacts of water withdrawal	1	**4**
Moderate summer and winter temperature	2	**5**

Based on this example strategies 3, 4, 5, and 8 would be given the highest priority, followed by 6, then 7, then 1, and last 2.

Artificial Production

Various processes are underway within the Columbia Basin that direct hatchery program implementation. The listing of certain populations of fish under the ESA has also dictated hatchery program modifications and reform. Below we describe some of the processes that affect hatchery production within the Wenatchee Subbasin as well as all of the programs that are currently and proposed to take place. The effect of these programs will also be discussed in terms of its relationships with the objectives and strategies listed above.

Principal processes that currently affect hatchery programs:

Federal:

Hatchery and Genetic Management Plans:

The Hatchery and Genetic Management Plan (HGMP) process was initiated to identify offsite mitigation opportunities associated with operation of the Federal Columbia River Power System. The HGMP process is designed to describe existing propagation programs, identify necessary or recommended modifications of those programs, and help achieve consistency of those programs with the Endangered Species Act. The HGMP process only addresses anadromous salmon and steelhead programs.

The primary goal of the HGMP process is to devise biologically-based artificial propagation management strategies that ensure the conservation and recovery of listed Evolutionarily Significant Units (ESUs). The HGMP process also seeks to document and implement hatchery reform in the Columbia Basin. Much of the initial work on the HGMP process was coordinated and combined with efforts to complete the Artificial Production Review and Evaluation (APRE – see below) analysis, which looked at the same sorts of information.

Artificial Production Review and Evaluation (APRE)

The APRE process seeks to document progress toward hatchery reform in the Columbia Basin. The NPCC used consultants and representatives of the Columbia Basin fishery managers to analyze existing programs and recommend reforms; a draft report that will go to the Council and the region has been prepared. The APRE process includes both anadromous and non-anadromous fish in its analysis.

US v. OR

United States v Oregon, originally a combination of two cases, Sohappy v. Smith and U.S. v. Oregon, legally upheld the Columbia River treaty tribes reserved fishing rights. Specifically the decision acknowledged the treaty tribes reserved rights to fish at “all usual and accustomed” places whether on or off the reservation, and were furthermore entitled to a “fair and equitable share” of the resource. This case is tied closely to U.S. v. Washington, which among other things defined “fair and equitable share” as 50 percent of all the harvestable fish destined for the tribes’ traditional fishing places, and established the tribes as co-managers of the resource.

In 1988, under the authority of U.S. v. Oregon, the states of Washington, Oregon and Idaho, federal fishery agencies, and the treaty tribes agreed to the Columbia River Fish Management Plan (CRFMP), which was a detailed harvest and fish production process. The fish production section reflects current production levels for harvest management and recovery purposes, since up to 90% of the Columbia River harvest occurs on artificially produced fish.

Hatchery production programs in the upper Columbia sub-basins are included in the management plans created by the fishery co-managers identified in the treaty fishing rights case *United States v Oregon*. The "relevant co-managers" described in the *U.S. v Orego*n management plans are, for the mid-Columbia sub-basins, the federal parties, Yakama Nation, and Washington Department of Fish and Wildlife.

Artificial Production and Supplementation:

Researchers have been describing relationships between genetic ancestry, ecological fitness, and relative survival rates of hatchery and wild salmonid populations. A working hypothesis emerged from this body of research suggesting that conventional hatchery rearing protocols diminished the fitness and survival of fish reared in a hatchery and released into natural production areas. Further, researchers hypothesized that hatchery-reared fish that interbred with wild fish in natural production areas contributed to reduced average population fitness in the wild population, thereby contributing to lower survival rates and reduced population productivity. Nearly 20 years of research has failed to conclusively answer the question of hatchery rearing effects on wild populations, but the issue has substantially altered perceptions of preferred hatchery rearing regimes and prudent uses of hatchery-reared fish.

Based on the demographic and genetic considerations described above, fishery co-managers and scientists in the Columbia Basin developed a concept of artificial propagation that was designed to provide wild and naturally-spawning populations with the very significant survival benefits of hatchery rearing, but in a manner that would also conserve or, at least, recognize the genetic benefits of maintaining the "wild" traits in those populations. The term, "supplementation," was applied to this new concept to describe the intention of supplementing wild population abundance and productivity through the use of innovative artificial propagation methods.

Supplementation is envisioned as a means to enhance and sustain the productivity of wild and naturally-spawning populations at levels exceeding the cumulative mortality burden imposed on those populations by habitat degradation and by natural cycles in environmental conditions. A supplementation hatchery is properly operated as an adjunct to the natural production system in a watershed. By fully integrating the hatchery with a naturally-producing population, high survival rates for the component of the population in the hatchery can raise the average productivity of the total population (hatchery component + naturally-producing component) to a level that compensates for the high mortalities imposed by human development activities.

The use of supplementation is appropriate where wild population productivity does not meet conservation and rebuilding goals prescribed by the fishery managers. These goals generally include maintaining the numerical abundance and spatial diversity of natural spawners as well as supporting some level of harvest. Supplementation also may be the preferred method for implementing mitigation actions required of human activities known to cause specific unavoidable mortalities to wild and natural salmonid populations, such as hydroelectric dam operations.

It is also important to recognize what supplementation cannot do. The use of supplementation will not, by itself, create a sustainable, naturally-producing population of salmonids in a watershed where the indigenous wild population has been diminished or extirpated. Habitat quality is the sole determinant of natural population productivity and sustainability. The use of supplementation can only "subsidize" population productivity to levels that compensate for poor habitat quality. If supplementation ceases without changing the underlying habitat conditions that required its use in the first place, the remaining, unsupplemented, naturally-producing population will be expected to resume the decline that was apparent before the application of supplementation. Only adequate habitat quality can ensure the long-term viability of unsupplemented, naturally-producing populations.

Within the Wenatchee subbasin, fishery co-managers hold open the potential and will continue to evaluate the application of providing supplementation programs for focal species as appropriate. Co-planners expect to work closely with the Wenatchee Planning Unit and other stakeholders within the ongoing salmon recovery forum in the development of the role of artificial production within the Wenatchee subbasin generally, and more specifically the appropriate application of supplementation techniques.

Federal ESA

Current ESA Section 10 Permits for listed summer steelhead (Permit #1395); listed spring chinook (Permit #1196); and non-listed anadromous fish (Permit # 1347) also direct artificial production activities associated with the habitat conservation plans. Douglas PUD, Chelan PUD, and WDFW are co-permittees, therefore provisions within the permits and associated Biological Opinions are incorporated into the hatchery programs undertaken in the HCP's.

State:

The state, along with the tribes and federal government has various forums in which they are active in management of artificial production programs. All have some role in determining or balancing these programs, as well as the ones that follow under "other". Essentially no specific new actions would occur until the action is determined to be warranted in the already established processes.

Other:

FERC processes:

Under current settlement agreements and stipulations, the three mid-Columbia PUDs pay for the operation of hatchery programs within the Columbia Cascade Province, including the Wenatchee subbasin (except for coho salmon production). These programs determine the levels of hatchery production needed to mitigate for the construction and continued operation of the PUD dams.

Habitat Conservation Plans:
In 2002, habitat conservation plans (HCPs) were signed by Douglas and Chelan PUDs, WDFW, USFWS, NOAA Fisheries, and the Colville Confederated Tribes. The overriding goal of the HCPs is to achieve no-net impact[1] on anadromous salmonids as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams. One of the main objectives of the hatchery component of NNI is to provide species specific hatchery programs that may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Biological Assessment and Management Plan:
The biological assessment and management plan (BAMP) was developed by parties negotiating the HCPs in the late 1990s. The BAMP was developed to document guidelines and recommendations on methods to determine hatchery production levels and evaluation programs. It is used within the HCP as a guiding document for the hatchery programs.

Current programs

Overview:

Artificial production of anadromous fish in the Wenatchee Subbasin includes spring Chinook, summer Chinook, summer steelhead, sockeye, and reintroduction of coho salmon (Table 7). Spring Chinook and summer steelhead are currently ESA-listed as endangered through the Endangered Species Act of 1973. Although once extirpated from the Wenatchee Subbasin, coho salmon have been reintroduced through current and substantial efforts by the Yakama Nation and BPA. Planning for and implementing a continued, and long-term coho reintroduction program is in the early phases, but is anticipated by co-managers to expand in the relatively near future to meet production goals. Hatchery programs in the Wenatchee Subbasin are guided by a two-pronged approach that encourages local adaptation, preservation and enhancement of specific populations while simultaneously spreading the risk through selection of several artificial production alternatives.

Table 7. Current artificial anadromous fish production in the Wenatchee Subbasin

Fish Species	Facility	Funding Source	Production level goals

[1] NNI refers to achieving a virtual 100% survival of anadromous salmonids as they pass the mainstem projects. This is achieved through 91% survival of adults and juveniles (or 93% for juveniles) passing the projects, and 7% compensation through hatchery programs and 2% contribution through a tributary fund, which will fund projects to improve salmonid habitat in the tributaries.

Spring Chinook	Eastbank Fish Hatchery Complex (Chiwawa acclimation pond) (Operated by WDFW)	Chelan County PUD	672,000
	Leavenworth National Fish Hatchery (Operated by USFWS)	Bureau of Reclamation	1,625,000
Steelhead	Eastbank Fish Hatchery Complex (Operated by WDFW)	Chelan County PUD	400,000
Summer Chinook	Eastbank Fish Hatchery Complex (Dryden acclimation pond) (Operated by WDFW)	Chelan County PUD	864,000
Sockeye	Eastbank Hatchery (Operated by WDFW)	Chelan County PUD	200,000
Coho	Leavenworth NFH (Operated by USFWS & YN)	BPA (Fish & Wildlife Program)	500,000
	Acclimation sites on Nason Creek, Beaver Creek and Icicle Creek (YN)	BPA (Fish & Wildlife Program)	500,000

Federal programs

Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS operates the Leavenworth NFH Complex in the Upper Columbia Region constructed by the U.S. Bureau of Reclamation (BOR) to replace fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The complex consists of three hatchery facilities, Leavenworth, Entiat, and Winthrop NFHs.

Leavenworth NFH

Leavenworth National Fish Hatchery (NFH) was originally authorized by the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and reauthorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. It began operations in 1942. It is currently used for adult collection, egg incubation and rearing of spring Chinook salmon. It also provides juveniles and/or adults for re-establishing spring Chinook runs in other Columbia River tributaries, as needed (e.g., Peshastin Creek adult out-plants).

State programs

Rock Island Fish Hatchery Complex

The Rock Island Fish Hatchery Complex (RIFHC) began operation in 1989 as mitigation for salmonids lost as a result of operation of Rock Island Dam. The facility was constructed by, and operates under funding from, Chelan PUD originally through the Rock Island Settlement Agreement. Currently, Chelan PUD and fisheries agencies and the Colville Confederated Tribes have signed a habitat conservation plan (HCP). Production levels and evaluation programs are outlined within the HCP (Table 7)**.**

Tribal programs

Yakama Nation/ BPA - Mid-Columbia Coho Reintroduction Program

In 1999, the BPA funded mid-Columbia Coho Reintroduction Program began releasing acclimated coho salmon smolts, and developing a locally adapted broodstock in the Wenatchee Basin. The program uses a combination of existing hatchery facilities, existing broodstock collection facilities, and low-cost incubation and ‘natural’ acclimation ponds. The coho program is guided by a multi-agency technical work group.

Program Goals and Objectives

Federal programs

Leavenworth National Fish Hatchery (NFH)**:**

Specific fishery objectives which were originally established for Leavenworth NFH were (from Calkins et al. 1939):

1) *“…to bring, by stream rehabilitation and supplemental planting, the fish populations in the 677 miles of tributary streams between Grand Coulee Dam and Rock Island Dam, up to figures commensurate with earlier undisturbed conditions and with the natural food supply in the streams.”*

2) *“…to produce, in addition, by the combination of artificial spawning, feeding, rearing and planting in these streams, a supplemental downstream migration equivalent to that normally produced by the 1,245 miles of streams and tributaries above Grand Coulee Dam.”*

Shelldrake (1993) updated the objectives of the mid-Columbia NFHs:

- *Hatchery production* [specific to each facility].
- *Minimize interaction with other fish populations through proper rearing and release strategies.*
- *Maintain stock integrity and genetic diversity of each unique stock through proper management of genetic resources.*
- *Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens.*
- *Conduct environmental monitoring to ensure that hatchery operations comply with water quality standards and to assist in managing fish health.*
- *Communicate effectively with other salmon producers and managers in the Columbia River Basin.*

The USFWS’s current mission for the Leavenworth complex is (USFWS 2002a):

> *“To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Pla*n”

Early spring Chinook salmon stocks used for the program came from several lower Columbia River locations. These include McKenzie River, OR (1941); Willamette River, OR (1965); Eagle Creek NFH (1966); Cowlitz River (1974, 76); Little White Salmon NFH (1974, 77-79), and the current stock originated from Carson NFH (1970-73, 75-81, 85). The Carson stock developed from adults, trapped at large, from Bonneville Dam in the 1950's. No eggs or fry have been imported into LNFH for almost 20 years.

State programs

Rock Island Fish Hatchery Complex

The goal of the RIFHC is to use artificial production to replace adult production lost due to smolt mortality at mainstem hydroelectric projects, while not reducing the natural production or long-term fitness of salmonid stocks in the area (WDF 1993). Specific goals of the WDFW hatcheries (WDF 1993) are:

- *Hatchery production* [in terms of number of fish released from each site],
- *Minimize interactions with other fish populations through rearing and release strategies, maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources.*
- *Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens,*
- *Conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health,*
- *Communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs, and*
- *Develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation obligations, estimate survival to adult, evaluate effects of the program on local naturally producing populations, and evaluate downstream migration rates in regards to size and timing of fish released.*

Tribal Coho Reintroduction Programs

Yakama Nation/ BPA - Mid-Columbia Coho Reintroduction Program

The long-term goal of the YN/BPA Mid-Columbia Coho Reintroduction Feasibility Project is to reestablish naturally reproducing coho salmon populations in mid-Columbia tributaries (Wenatchee, Entiat, and Methow), with numbers at or near carrying capacity that provide opportunities for harvest (YN et.al. 2002). The long-term goal is closely tied to the vision of reintroduction of coho in the Yakima basin and other areas from which the species has been eliminated. Mid-Columbia coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan) and by the four Columbia River Treaty Tribes and has been affirmed as a priority to be funded by the Northwest Power & Conservation Council.

Since 1996, the program has been studying the feasibility of reintroducing coho salmon into mid-Columbia basins from which they were extirpated. The program's short-term goals during this initial phase were to:

1) determine if a broodstock could be developed from lower Columbia River stocks that would produce progeny that could migrate as adults the much longer distances to mid-Columbia basins; and
2) determine if these coho would pose a risk to other listed or sensitive fish species.

The results of studies have convinced resource managers that coho reintroduction is feasible. Smolt–to-adult survival rates for the first two years of returning mid-Columbia brood coho are higher than for reprogrammed lower Columbia brood coho. While questions remain, the feasibility studies demonstrate that they are questions of *how best* to achieve the goal of reintroducing a self-sustaining, locally adapted coho population, rather than *whether* it can be done. Studies completed during the feasibility phase will direct future decisions about how the long-term vision will be achieved.

Program Operations

Federal

Leavenworth National Fish Hatchery

Juvenile releases: Juveniles are released annually as yearlings in mid-April. The yearlings are forced from the ponds, directly into Icicle Creek, when the majority is in a smolt or pre-smolt stage. Timing of release is coordinated with Columbia mainstem project operations to help maximize downstream migration survival. All juveniles released from LNFH are adipose fin-clipped. With 100% marked juveniles, subsequent adult harvest can be maximized while also strengthening the ability to evaluate ecological effects. The current release goal is 1,625,000 smolts annually. From 1971 to 2001, annual releases of spring Chinook from LNFH have averaged 1,649,074 fish.

Hatchery Barrier: Built in 1938 – 1940, the barrier was designed to exclude ascending adults from areas upstream of the hatchery and to help insure sufficient adults for brood. In recent years, the USFWS, along with other entities, have investigated the potential of providing passage for certain fish species to areas above the barrier. The effects of, and potential solutions to, the barrier issue are currently being addressed in a Final Environmental Impact Statement (FEIS) that has been drafted and issued. Current plans are to provide passage in the next few years (2005 or 2006).

Hatchery water intake system: The hatchery's water delivery system consists of three major components and conveyance systems: 1) the gravity intake on Icicle Creek, 2) the Snow Lake Supplementation Water Supply Project and, 3) the well system on hatchery property.

During construction of the hatchery, it was recognized that surface flow in Icicle Creek might at times be insufficient to meet production demands. A supplementary water supply project in Snow and Nada Lakes was therefore developed and a water right to 16,000 acre feet of Snow Lake was obtained. These lakes are located approximately 7 miles from the hatchery and about one-mile above it in elevation.

State program

Program operations for the various species raised under the RIFHC are as follows:

Sockeye
Broodstock is captured at Tumwater Dam on the Wenatchee River. Adults are hauled to Lake Wenatchee, where they are held and spawned. Eggs are then incubated and early reared at Eastbank Hatchery. The hatchery production level is currently 200,000 subyearlings, reared in net pens in Lake Wenatchee from July through November. Sockeye are released at two different times (August and November) in an effort to reduce post-release mortality.

Spring Chinook
Returning spring Chinook adults are collected at a weir on the Chiwawa River and a ladder trap at Tumwater Dam. Fish are then hauled to Eastbank Hatchery, where they are spawned, incubated, and reared until the following October.

Production at Eastbank Fish Hatchery has varied considerably since the program began with brood year 1989. The variability in production is a function of poor adult returns, inefficient traps, and different broodstock collection strategies stemming from adaptive management strategies for this population. Smolt production from the Eastbank Fish Hatchery has averaged 116,012 smolts annually, representing 17.3% of the interim production level (672,000) identified in the BAMP (1998). Under the Chelan PUD's HCP, compensation for spring Chinook for the Wenatchee independent population could be decreased, possibly prior to 2013.

Summer Chinook
Artificial production of summer Chinook for the Wenatchee Subbasin is run under the RIFHC. Summer Chinook production at Eastbank Hatchery is intended to mitigate for summer Chinook losses at Rock Island Dam. The production level for the Wenatchee River is a total of 864,000 yearling summer Chinook at 10 fish/lb (BAMP 1998).

Broodstock (492 adults) are collected at the left and right bank Dryden traps and Tumwater Dam trapping facility and transported to the Eastbank Hatchery. Incubation, spawning, and initial rearing of Wenatchee summer Chinook take place at the Eastbank facility. The fish are then transferred to the Dryden Acclimation Pond towards the end of their second winter, where they are volitionally released at smolt size (10fish/lb.) into the Wenatchee River in April-May.

Summer Steelhead
Adult Wenatchee River summer steelhead are collected for broodstock from the run-at-large at the right and left bank Dryden Dam traps and Tumwater Dam. The program goal is to collect a minimum of 50% natural origin adults and to exclude progeny of HxH matings in the hatchery component. Due to adult steelhead holding temperatures at Eastbank FH, steelhead are transferred to, held, and spawned at Wells FH. Incubation and final rearing occurs at Eastbank FH facilities.

The annual release goal For Eastbank FH is 400,000 smolts into the Wenatchee River, Nason Creek, and Chiwawa River basins however, smolt production from the Eastbank

Fish Hatchery has averaged 266,632 smolts annually, representing 66.7% of the interim production level identified in the BAMP (1998).

Captive Brood for spring Chinook
Currently, Grant PUD is engaged in a captive brood program for White River (Wenatchee Basin) spring Chinook. Current production is generally less than 50,000 fish released, but under their Section 7 (ESA) consultation, they will be required to increase production of White River spring Chinook top close to 200,000.

Non-anadromous fish releases
Non anadromous fish have been planted within the Wenatchee Basin since the early 1900s. Rainbow trout, cutthroat trout, brook trout, and a few brown trout have all been planted at various times through multiple hatchery programs.

Following micro-habitat work in the 1980s that showed negative effects on pre-smolt steelhead from "catchable" releases of rainbow trout, all releases of rainbow were shifted from streams to various lakes within the basin which did not have connectivity to anadromous areas.

Tribal program
Yakama Nation/ BPA - Mid-Columbia Coho Reintroduction Program:

Returning coho salmon adults are collected primarily at Dryden Dam with supplemental collection at Tumwater Dam and weirs installed on Icicle Creek (Dam 5). Coho broodstock are hauled to Entiat National Fish Hatchery (NFH), where they are spawned. Approximately 50% of the eggs are incubated at Entiat NFH and 50% are incubated at YN's Peshastin Incubation Facility. Upon reaching the eyed stage, the coho eggs are transferred to Willard NFH and Cascade FH for rearing. Pre-smolts are returned to the Wenatchee Basin for acclimation prior to release. The duration of acclimation varies from one to five months, with most sites maintaining a 6-week acclimation period.

Since the programs inception, production goals have been reached in all years except brood year 1999, largely the result of low Columbia River flows during 2001 emigration and the resulting reduced release-to-McNary Dam survival index as measured through PIT tagged releases (Murdoch et al. 2004). The program is currently focusing on continued broodstock development and associated local adaptation.

<u>Conservation of the Species:</u> The capture of endangered UCR spring Chinook salmon and summer steelhead by WDFW for artificial propagation efforts are designed to benefit the species. The primary objectives of these efforts are to preserve extant spring Chinook and steelhead populations in the region, and to boost the abundance of remaining stocks. There are risks of ecological and genetic impacts to the ESA-listed juvenile and adult spring Chinook salmon and steelhead resulting from the proposed programs. However, the risk of extinction to natural populations is high enough that aggressive intervention is required.

The reintroduction of coho salmon is helping to restore the historic fish assemblage and community structure in the Wenatchee basin. Volitional release strategies practiced at coho acclimation sites are designed to limit adverse ecological interactions by reducing potential interaction between hatchery smolts and naturally produced fish.

<u>Genetic and Ecological Effects on Natural Populations and how the artificial programs relate to habitat objectives and strategies:</u>

Genetics:
The genetic risks to naturally produced populations from artificial propagation include reduction in the genetic variability (diversity) among and within populations, genetic drift, selection, and domestication which can contribute to a loss of fitness for the natural populations (Hard *et al.*1992; Cuenco *et al.* 1993; NRC 1996; and Waples 1996).

Disease:
Disease interactions between hatchery fish and listed fish in the natural environment may be a source of pathogen transmission. Because the pathogens responsible for diseases are present in both hatchery and natural-origin populations, there is some uncertainty associated with determining the extent of disease transmission from hatchery fish (Williams and Amend 1976; Håstein and Lindstad 1991).

Competition:
Direct competition for food and space between hatchery and listed fish may occur in spawning and/or rearing areas, the migration corridor, and ocean habitat. These impacts are assumed to be greatest in the spawning and nursery areas and at points of highest fish density (release areas) and to diminish as hatchery smolts disperse (USFWS 1994).

Competition for space and cover in the Wenatchee River probably occurs between hatchery and natural fish shortly after release and during downstream migration, but based on the smolt travel times the duration of interaction is minimal in the river (WDFW 1998a). Rearing and release strategies at all WDFW salmon and steelhead hatcheries are designed to limit adverse ecological interactions through minimizing the duration of interaction between newly liberated hatchery salmon and steelhead and naturally produced fish.

The YN has extensively evaluated competition between reintroduced coho salmon and listed and sensitive species. Studies of hatchery coho smolt predation on endangered spring chinook and steelhead fry (Dunnigan 1999, Murdoch and LaRue 2002, Murdoch et al. *In Prep.*) have shown that hatchery coho rarely feed on other fish during juvenile migration; and studies of coho migration through Lake Wenatchee, where a sensitive population of sockeye rear, indicate that coho and sockeye tend to occupy different parts of the lake at different times of the day and night. Two years of studies examining competition for space and food, indicate that juvenile spring chinook, coho and steelhead select different micro-habitats. The presence of coho salmon did not affect the growth or condition of juvenile spring chinook or steelhead (Murdoch et. al. 2004, Murdoch et. al. *In Prep)*

Conclusions*:*
By implementing the strategies outlined within this Plan, habitat for focal species will increase. By increasing habitat within the Subbasin, the probability of recovery/preservation of focal species will increase and other benefits (e.g., more sustainable water resources) will occur for not only the natural resources, but the human residents within the Basin too.

By following the guiding principals of the Rock Island Hatchery Complex, and the reduction of out-of-basin hatchery fish in the broodstock, the genetic risks to naturally produced fish should be reduced or eliminated.